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Manufacturing Decline and House Price Volatility*

Isaiah Hull — *Sveriges Riksbank*
Conny Olovsson — *Sveriges Riksbank*
Karl Walentin† — *Sveriges Riksbank*
Andreas Westermark — *Sveriges Riksbank*

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Abstract

Using a unique dataset of all Swedish housing transactions over the 2009-2017 period, we find that an increase in manufacturing's share of employment is positively associated with house price growth volatility and negatively associated with risk-adjusted housing returns. Both effects appear to be related to manufacturing's impact on firm concentration and employment volatility. Moreover, as we demonstrate in an application, our results have implications for portfolio choice. They also suggest that the manufacturing decline since 1970 could account for a 32% reduction in house price volatility in Sweden, and similar reductions in the U.S., U.K., and Japan.

Keywords: House Prices, Portfolio Choice, Manufacturing, Volatility

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†Corresponding author: Karl Walentin. Email: karl.walentin@riksbank.se. Tel: + 46 8 787 04 91. Fax: +46 8 0821 05 31. Research Division, Sveriges Riksbank, SE-103 37, Stockholm, Sweden.

1 Introduction

Existing work has shown that labor income risk shifts housing demand, potentially generating house price volatility (Adelino et al., 2018). Since manufacturing is a large and volatile sector in most high income countries, its decline as a share of employment and income since the 1970s has important implications for house price risk.[1] We examine this relationship using a unique dataset of all property transactions in Sweden over the 2009-2017 period.[2] This is particularly important because other drivers of country-level house price volatility, such as financial crises, tend to be transitory; whereas the decline in the manufacturing share appears to be permanent. The decline in manufacturing also tends to be broadly-based geographically within a country, which is not true in general for other regional drivers of house price growth volatility. Furthermore, as recent work has shown (Kuhn et al., 2018), households with below-median income have historically held few assets besides housing. Thus, shifts in house price volatility have substantial implications for portfolio choice and welfare, since house price volatility is associated with consumption volatility.

The dataset we construct allows us to exploit geographic and time variation to identify the impact of manufacturing share on house price growth volatility and risk-adjusted returns. Furthermore, it also permits us to evaluate the channels through which dependence on manufacturing affects the housing market. In particular, we measure how house price growth volatility is affected by firm concentration and employment volatility.[3] Our comprehensive geographic coverage enables us to measure volatility and risk-adjusted returns at all levels of geography. While most of our findings and simulation exercises focus on regional and national volatility, we will also

[1]Case and Mayer (1996) and Howard and Liebersohn (2018) show that manufacturing has an impact on the level of local and regional house prices. See Charles et al. (2013) and Charles et al. (2018) for an overview of the impact of manufacturing's decline on employment, the labor market, and drug abuse.

[2]See Zhou and Haurin (2010) for an overview of housing characteristics that typically generate volatility. They use American Housing Survey data to show that volatility is typically higher for very high and very low quality homes, atypical homes, "land leveraged" homes, and minority-owned homes.

[3]We show that the generation of employment growth volatility at least partly explains the relationship between manufacturing share of employment and house price growth volatility. The existing literature has also documented a robust association between income level and volatility, and house price growth volatility (e.g. Hartman-Glaser and Mann (2017), Peng and Thibodeau (2017), and Peng and Thibodeau (2013).)

examine how volatility varies within region.[4]

Our dependent variable in most regression exercises is house price growth volatility. We construct this variable by first computing returns on repeat sales and then applying the Davidian and Carroll (1987) method to obtain a measure of instantaneous volatility with both time and geographic variation.[5] The first exercise estimates the impact of manufacturing share at the region level in 2008 on our measure of volatility for housing transactions between 2009 and 2017. We find that a 10 percentage point (ppt) increase in the manufacturing share implies a 0.79 to 1.42ppt increase in house price growth volatility. For the median property, this is equivalent to a 12% to 21% increase in house price growth volatility. These results are largely invariant to specification and remain significant whether we adjust standard errors for heteroskedasticity and autocorrelation or cluster them at the narrowest geographic unit. We also show that the results hold both in an instrumental variables (IV) setting and also when volatility is aggregated up to the regional level in a cross-sectional regression. Furthermore, the dynamic regressions are robust to the inclusion of geographic fixed effects, which capture the impact of Saiz-style (2010) measures of housing supply elasticity on house price volatility. This suggests that the effect measured in our dynamic regressions is likely to be related to demand-driven factors, such as expected future income and employment.

In addition to measuring the impact of manufacturing share on house price growth volatility, we also try to determine the channels that mediate this relationship. The first channel we explore is employment growth volatility, which may be affected by dependence on manufacturing share at the national, regional, or local level. Higher employment volatility could generate fluctuations in housing demand, which would in-

[4] Flavin and Yamashita (2002) provide the first examination of idiosyncratic volatility at the property level. Giacoletti (2017) documents idiosyncratic variation in house price volatility within the Los Angeles, San Diego, and San Francisco metropolitan areas. Landvoigt et al. (2015) examines San Diego and finds that ZIP codes with lower house prices in 2000 experienced greater capital gains volatility leading up to the Great Recession.

[5] Our selected measure of volatility has been used in finance (e.g. Schwert (1989)), macroeconomics (e.g. McConnell and Perez-Quiros (1990)), and real estate economics (e.g. Goodman and Thibodeau (1998)). Furthermore, Bollerslev et al. (2015) emphasize the importance of using the repeat-sales method when constructing measures of local house prices and house price volatility from microdata.

crease house price volatility. This relationship has been documented in existing work for manufacturing share and output volatility (Carvalho and Gabaix, 2013). Additionally, the literature has demonstrated an association between house price growth and manufacturing share (Case and Mayer (1996) and Howard and Liebersohn (2018)). We find that regional variation in employment growth volatility is positively associated with house price growth volatility. In particular, when we include employment growth volatility in a regression of house price growth volatility on manufacturing share of employment, we find that the magnitude of the coefficient on manufacturing share is reduced by 39%. Furthermore, removing manufacturing share increases the magnitude of the coefficient on employment growth volatility by 80%. This suggests that manufacturing share may partially affect house price volatility through employment growth volatility.

Another channel we examine is the impact manufacturing has on the concentration of employment into a smaller number of firms. In our sample, for instance, 9 of 15 of the largest employers in Sweden are manufacturers, even though manufacturing employs less than 15% of the workers. Thus, employment in areas dominated by manufacturing might be more vulnerable to firm-specific shocks. We test this hypothesis by evaluating how firm concentration affects house price growth volatility. We do this by constructing local Herfindahl-Hirschman Indices (HHIs). A high HHI value implies high firm concentration, indicating that local employment and income are more exposed to firm-specific shocks. Our preferred regression specification includes region-time fixed effects, time-varying local controls, and property level controls. We find that a one standard deviation increase of the local HHI index is associated with with a 1.01 to 1.45ppt increase in house price growth volatility. For the median property, this is equivalent to a 15% to 21% increase in house price growth volatility. These findings are largely invariant to the choice of specification and are robust to choice of standard error adjustment.[6]

[6]We also establish independent evidence for the firm concentration channel by estimating how sensitive house price growth volatility is to news about individual manufacturers in Section 5.1. Beyond this, we perform a separate exercise using regional news on both manufacturing and housing over the 1850-2017 period.

Finally, we evaluate whether the house price growth volatility associated with manufacturing is compensated for by higher returns and find that it is not. We find that a 10ppt increase in manufacturing is associated with a 0.22 to 0.25ppt reduction in the housing returns Sharpe ratio, which suggests that the decline in manufacturing's share since the 1970s may have made housing a better investment. Similarly, a doubling of firm concentration is associated with a Sharpe ratio reduction of 0.16 to 0.21ppt.

Beyond our empirical results, we work through two applications that highlight the importance of our findings. The first evaluates the portfolio choice implications of a positive association between manufacturing share and house price growth volatility. Among other things, we show that the portfolio component of a homeowner's location choice can be distilled to a comparison between housing return volatilities and income covariances with housing returns across different cities. Furthermore, under reasonable assumptions, we show that manufacturing workers can typically improve their welfare by living and working in different cities, as long as non-portfolio considerations, such as commuting costs, do not dominate. To the contrary, it is often optimal for those in the service sector to live and work in the same place.

Our second application aggregates our estimates up to the national level and examines the implication of the decades-long decline in manufacturing's share of employment. We show that this could explain part of the reduction in house price growth volatility during the Great Moderation in high income countries, such as Sweden, the U.S., the U.K., and Japan.[7] In particular, the 16ppt manufacturing employment share reduction in Sweden since 1970 could account for a 2.2ppt (32%) decline in house price growth volatility. Similarly, the 17.5ppt decline in manufacturing share in the U.S. since 1970 would account for a 2.5ppt decline in house price growth volatility. It would also account for volatility reductions of 3.3ppt in the U.K. and 1.4ppt in Japan. Furthermore, it is possible that this could have improved the attractiveness of

Exploiting variation in time and geography, we document a long-run relationship between manufacturing and housing. The results from this exercise are available on request.

[7] Mack and Martinez-Garcia (2012) find that house price growth volatility experienced a secular decline that coincided with the Great Moderation.

homeownership.

The paper is organized as follows. Section 2 describes the data. Section 3 describes our main empirical specification and results. Section 4 examines the channels through which manufacturing affects house price volatility. Section 5 provides two extensions of our main results. Section 6 discusses related applications. And finally, Section 7 concludes.

2 Data

Our main exercises use a unique dataset that consists of all property transactions in Sweden over the 2009-2017 period. Each observation contains the sales date, final price, property type, street address, GPS coordinates, number of rooms, and area in square meters. It also contains each property's region, municipality, and parish, which we recover by reverse geocoding its GPS coordinates. Note that we use the term "region" to refer to the largest subnational administrative unit, "municipality" to refer to the second largest, and "parish" to refer to the smallest.[8]

We limit the sample to properties that were sold at least twice over the 2009-2017 period and compute annualized returns for each sales pair. Following Landvoigt et al. (2015), we drop abnormal returns ($> 50\%$) and sales pairs with a short holding period ($< 6mo.$). This leaves us with 44,895 properties with at least two sales. Additionally, we compute the time between sales and the number of transactions per parish-quarter.

In addition to property transaction data, we also collect the number of establishments located within commuting distance (25km) of the GPS coordinate centroid of each parish for the 15 largest employers in Sweden: Volvo, Ericsson, Electrolux, Svenska Cellulosa, Scania, Atlas Copco, Sandvik, SKF, Assa Abloy, Vattenfall, ICA, Securitas, Telia, Axel Johnson, and H&M. The centroid is computed as the average latitude and longitude of all properties located within the same parish. We also compute the

[8] Län, kommun, and församling are Swedish geographic designations that roughly translate to "county," "municipality," and "parish." We avoid the direct translation to county to avoid confusion with U.S. counties. As a share of the country's size, Swedish counties are closer to U.S. states than to U.S. counties.

distance in kilometers between each property and its parish and region centroids.[9]

In addition to the housing dataset, we also assemble all newspaper articles between the 2009-2017 period in the main Swedish business newspaper, Dagens Industri. We use these articles to identify all references to the largest manufacturers: Volvo, Ericsson, Electrolux, Svenska Cellulosa, Scania, Atlas Copco, Sandvik, SKF, and Assa Abloy. We then divide the number of references by the total number of articles, giving us the share of all news that is attributable to the largest manufacturing firms at a monthly frequency. We deseasonalize this news using the X-13 ARIMA-SEATS method and detrend it using Hodrick-Prescott filtering.

Our regressor of interest in most specifications is manufacturing's share of employment at the region level. We use both time-varying (annual) and static measures. For the static case, we always use the 2008 value, which predates our sample and limits potential endogeneity issues. For the dynamic case, we use the contemporaneous value of the manufacturing share for the years it is available (2009-2015). This variable is constructed by Statistics Sweden. In addition to manufacturing's share of employment, we also use manufacturing's share of income and output in different regressions.

Finally, we collect controls for population density, real per capita income, real per capita income growth, and employment growth for 20 of the 21 subnational regions.[10] These variables are produced by Statistics Sweden. Population density is measured annually and is defined as persons per square kilometer. Real per capita income is measured annually and is used to compute real per capita income growth. Nominal income is deflated to real per capita income using the consumer price index. Employment growth is computed as the percentage change in the number of individuals employed in a given region since the previous quarter. For all level variables, we use either the 2008 value or the time-varying values as controls, depending on the regression specification.

The aforementioned descriptive statistics at the property and region level are shown

[9] Since each centroid is defined as the mean GPS coordinates for a region or parish, distance to the centroid may capture distance to the urban or residential center.

[10] We omit one region for which the number of housing transactions is insufficient for inclusion in our empirical exercises.

in Table 1. Figure 1 contains two region level maps of Sweden. Subfigure (a) shows the geographic distribution of house price growth volatility. Subfigure (b) shows manufacturing's share of employment. A darker shade indicates higher volatility in (a) and a higher manufacturing share in (b).

3 Empirical Specification

We first regress property-level returns, r_{jt}, from repeat sales[11] on location-time fixed effects, γ_{kt}, and a vector of property level controls, X_{jt}. Property-level controls include area in square meters, distance to parish centroid, dummies for property type, dummies for number of rooms, number of months between transaction dates, and number of transactions that occurred in the same quarter and parish.

$$r_{jt} = X_{jt}\beta + \gamma_{kt} + \epsilon_{jt}. \tag{1}$$

In equation (1), t refers to the time period, j to the property, and k to the geographic location. We use a quarterly time period in all specifications. For the location, we use parish, which is the narrowest available geographic unit. We pool fixed effects for small parishes with fewer than 100 sales; however, the results are qualitatively similar if we drop them or instead use municipality or region, rather than parish. Our results are also similar if we use separate region and time fixed effects, rather than using region-time fixed effects.

We next extract the regression residuals:

$$\hat{\epsilon}_{jt} = r_{jt} - X_{jt}\hat{\beta} - \hat{\gamma_{kt}}. \tag{2}$$

We use an unbiased, instantaneous estimator of the standard deviation of ϵ_{jt} as our measure of volatility, which was introduced by Davidian and Carroll (1987) and

[11] We compute returns as the percentage change in the price. Unlike Giacoletti (2017), we do not have access to remodeling expenses and do not differentiate between idiosyncratic volatility generated by non-stochastic, unobserved expenditures and other sources; however, this is unlikely to affect our results, since we are primarily interested in volatility at the parish, region, and national levels.

has been widely used in finance (e.g. Schwert (1989)), macroeconomics (e.g. McConnell and Perez-Quiros (1990)), and urban economics (e.g. Goodman and Thibodeau (1998)). It contains both time and geographic variation.

$$\hat{\sigma}_{jt} = \sqrt{\frac{\pi}{2}}|\hat{\epsilon}_{jt}|. \tag{3}$$

Note that equation (2) detrends house price growth rates at all levels of geography, but does not detrend the equivalent components of volatility. Thus, our measure of instantaneous volatility, $\hat{\sigma}_{jt}$, will vary over time and across geographic location; however, our results are robust to the use of alternative specifications of (2), including ones which use separate time and geographic fixed effects to detrend returns. Since our results do not appear to depend on changes in the dispersion of property-level volatilities within region over time, this suggests that our findings capture the relationship between time-varying volatility in house prices and dependence on manufacturing.

The benefit of using our selected measure of volatility is that it can be computed at a point in time and at the property level. Other common measures of volatility must be computed at the region level and over multiple periods of time. While such alternative measures may contain less noise, they substantially reduce the variation in the data and introduce issues with timing. Importantly, however, our findings are robust to the aggregation of the instantaneous measure of volatility, which suggests that our results do not heavily rely on this choice.

3.1 Main Results

In this subsection, we test our main hypothesis that dependence on manufacturing increases house price growth volatility. We do this by exploiting region and region-time variation in manufacturing, which Carvalho and Gabaix (2013) identify as a volatile sector:

$$\hat{\sigma}_{jt} = M_{it}\zeta + X_{jt}\theta + Z_{it}\eta + \xi_t + \mu_k + \nu_{jt}. \tag{4}$$

In equation (4), M_{it} is manufacturing's share of employment, income, or output in region i at time t; X_{jt} is a vector of property level controls; Z_{it} is vector of region level controls; ξ_t is a time fixed effect; and μ_k is a parish fixed effect.

Table 2 contains our baseline results. Note that we adopt a commonly-used measure of volatility that is constructed by performing the equation (1) regression with parish-year-quarter fixed effects. For parishes with fewer than 100 repeat sales, we pool fixed effects. Column 1 tests our core hypothesis using manufacturing's share of employment at the region level in 2008. No controls are included. Column 2 adds yearly fixed effects and columns 3-9 include year-quarter fixed effects. Columns 4-9 include property level characteristics as controls: area in square meters, dummies for the number of rooms, dummies for the property type, and distance from the region's center in kilometers, the number of months between transaction dates, and the number of transactions that occurred in the same quarter and parish.

Other than $distance\_to\_region\_center_j$, the distance between a property and its region's GPS centroid, and $months\_between\_transactions_{jt}$, the number of months between the pair of transactions in a repeat sale, we omit all property level controls from the tables to save space and improve readability.[12] Column 5 includes static, region level controls for the log of population density and the log of real per capita income. And finally, columns 6-9 include time-varying controls for the log of real income per capita (annual), the log of population density (annual), real per capita income growth (annual), and employment growth (quarterly). Column 7 clusters standard errors at the parish level. All other columns use heteroskedasticity and autocorrelation robust standard errors.[13] Note that time-varying controls are not available for all years at the region level. Including them forces us to reduce our sample size from 43,009 to 14,972. Note also that we cannot use parish fixed effects in this specification because we only have variation in the regressor of interest at the region level.

[12] Note that $months\_between\_transactions_{jt}$ is negative and significant at 1% in all specifications, which coincides with findings for the U.S. in Giacoletti (2017).

[13] As a convention, we provide heteroskedasticity and autocorrelation robust standard errors for all results. We also include separate cluster robust standard errors for each table's main result. Neither choice yields consistently smaller standard errors.

Our preferred specifications are given in columns 5 and 6. Note that the coefficients on manufacturing employment share are positive and significant at the 1% level and indicate that a unit increase in manufacturing's employment share would increase house price growth volatility by between 7.9 and 14.2ppt, depending on specification. Since manufacturing share ranges from 0 to 1, it may be more instructive to compare the region with the lowest manufacturing share of employment in 2008, Stockholm (0.145), to the region with the highest, Kalmar (0.366). This would translate into a 1.75 to 3.14ppt increase in house price growth volatility. For the median property, this is equivalent to a 26% to 46% increase in house price growth volatility. Finally, our results for manufacturing's share of income and output at the region level in 2008 are both significant at the 1% level and quantitatively similar to our baseline results. They also hold and explain a high share of variation in aggregate and local volatility in a separate cross-sectional regression.[14]

We next extend our initial result by using a time-varying measure of manufacturing's share of employment in columns 1-8 of Table 3. This enables us to include parish fixed effects to soak up cross-sectional variation that could comove with manufacturing's share. We also include time-varying region level controls, year-quarter fixed effects, and property level controls in our preferred specifications, which are shown in columns 5 and 8. Note that column 2 uses an IV specification, where manufacturing's employment share is instrumented by a one period lag of itself.[15] All other columns use OLS. Additionally, all columns use heteroskedasticity and autocorrelation robust standard errors, except column 8, which clusters standard errors at the parish level. Again, we find that the impact of manufacturing's share of employment on house price growth volatility remains positive and is statistically significant in all specifications. The magnitude of the effect is similar to what we identified in Table 2. Namely, a 10ppt increase in manufacturing share is associated with a 0.78 to 1.42ppt increase in

[14]We perform a separate cross-sectional regression of the region mean of property volatility on the average manufacturing shares of income, output, and employment. The regression on output yields the largest coefficient (18.93) and adjusted R-squared (0.388).

[15]The purpose of the IV exercise is provide further evidence that reverse causality and omitted variable bias are unlikely to be driving our results.

house price growth volatility.

4 Channels

In this section, we explore two potential channels through which the manufacturing employment share might affect house price growth volatility: employment growth volatility and firm concentration. As Carvalho and Gabaix (2013) have demonstrated, manufacturing is a relatively volatile sector. Consequently, an increase in manufacturing's share of employment in a given region will tend to increase volatility in employment and income within that region, which might translate into volatility in demand in the local housing market. Furthermore, dependence on manufacturing also tends to concentrate employment, which may increase the sensitivity of local housing demand to firm-specific shocks. We will test each of these channels more formally in this section.

4.1 Employment Growth Volatility

We first test the hypothesis that employment growth volatility is one of the channels through which manufacturing share affects house price growth volatility. In columns 9-10 of Table 3, we include employment growth volatility as a regressor. We compute this control as the standard deviation of region level employment growth over the 2009-2017 period. Comparing columns 5 and 9, we can see that manufacturing's employment share remains significant, but its magnitude declines from 20.3 to 12.7. Similarly, removing manufacturing's employment share in column 10 increases the magnitude of employment growth volatility from 1.34 to 2.43. Note that these results are also robust to clustering standard errors at the parish level.[16] This suggests that the impact that manufacturing's share of employment has on house price growth volatility may be related to the impact it has on employment growth volatility.[17]

[16]For the sake of readability, we omit this and several other robustness checks from the table; however, all results are available on request.

[17]Note that the estimates for manufacturing income share and manufacturing output share are larger and more statistically significant than manufacturing employment share in cross-sectional regressions that include employment growth volatility. This suggests that the relationship between house price growth volatility and

We also consider whether manufacturing explains a substantial share of the cross-sectional variation in region-level volatility. We do this in a set of cross-sectional regressions, shown in Table 4, where we regress the region level mean of property volatility on the region level employment growth volatility and manufacturing share. Note that the measure of volatility captures instantaneous differences in variation over time, even though the regression itself is cross-sectional. Columns 1-3 provide the estimates for the manufacturing shares of employment, income, and output on regional house price volatility. In each case, we average manufacturing share observations over the time dimension. The magnitudes of the estimates are similar to the uncontrolled results in Table 3. Column 4 shows results for employment growth volatility in isolation. Columns 5-7 include both employment growth volatility manufacturing employment, income, and output share, respectively. Column 6 yields an adjusted R-squared of 0.44, which suggests that manufacturing share and employment growth volatility explain a high share of the aggregate and regional volatility.

4.2 Firm Concentration

Another channel through which manufacturing may affect the housing market is through the concentration of employment and income. In particular, higher firm concentration will tend to leave the local or regional housing market exposed to firm-specific shocks. Indeed, at the regional level, manufacturing share and firm concentration have a 0.536 correlation; however, firm concentration is available at the local level, where it may be more relevant for house price volatility, which we exploit in our next exercise, shown in Table 5. Here, we measure the impact of firm concentration on house price growth volatility. The regressor of interest in all specifications is the Herfindahl-Hirschman Index (HHI) at the parish level,[18] which we compute as follows:

$$hhi_k = s_0^2 + ... + s_F^2. \tag{5}$$

manufacturing does not come entirely through employment volatility.

[18] At the region level, HHI and manufacturing's employment share are positively correlated (0.536); however, only HHI can be constructed at the parish level.

Note that s_l is firm l's share of establishments in parish k.[19] We compute this using data on the number of establishments within commuting distance (25km) of each parish's GPS centroid for each of the 15 largest employers in Sweden: Volvo, Ericsson, Electrolux, Svenska Cellulosa, Scania, Atlas Copco, Sandvik, SKF, Assa Abloy, Vattenfall, ICA, Securitas, Telia, Axel Johnson, and H&M. Using the narrowest geographic unit, parish, allows us to include region-year-quarter fixed effects in columns 7-9, which absorb all permanent and region level variation in volatility. We use two different regression specifications:

$$\hat{\sigma}_{jt} = log(hhi_k)\zeta + X_{jt}\theta + Z_{kt}\eta + \xi_t + \mu_i + v_{jt}. \quad (6)$$

The first specification, given in equation (6), includes parish level controls, Z_{kt}; time fixed effects, ξ_t; and region fixed effects, μ_i. The second specification, given in (7), replaces region and year-quarter fixed effects with region-year-quarter fixed effects, κ_{it}:

$$\hat{\sigma}_{jt} = log(hhi_k)\zeta + X_{jt}\theta + Z_{kt}\eta + \kappa_{it} + \nu_{jt}. \quad (7)$$

In column 1 of Table 5, we perform the regression with no controls. We next add year fixed effects in column 2 and year-quarter fixed effects in columns 3-6. In columns 3-8, we limit the sample to cover only years 2015-2017. This is to limit potential endogeneity issues, since our measure of firm concentration is only available for 2017. Importantly, however, our specifications with the most extensive set of controls and region-year-quarter fixed effects, shown in columns 6-9, suggest that this does not appear to bias the coefficient estimates upward in the full sample. Column 8 clusters standard errors at the parish level. All other columns use heteroskedasticity and autocorrelation robust standard errors. For all estimates, we find a positive, quanti-

[19] Since we cannot compute market share at the parish level, we instead use a measure of establishment share for the largest firms in Sweden. Note that we use parish, rather than region, since parish is a narrower geographic unit and is available for establishment location data; however, the results are not sensitive to the choice of geographic unit or the commuting distance assumption.

tatively similar effect that is significant at the 1% level. Our preferred specifications in columns 7 and 9 suggest that a doubling of firm concentration is associated with a 1.45 to 1.81ppt increase in house price growth volatility. For the median property, this is equivalent to an 21% to 26% increase in house price growth volatility.

5 Extensions

In this section, we extend our main results along two directions. First, we use a novel dataset to measure the impact of news about manufacturers on house price growth volatility. If the impact of manufacturing operates through the channels we propose – namely, through employment concentration and volatility – then we might expect news about manufacturing to have a larger impact on local housing demand in areas where manufacturers are located. We test that formally in this section. And second, we extend our main result by examining whether households are compensated for the excess volatility associated with dependence on manufacturing. We do this by measuring the impact of manufacturing's share on the Sharpe ratio. We also directly measure the impact of the channels through which manufacturing's employment share operates on the Sharpe ratio.

5.1 Impact of Manufacturing News

We first test our hypothesis about manufacturing news and house price growth volatility. We do this by exploiting news and location information about the largest manufacturers in Sweden. Specifically, we identify the number of manufacturing establishments located within a 25km radius of the parish centroid.[20]

In addition to this, we collect news about manufacturing firms by scraping a Swedish newspaper archive for all articles between 2009 and 2017 in the largest business newspaper, Dagens Industri. We count both the total number of articles written and the

[20] Specifically, we take the subset of the largest 15 firms by employment that are operating in the manufacturing sector: Assa Abloy, SKF, Sandvik, Atlas Copco, Svenska Cellulosa, Ericsson, Volvo, Electrolux, and Scania.

number of articles that specifically reference manufacturing firms. Both counts were computed at a monthly frequency, which is higher than the annual frequency at which manufacturing share is available. We then produce a time series of the ratio of manufacturing firm news to total news, which we then deseasonalize using the X-13 ARIMA-SEATS method and Hodrick-Prescott filter.[21] The time series plots are shown in Figure 2. Note that the regression exercises described in this section use a single series for all firms, rather than the individual series.

As with the firm concentration regressions, our variable of interest, manufacturer news, has variation at the parish level; however, it also has time variation, since it consists of the interaction of a binary variable that indicates whether a manufacturing establishment is present[22] with news about manufacturers, which is time-varying. We again use the specification from the firm concentration regressions and examine results for both housing return volatilities and Sharpe ratios.

Our findings for this exercise are given in Table 8. Columns 1-3 show the results for housing return volatility and columns 4-6 show the results for the Sharpe ratio. All specifications include property-level controls, time-varying parish controls, and region-year-quarter fixed effects. Columns 1-2 and 4-5 restrict the sample to the years 2015, 2016, and 2017 to mitigate potential endogeneity issues related to the firm location data, which is only available for 2017. Finally, columns 2 and 5 cluster standard errors at the parish level. All other specifications use Newey-West standard errors.

Overall, we find that manufacturing news has a positive and statistically significant effect on house price growth volatility in parishes with manufacturers, and a negative, but statistically insignificant impact on the Sharpe ratio. The impact on house price growth volatility in our preferred specifications ranges from 0.0873 to 0.1546. Thus, a one standard deviation increase in news about manufacturing is associated with a 0.17 to 0.31ppt increase in house price growth volatility in parishes with at least one manufacturing establishment.

[21] We set the value of λ on the HP filter to 129,600.

[22] We again require an establishment to be located within 25km of the parish centroid to be identified as present.

5.2 Compensation for Excess Volatility

Thus far, we have shown that manufacturing is associated with increased house price volatility. It remains unclear, however, whether homeowners are compensated for this increased volatility with higher house price growth. We might expect this to be the case in equity markets; however, it may not be true in the housing market, where location choices are not primarily determined by expected return and volatility. Peng and Thibodeau (2017), for instance, have shown that other sources of house price volatility, such as zip-code level median income in the U.S., are not compensated for by increased house price appreciation.

Measuring the Sharpe ratio is one way to identify the extent to which homeowners are compensated for higher volatility:

$$S_{jt} = \frac{E[r_{jt} - r^*]}{\sigma_{jt}}. \tag{8}$$

Here, S_{jt} is the Sharpe ratio for property j at time t, r_{jt} is the return to housing, r^* is the return to the safe asset, and σ_{jt} is the standard deviation of the housing return. The Sharpe ratio was originally developed to measure mutual fund performance (Sharpe, 1966), and can be interpreted here as the expected excess return to housing per unit of volatility.

We approximate the housing return with the house price growth rate at the property level,[23] and use the annualized return to three month Swedish government bonds as the risk free rate. Finally, we again adopt the property-level measure of instantaneous volatility introduced in equation (3) for σ_{jt}.

Our specification for the Sharpe ratio regressions is given below.

$$S_{jt} = M_{it}\zeta + X_{jt}\theta + Z_{it}\eta + \xi_t + \mu_k + \nu_{jt}. \tag{9}$$

Note that S_{jt} is the realized Sharpe ratio for property j at time t; M_{it} is manufacturing's

[23]Note that we do not have access to remodeling costs, so we follow the literature by using house price growth to approximate the house price return.

share of employment, income, or output in region i at time t; X_{jt} is a vector of property level controls; Z_{it} is vector of region level controls; ξ_t is a time fixed effect; and μ_k is a parish fixed effect. All reported Sharpe ratios are annualized. The median Sharpe ratio in our sample is 1.26, which exceeds historical equity performance, and is likely related to the period we cover, where house price growth was high and the risk free rate was low and sometimes negative. Sharpe ratios estimated for Sweden and other countries over longer time horizons have typically been below unity (e.g. Favilukis et al. (2017); Jórda et al. (2017); Flavin and Yamashita (2002)); however, Nordic countries have generally had high housing Sharpe ratios since the 1950s (Jórda et al., 2017). The housing Sharpe ratio in the U.S. during the late 1990s and early 2000s was similar to our estimate for Sweden; and several state housing markets are likely to have exceeded it. See Lo (2003) for a comparison of Sharpe ratio estimates for different categories of assets.

Our findings are summarized in Table 6. Note that the specifications in columns 1-10 are identical to those used in the volatility regressions, which were shown in Table 3, except that our dependent variable is now the housing returns Sharpe ratio. In all cases, the sign on the region-level manufacturing share of employment is negative, suggesting that an increase in the manufacturing share is associated with a decrease in the Sharpe ratio. This implies that the increase in house price volatility associated with manufacturing is not fully compensated for by increased house price appreciation.

Note that this finding is less robust than our original results for house price growth volatility. In particular, including time-varying region controls requires us to drop the 37% of the sample for which such controls are not available. When we do this, the results remain significant when standard errors are clustered at the parish level, but not when we use Newey-West standard errors. Overall, 7 of 9 specifications yield estimates that are significant at a 1% level. Our preferred specifications, given in columns 5 and 8, are both significant at the 1% level and suggest that a 10ppt increase in the manufacturing share is associated with a 0.05 to 0.25ppt decrease in the Sharpe ratio. Again, moving from the region with the lowest share of manufacturing employment in 2008, Stockholm (0.145), to the region with the highest, Kalmar (0.366), would translate into a 0.11 to 0.55ppt decrease in the Sharpe ratio. For the median home, this effect amounts to a 9% to 44% reduction in the Sharpe ratio.

Furthermore, columns 9 and 10 indicate that part of the effect of manufacturing on the Sharpe ratio comes through employment growth volatility. In particular, in column 9, we add employment growth volatility to the regression specification given in column 5, which reduces the coefficient on manufacturing employment share from -2.52 to -2.2. Additionally, upon removing manufacturing share in column 10, the impact of employment growth volatility becomes significant and increases in magnitude from -0.05 to -0.24. Thus, a one standard deviation increase in employment growth volatility is associated with a 0.11 decrease in the Sharpe ratio. In terms of house price volatility, this effect is similar to moving from the region with the lowest manufacturing share to the region with the highest.

Finally, we consider the impact of firm concentration on the Sharpe ratio. If volatility in manufacturing emerges from the effect it has on concentrating employment, income, and output, then we might expect measures of firm concentration to be associated with the volatility and Sharpe ratio of housing returns. We have already shown the former. We will show the latter in the exercise below, where we re-use the specification given in equation (7), but change the dependent variable to the Sharpe ratio, S_{jt}, as shown in equation (10):

$$S_{jt} = log(hhi_k)\zeta + X_{jt}\theta + Z_{kt}\eta + \kappa_{it} + \nu_{jt}. \tag{10}$$

The results for this exercise are given in Table 7. Here, we again find strong evidence that homeowners are not compensated for the increased volatility associated with firm concentration. In particular, 8 out of 9 specifications are significant at the 1% level and 1 is significant at the 5% level. Our preferred specifications in columns 7 and 9 suggest that a doubling of firm concentration is associated with a 0.125 to 0.156ppt decrease in the Sharpe ratio. For the median property, this is equivalent to an 10% to

12% decrease in the Sharpe ratio.

6 Applications

We now consider two applications of our findings on the impact of manufacturing on house price growth volatility and, relatedly, the Sharpe ratio. The first application considers the portfolio choice implications of the housing location decision in a setting where housing returns comove with labor income. In particular, we couple our estimated results with a theoretical model to evaluate the portfolio gains of living and working in separate locations. The second application considers the aggregate implications of our volatility findings. Here, we show that effects estimated at the regional level translate into volatility in national level house price indices. Thus, the relationship between manufacturing and house price volatility should also persist at the aggregate level. We use our estimates to show what this implies about the long run decline in manufacturing share on house price growth volatility in four countries.

6.1 Location Choice

The literature has shown that households hedge labor income risk by adjusting risky asset holdings (Betermier et al., 2012); and respond to comovement between unemployment and house price risk by reducing investment in owner-occupied housing (Jansson, 2017). In our first application, we consider a related portfolio choice problem, where a worker has obtained a job and must now choose housing; however, rather than selecting a quantity of housing or deciding whether to switch to the rental market, the homeowner will instead choose a location in which to purchase a home. Note that we will explicitly consider only the portfolio choice dimension of the problem, abstracting away from dimensions such as local amenities and commuting costs.

We will use a standard model in the Markowitz-Sharpe style[24] in which a household attempts to maximize the Sharpe ratio of its portfolio; however, there will be two devi-

[24] See Markowitz (1952), Sharpe (1966), and Sharpe (1994) for an overview of portfolio optimization.

ations from the standard model: 1) the portfolio will contain exogenously determined labor income; and 2) the choice over remaining assets will be discrete. That is, an agent must either choose to live in a city where manufacturing is dominant or where services are dominant.

In the model, a household supplies one unit of labor to a job in sector g, where $g \in \{m, s\}$, and earns labor income, l_g, with volatility σ_{l_g}, where m and s denote manufacturing and services. The household also chooses whether to live in a city that is dominated by either the manufacturing sector ($w = 1$) or the service sector ($w = 0$). Houses in areas dominated by sector g generate a return of r_g and have a return volatility of σ_g. For the sake of simplicity, we will treat all returns as excess returns (i.e. less the risk free rate). This yields the following portfolio optimization problem, where ρ is a fixed portfolio share weight of income and w is a discrete portfolio weight on housing location choice:

$$\max_{w\in\{0,1\}} \frac{\rho l_g + (1-\rho)(w r_m + (1-w) r_s)}{\sqrt{\rho\sigma_{l_g}^2 + (1-\rho)(w\sigma_m^2 + (1-w)\sigma_s^2) + \rho(1-\rho)(w\sigma_{l_g,m} + (1-w)\sigma_{l_g,s})}}. \quad (11)$$

Note that there is no covariance term, $\sigma_{m,s}$, because it is not possible to hold housing located in the city dominated by manufacturing and services simultaneously. If the worker chooses to live in the city with a dominant manufacturing sector, we have $w = 1$, and equation (11) becomes:

$$\frac{\rho l_g + (1-\rho) r_m}{\sqrt{\rho\sigma_{l_g}^2 + (1-\rho)\sigma_m^2 + (1-\rho)\sigma_{l_g,m}}}. \quad (12)$$

Alternatively, if the worker chooses to live in the city with a dominant service sector, we have $w = 0$, and equation (11) becomes:

$$\frac{\rho l_g + (1-\rho) r_s}{\sqrt{\rho\sigma_{l_g}^2 + (1-\rho)\sigma_s^2 + \rho(1-\rho)\sigma_{l_g,s}}}. \quad (13)$$

Let's now consider the case of a worker in the service sector (i.e. g=s) who wishes to choose a housing location optimally. She will choose to both work and live in a service sector dominated city if the following condition holds:

$$\frac{\rho l_s + (1-\rho)r_s}{\sqrt{\rho\sigma_{l_s}^2 + (1-\rho)\sigma_s^2 + \rho(1-\rho)\sigma_{l_s,s}}} > \frac{\rho l_s + (1-\rho)r_m}{\sqrt{\rho\sigma_{l_s}^2 + (1-\rho)\sigma_m^2 + \rho(1-\rho)\sigma_{l_s,m}}}. \tag{14}$$

We will also assume that manufacturing does not generate a premium on house price returns, which is roughly consistent with our findings.[25] Under these conditions, the household will live in the city dominated by the service sector if the following condition holds:

$$\sigma_m^2 + \rho\sigma_{l_s,m} > \sigma_s^2 + \rho\sigma_{l_s,s}. \tag{15}$$

Empirically, we have demonstrated that $\sigma_m^2 > \sigma_s^2$. Additionally, it is reasonable to assume that labor income in the service sector comoves more strongly with house prices in the service sector-dominated city than house prices in the manufacturing-dominated city. Thus, $\sigma_{l_s,s} > \sigma_{l_s,m}$, which suggests that we may rewrite equation (15) as follows:

$$\underbrace{(\sigma_m^2 - \sigma_s^2)}_{>0} + \underbrace{\rho(\sigma_{l_s,m} - \sigma_{l_s,s})}_{<0} > 0. \tag{16}$$

According to equation (16), if a worker's portfolio share of labor income, ρ, is low, then the relative volatilities of housing returns will matter more for her location choice than the relative covariances between labor income and housing returns. Note that this is most likely to be true for high income workers. Here, such a worker in the service sector would choose to live in a city dominated by the service sector. Alternatively, if the comovement between labor income and housing returns is weak, then relative return volatilities will again dominate, which will result in the service sector worker living in the city with a dominant service sector.

If we instead consider the case of a manufacturing worker who is deciding where to locate, we get the following condition for living in the manufacturing-dominated city:

[25] We have demonstrated that the Sharpe ratio tends to be negatively associated with manufacturing. That is, households are not fully compensated for the increase in volatility generated by manufacturing with higher house price appreciation. Note that this is somewhat weaker than the claim we make here, since we assume that there is no premium.

$$\underbrace{(\sigma_s^2 - \sigma_m^2)}_{<0} + \underbrace{\rho(\sigma_{l_m,s} - \sigma_{l_m,m})}_{<0} > 0. \tag{17}$$

Since this condition is never satisfied, it will never be optimal for a manufacturing worker to live in the manufacturing city, unless non-portfolio choice concerns – such as commuting costs, local amenities, or the cost of living – dominate.

Overall, we show that manufacturing workers may capture substantial portfolio gains by living and working in different locations; however, this is is often not the case for service sector workers. Our findings in the empirical section (e.g. Table 2) also suggests that living closer to the center of a region is another way in which households can reduce volatility and increase their housing return Sharpe ratio, regardless of whether manufacturing or services is dominant in that region.

6.2 Aggregate Effects of Manufacturing Decline

Our main empirical exercise established a statistically robust and economically significant relationship between dependence on manufacturing and house price volatility at the region level. We then proposed channels through which dependence on manufacturing might translate into house price volatility and demonstrated that those channels have empirical relevance. Given the lack of exogenous variation in the data, we refrain from making strong claims about causality; however, we can plausibly rule out reverse causality and have carefully controlled for confounders through the use of a large set of granular fixed effects and local controls. We have also exploited specifications with lags and employed IV to provide evidence against alternative hypotheses.

In this subsection, we will examine the implications of these findings for aggregate house price volatility. Note that most of our effects were measured at the level of the largest subnational administrative unit, which we referred to as "region" throughout the paper. There are 21 such regions in Sweden, three of which account for 53% of the country's housing transactions. Consequently, movements in apparently regional factors, such as manufacturing share or employment volatility, may translate into aggregate movements in house price volatility. This is particularly likely to be true for manufacturing, which has experienced a secular decline across all regions since 1970.

We first note that national house price indices are typically computed at the regional level and then aggregated using transaction shares. This implies that a house price index can be decomposed into its regional parts as follows:

$$P_t = \alpha_1 p_{1t} + ... + \alpha_n p_{nt} \tag{18}$$

In equation (18), P_t is the aggregate house price in period t, p_{it} is the house price in region i, and α_i is the transaction share of region i. Note that n is the number of regions and $\sum_i^n \alpha_i = 1$. This implies that the variance of the aggregate index can be decomposed as follows:

$$\sigma^2_{P_t} = \sum_{i=1}^{n} \alpha_i^2 \sigma^2_{p_{it}} + \sum_{1<i\leq j} \alpha_i \alpha_j \sigma_{p_{it},p_{jt}}. \tag{19}$$

For simplicity, assume that house price variances are identical across region in period 0 (e.g. $\sigma_{p_{10}} = ... = \sigma_{p_{n0}}$) and all covariance terms are zero.[26] Now, consider an increase in the house price variance in region j in period 1. We may write the implied percentage change in the national house price index as follows:

$$\frac{\Delta\sigma_{P_1}}{\sigma_{P_0}} = \frac{\alpha_j^2}{\sum_{i=1}^n \alpha_i^2} \frac{\Delta\sigma^2_{p_{j1}}}{\sigma^2_{P_{j0}}}. \tag{20}$$

This suggests that a 10% increase in the variance of region j would translate into a $0.10 * \alpha_j^2 / \sum_{i=1}^n \alpha_i^2$ percent increase in aggregate house price variance. For example, a 10% house price variance increase in the Stockholm region, which has a transaction share of 0.27, would yield a 6.1% increase ($0.10 * 0.27^2/0.122$) in national house price variance. This suggests that reductions in the manufacturing share at the regional level can translate into substantial reductions in national-level house price volatility.

[26]In practice, the covariance terms are positive, which would increase the size of the effects we capture in this exercise. Additionally, the shock exposure we study – which partly drives covariance in house prices across region – also positively covaries.

Above, we have 1) measured the impact of manufacturing at the regional-level using microdata; and 2) demonstrated that fluctuations at that level can plausibly translate into national level aggregate fluctuations. We now use our earlier empirical findings to simulate the national level implications for house price volatility in Sweden, the U.S., the U.K., and Japan. We will focus exclusively on the partial effects that would have been generated by the manufacturing share reductions in each country.

Figure 3 plots the results of this simulation exercise.[27] In each case, we use the estimated relationship between manufacturing employment share[28] and house price volatility estimated in this paper. We interact this measure with the manufacturing employment share for the country being simulated. Each series can be interpreted as the cumulative percentage point change in house price volatility since 1970. All countries experienced a decline in manufacturing share, implying volatility declines of between 1.4 and 3.3ppt. The decline for Sweden (2.2ppt) is approximately 32% of its 2009-2017 volatility level. While we have the manufacturing share for other countries, we do not have microdata to estimate the size of the effect separately.

7 Conclusion

Using a unique dataset of all Swedish housing transactions over the 2009-2017 period, we document a statistically robust and economically significant association between regional dependence on manufacturing and house price growth volatility. We show that this relationship can plausibly be accounted for by manufacturing's impact on firm concentration and employment volatility. In addition to this, we show that such volatility increases are not compensated for in the form of higher house price growth. Rather, manufacturing is associated with lower housing return Sharpe ratios.

[27]Importantly, we capture only the partial decline attributable to the reduction in manufacturing share. In certain periods, this decline was dominated by other sources of volatility. Most notably, house price volatility increased sharply in the U.S., U.K., and Sweden around the Great Recession. It also increased in Sweden during the early 1990s.

[28]For each country, we use the U.S. Bureau of Labor Statistics' "Percent of Employment in Manufacturing" series.

Our results have implications for both optimal portfolio choice and the impact of national-level manufacturing share declines on house price volatility. On the portfolio choice side, we combine our empirical results with a theoretical model to demonstrate that living and working in an industrial city is often welfare-reducing, unless non-portfolio considerations, such as commuting costs, dominate. To the contrary, living and working in a service sector-dominated city is often optimal under reasonable assumptions.

Finally, we examine the implications of our results for the national-level manufacturing share declines that have occurred in high income countries since the 1970s. Our results suggest that the manufacturing share decline could explain part of the reduction in house price growth volatility during the Great Moderation. In particular, the 16ppt reduction in Sweden's manufacturing since 1970 could account for a 2.2ppt (32%) decline in house price growth volatility. Similarly, the 17.5ppt decline in manufacturing share in the U.S. since 1970 would account for a 2.5ppt decline in house price growth volatility. It would also account for volatility reductions of 1.4ppt in the U.K. and 3.3ppt in Japan. This has welfare implications because house price volatility induces individual consumption volatility. This can happen through several channels, including binding collateral constraints and the housing wealth effect on consumption. This is particularly important because housing is the dominant asset for a large share of the population (Kuhn et al., 2018).

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8 Tables and Figures

Table 1: Descriptive statistics: property and region level

Variable	Mean	SD	25%	50%	75%	N
Property level statistics						
Area	102.39	46.52	68.00	100.00	128.00	44895
Latitude	59.01	2.16	57.72	59.26	59.56	44895
Longitude	15.82	2.51	13.42	16.21	17.96	44895
Distance to region center (km)	35.22	27.49	14.09	30.23	48.05	44895
Annualized return	9.23	12.39	2.51	8.01	14.92	44895
Return volatility	10.11	10.72	3.12	6.82	12.86	44895
Time between sales (month)	32.19	19.14	17.00	28.00	44.00	44895
Sharpe ratio	1.72	2.00	0.27	1.26	2.36	44895
Region and parish level statistics						
Real per capita income growth	2.70	0.27	2.50	2.67	2.88	20
Population density (persons / sqkm)	45.16	66.25	14.20	26.70	49.38	20
Employment growth	0.64	0.23	0.56	0.64	0.78	20
Manufacturing income share	0.28	0.06	0.26	0.29	0.32	20
Manufacturing output share	0.29	0.05	0.27	0.30	0.32	20
Manufacturing employment share	0.27	0.05	0.25	0.27	0.31	20
Employment growth volatility	1.86	0.45	1.67	1.84	2.18	20
Herfindahl-Hirschman Index (HHI)	3600.70	2346.64	1330.85	2583.87	5709.03	90
Transactions	218.28	302.11	67	115	225	6015
Manufacturer news	-0.02	1.99	-1.23	-0.37	0.59	6015

Notes: The descriptive statistics are divided into property level and region level groups. Property level statistics include area in square meters, latitude, longitude, distance to region center, annualized return, return volatility, and the Sharpe ratio. We use an instantaneous, unbiased estimate of volatility at the property level, which is described in the Empirical Results section. Region and parish level statistics include real per capita income growth (annual), population density (annual), employment growth (quarterly), manufacturing income share (annual), manufacturing employment share (annual), and employment growth volatility. Each region level variable is averaged over its time dimension before descriptive statistics are computed. We include the HHI index in the list of region level variables; however, we also compute it at the parish level and include this measure in Table 5 regressions. Finally, we include the number of transactions (monthly) and manufacturer news (monthly) at the parish level.

Table 2: Impact of 2008 manufacturing share on house price growth volatility

	(1) (OLS)	(2) (OLS)	(3) (OLS)	(4) (OLS)	(5) (OLS)	(6) (OLS)	(7) (OLS)	(8) (OLS)	(9) (OLS)
manufacturing_employment_share$_{t=2008}$	15.7934***	15.2591***	15.3348***	15.9253***	14.2401***	7.8895***	7.8895**		
	(0.7311)	(0.7352)	(0.7355)	(0.9032)	(1.5706)	(2.6872)	(3.3040)		
manufacturing_income_share$_{t=2008}$								6.5165*	
								(3.4857)	
manufacturing_output_share$_{t=2008}$									10.0563**
									(5.0096)
log(population_density$_{t=2008}$)					-0.2062***				
					(0.0712)				
log(per_capita_income$_{t=2008}$)					0.6580				
					(1.2543)				
log(population_density$_{it}$)						-0.1908	-0.1908	-0.2035	0.0514
						(0.1213)	(0.1365)	(0.1394)	(0.1801)
log(per_capita_income$_{it}$)						-2.4992	-2.4992	-2.9014	-3.6810
						(2.1666)	(2.6227)	(2.9534)	(2.5916)
per_capita_income_growth$_{it}$						-0.2324	-0.2324	-0.2191	-0.2403
						(0.1893)	(0.2150)	(0.2170)	(0.2181)
employment_growth$_{it}$						0.0481	0.0481	0.0495	0.0500
						(0.0696)	(0.0660)	(0.0665)	(0.0667)
distance_to_region_center$_j$				0.0084***	0.0068***	0.0134***	0.0134***	0.0130***	0.0134***
				(0.0023)	(0.0023)	(0.0041)	(0.0030)	(0.0029)	(0.0029)
months_between_transactions$_{jt}$				-0.1254***	-0.1255***	-0.1715***	-0.1715***	-0.1714***	-0.1715***
				(0.0032)	(0.0032)	(0.0076)	(0.0153)	(0.0154)	(0.0153)
transactions$_{kt}$				-0.0008***	-0.0008***	-0.0013***	-0.0013***	-0.0013***	-0.0013***
				(0.0001)	(0.0001)	(0.0003)	(0.0005)	(0.0005)	(0.0005)
Year FE	NO	YES	NO	NO	NO	NO	NO	NO	NO
Year-Quarter FE	NO	NO	YES	YES	YES	YES	YES	YES	YES
Property Controls	NO	NO	NO	YES	YES	YES	YES	YES	YES
Static Region Controls	NO	NO	NO	NO	YES	NO	NO	NO	NO
Time-Varying Region Controls	NO	NO	NO	NO	NO	YES	YES	YES	YES
Standard Errors	NW	NW	NW	NW	NW	NW	CL	NW	NW
Adj. R-squared	0.0108	0.0146	0.0159	0.0671	0.0673	0.0819	0.0819	0.0818	0.0819
N	43009	43009	43009	43009	43009	14972	14972	14972	14972

Notes: The dependent variable is the unbiased estimate of instantaneous house price return volatility at the property level, σ_{jt}. We regress σ_{jt} on three measures of manufacturing dependence at the region level in 2008: 1) manufacturing's share of employment; 2) manufacturing's share of income; and 3) manufacturing's share of output. Property controls include area in square meters, dummies for the number of rooms, dummies for the property type, distance from the region's center in kilometers, and the number of months between transaction dates. Static region controls include the log of real per capita income and the log of population density. Time-varying region controls include employment growth (quarterly), the log of per capita income (annual), per capita income growth (annual), and the log of population density (annual), and the number of transactions that occurred in the same parish (quarterly). Note that the time-varying controls are not available at the region level for all periods, which lowers the number of observations in 6-9. We cannot include region fixed effects because the regressor of interest is static. Standard errors are either Newey-West (NW) or clustered at the parish level (CL). Note that k indexes parish. * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 3: Impact of time-varying manufacturing share and employment volatility on house price growth volatility

	(1) (OLS)	(2) (IV)	(3) (OLS)	(4) (OLS)	(5) (OLS)	(6) (OLS)	(7) (OLS)	(8) (OLS)	(9) (OLS)	(10) (OLS)
manufacturing_employment_share$_{it}$	17.2227***	17.5062***	16.4857***	16.6450***	20.3619***	7.7324**	6.5824*	6.5824***	12.7137***	
	(1.1492)	(1.1557)	(1.1687)	(1.1681)	(1.4076)	(3.0249)	(3.4432)	(0.3424)	(3.7331)	
employment_growth_volatility$_i$									1.3409*	2.4325**
									(0.8006)	(1.1294)
log(population_density$_{it}$)						-0.1289	-0.0396	-0.0396*		
						(0.1265)	(0.1459)	(0.0228)		
log(per_capita_income$_{it}$)						-3.5866*	-4.3894	-4.3894***		
						(2.0390)	(2.7667)	(0.5254)		
employment_growth$_{it}$						0.0509	0.0537	0.0537		
						(0.0696)	(0.0698)	(0.0669)		
per_capita_income_growth$_{it}$						-0.2183	-0.2219	-0.2219		
						(0.1891)	(0.1943)	(0.1719)		
distance_to_region_center$_j$					0.0037	0.0134***	0.0149***	0.0149***	0.0030	0.0056
					(0.0032)	(0.0041)	(0.0047)	(0.0013)	(0.0125)	(0.0110)
months_between_transactions$_{jt}$					-0.1271***	-0.1720***	-0.1721***	-0.1721***	-0.1715***	-0.1706***
					(0.0052)	(0.0076)	(0.0076)	(0.0154)	(0.0152)	(0.0149)
transactions$_{kt}$					-0.0008***	-0.0013***	-0.0003	-0.0003	-0.0007	-0.0008
					(0.0002)	(0.0003)	(0.0005)	(0.0003)	(0.0007)	(0.0007)
Year FE	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO
Year-Quarter FE	NO	NO	NO	YES	YES	YES	YES	YES	YES	NO
Property Controls	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
Time-Varying Region Controls	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO
Parish FE	NO	NO	NO	NO	NO	NO	YES	YES	NO	NO
Standard Errors	NW	NW	NW	NW	NW	NW	NW	CL	NW	NW
Adj. R-squared	0.0090	0.0090	0.0102	0.0121	0.0601	0.0818	0.0906	0.0906	0.0615	0.0596
N	24315	24315	24315	24315	24315	14972	14972	14972	24315	24315

Notes: The dependent variable is the unbiased estimate of instantaneous house price return volatility at the property level, σ_{jt}. We regress σ_{jt} on manufacturing's employment share at the region level. Property level controls include area in square meters, dummies for the number of rooms, dummies for the property type, distance from the region's center in kilometers, and the number of months between transaction dates. Time-varying region controls include employment growth (quarterly), the log per capita income (annual), per capita income growth (annual), the log of population density (annual), and the number of transactions that occurred in the same parish (quarterly). Note that the time-varying controls are not available at the region level for all periods, which lowers the number of observations in 6-8. Columns 7-8 include parish fixed effects. Columns 9 and 10 include employment growth volatility at the region level, computed as the standard deviation of employment growth over the 2009-2017 period. Standard errors are either Newey-West (NW) or clustered at the parish level (CL). Note that k indexes parish. * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 4: Regional impact of employment volatility and manufacturing share on house price growth volatility

	(1) (OLS)	(2) (OLS)	(3) (OLS)	(4) (OLS)	(5) (OLS)	(6) (OLS)	(7) (OLS)
manufacturing_employment_share$_i$	14.7645**				11.4484*		
	(6.1759)				(6.0791)		
manufacturing_income_share$_i$		15.8125***				13.7797***	
		(4.8682)				(4.5487)	
manufacturing_output_share$_i$			18.9305***				15.7594**
			(5.2412)				(5.7282)
employment_growth_volatility$_i$				1.5659**	1.2004*	1.2076**	0.8048
				(0.6667)	(0.6535)	(0.5654)	(0.6342)
Adj. R-squared	0.1988	0.3345	0.3880	0.1921	0.2922	0.4444	0.4081
N	20	20	20	20	20	20	20

Notes: The dependent variable, σ_i, is the unbiased estimate of instantaneous house price return volatility at the property level, σ_{jt}, averaged over properties and time (2009-2015) within each region. We regress σ_i on the standard deviations of employment growth over the 2009-2015 period, as well as manufacturing employment, income, and output. In each case, we average the measure of manufacturing share over the time dimension. All specifications use OLS. Standard errors are shown in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 5: Impact of firm concentration on house price growth volatility

	(1) (OLS)	(2) (OLS)	(3) (OLS)	(4) (OLS)	(5) (OLS)	(6) (OLS)	(7) (OLS)	(8) (OLS)	(9) (OLS)
log(hhi_k)	1.3584***	1.2933***	1.4405***	1.5590***	1.0141***	1.8903***	1.8113***	1.8113***	1.4516***
	(0.0592)	(0.0594)	(0.0703)	(0.1128)	(0.1679)	(0.2193)	(0.2180)	(0.4086)	(0.1744)
log($parish\_size_{kt}$)						0.5387***	0.4941***	0.4941	0.5142***
						(0.1950)	(0.1876)	(0.5093)	(0.1507)
$mean\_distance\_to\_region\_center_{kt}$				-0.0002	-0.0009	0.0007	0.0006	0.0006	0.0009
				(0.0005)	(0.0007)	(0.0011)	(0.0011)	(0.0010)	(0.0008)
$mean\_distance\_to\_parish\_center_{kt}$				0.0016	0.0085***	0.0119***	0.0125***	0.0125***	0.0144***
				(0.0028)	(0.0030)	(0.0032)	(0.0032)	(0.0010)	(0.0027)
$distance\_to\_region\_center_j$						-0.0148***	-0.0134***	-0.0134	-0.0123***
						(0.0042)	(0.0041)	(0.0104)	(0.0033)
$distance\_to\_parish\_center_j$						-0.0285***	-0.0267***	-0.0267**	-0.0234***
						(0.0073)	(0.0073)	(0.0113)	(0.0059)
$months\_between\_transactions_{jt}$				-0.1126***	-0.1155***	-0.1155***	-0.1187***	-0.1187***	-0.1300***
				(0.0036)	(0.0035)	(0.0034)	(0.0034)	(0.0092)	(0.0030)
$transactions_{kt}$				-0.0004**	-0.0004**	-0.0002	-0.0003	-0.0003	-0.0005***
				(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
Year FE	NO	YES	NO	NO	NO	NO	NO	NO	NO
Year-Quarter FE	NO	NO	YES	YES	YES	YES	NO	NO	NO
Property Controls	NO	NO	NO	YES	YES	YES	YES	YES	YES
Time-Varying Parish Controls	NO	NO	NO	NO	NO	YES	YES	YES	YES
Region FE	NO	NO	NO	NO	YES	YES	NO	NO	NO
Region x Year-Quarter FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Year $\geq$ 2015	NO	NO	YES	YES	YES	YES	YES	YES	NO
Standard Errors	NW	NW	NW	NW	NW	NW	NW	CL	NW
Adj. R-squared	0.0096	0.0128	0.0142	0.0616	0.0833	0.0851	0.1040	0.1040	0.0958
N	44897	44897	28103	28103	28103	28103	28103	28103	44897

Notes: The dependent variable is the unbiased estimate of instantaneous house price return volatility at the property level, σ_{jt}. We compute the centroid of a parish as the mean longitude and latitude of properties located within it in our dataset. We then regress σ_{jt} on the parish level HHI index. The HHI index is computed using the number of establishments present in a given parish for each of the largest 15 employers in Sweden: Volvo, Ericsson, Electrolux, Svenska Cellulosa, Scania, Atlas Copco, Sandvik, SKF, Assa Abloy, Vattenfall, ICA, Securitas, Telia, Axel Johnson, and H&M. Property level controls include area in square meters, dummies for the number of rooms, dummies for the property type, and the number of months between transaction dates. For columns 3-8, we limit the sample to 2015-2017 to avoid possible issues with endogeneity, since the firm location data is only available for 2017. Columns 5 and 6 include region fixed effects. Columns 7-9 include region-year-quarter fixed effects. Columns 6-9 include additional parish level controls: the average property size, the average distance to the parish's centroid in kilometers, the average distance to the region's centroid in kilometers, the log of the number of properties located in the parish, and the number of transactions that occurred in the same parish (quarterly). Standard errors are either Newey-West (NW) or are clustered at the parish level (CL). Note that k indexes parish. * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 6: Impact of time-varying manufacturing share and employment volatility on Sharpe ratio for housing returns

	(1) (OLS)	(2) (IV)	(3) (OLS)	(4) (OLS)	(5) (OLS)	(6) (OLS)	(7) (OLS)	(8) (OLS)	(9) (OLS)	(10) (OLS)
manufacturing_employment_share$_{it}$	-4.3624***	-4.4127***	-3.7916***	-3.8459***	-2.5203***	-0.0100	-0.5053	-0.5053***	-2.2030***	
	(0.2126)	(0.2010)	(0.2080)	(0.2073)	(0.2263)	(0.4207)	(0.4839)	(0.0613)	(0.5275)	
employment_growth_volatility$_i$									-0.0559	-0.2442*
									(0.0716)	(0.1311)
log(population_density$_{it}$)						-0.0907***	-0.0505**	-0.0505***		
						(0.0185)	(0.0210)	(0.0035)		
log(per_capita_income$_{it}$)						2.2681***	1.3673***	1.3673***		
						(0.3088)	(0.4165)	(0.0962)		
employment_growth$_{it}$						-0.0039	-0.0063	-0.0063		
						(0.0105)	(0.0105)	(0.0095)		
per_capita_income_growth$_{it}$						-0.0453	-0.0264	-0.0264		
						(0.0290)	(0.0296)	(0.0301)		
distance_to_region_center$_j$					-0.0011**	-0.0013**	-0.0015**	-0.0015***	-0.0010	-0.0015
					(0.0005)	(0.0006)	(0.0006)	(0.0001)	(0.0012)	(0.0010)
months_between_transactions$_{jt}$					0.0064***	0.0066***	0.0067***	0.0067***	0.0064***	0.0061***
					(0.0008)	(0.0011)	(0.0011)	(0.0009)	(0.0013)	(0.0014)
transactions$_{kt}$					0.0001***	0.0001*	-0.0000	-0.0000	0.0001	0.0002*
					(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Year FE	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO
Year-Quarter FE	NO	NO	NO	YES	YES	YES	YES	YES	YES	NO
Property Controls	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
Time-Varying Region Controls	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO
Parish FE	NO	NO	NO	NO	NO	NO	YES	YES	NO	NO
Standard Errors	NW	NW	NW	NW	NW	NW	NW	CL	NW	NW
Adj. R-squared	0.0202	0.0202	0.0559	0.0590	0.0772	0.0432	0.0499	0.0499	0.0773	0.0752
N	22845	22845	22845	22845	22845	14296	14296	14296	22845	22845

Notes: The dependent variable is the realized Sharpe ratio at the property level, S_{jt}. We regress S_{jt} on manufacturing's employment share at the region level. Property level controls include area in square meters, dummies for the number of rooms, dummies for the property type, distance from the region's center in kilometers, and the number of months between transaction dates. Time-varying region controls include employment growth (quarterly), the log per capita income (annual), per capita income growth (annual), the log of population density (annual), and the number of transactions that occurred in the same parish (quarterly). Note that the time-varying controls are not available at the region level for all periods, which lowers the number of observations in 6-8. Columns 7-8 include parish fixed effects. Columns 9 and 10 include employment growth volatility at the region level, computed as the standard deviation of employment growth over the 2009-2017 period. Standard errors are either Newey-West (NW) or clustered at the parish level (CL). Note that k indexes parish. * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 7: Impact of firm concentration on Sharpe ratio for housing returns

	(1) (OLS)	(2) (OLS)	(3) (OLS)	(4) (OLS)	(5) (OLS)	(6) (OLS)	(7) (OLS)	(8) (OLS)	(9) (OLS)
log(hhi$_k$)	-0.3674***	-0.3259***	-0.3449***	-0.2102***	-0.0554*	-0.1476***	-0.1251***	-0.1251**	-0.1561***
	(0.0136)	(0.0133)	(0.0174)	(0.0234)	(0.0318)	(0.0432)	(0.0433)	(0.0613)	(0.0340)
log(parish_size$_{kt}$)						0.0193	0.0419	0.0419	0.0519
						(0.0419)	(0.0418)	(0.0724)	(0.0316)
mean_distance_to_region_center$_{kt}$						0.0001	-0.0005	-0.0005	-0.0009
						(0.0009)	(0.0009)	(0.0016)	(0.0007)
mean_distance_to_parish_center$_{kt}$						0.0051***	0.0049***	0.0049***	0.0048***
						(0.0015)	(0.0015)	(0.0016)	(0.0012)
distance_to_region_center$_j$				0.0001	0.0001	-0.0001	-0.0001	-0.0001	-0.0002
				(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
distance_to_parish_center$_j$				-0.0010**	-0.0023***	-0.0029***	-0.0030***	-0.0030***	-0.0037***
				(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0002)	(0.0004)
months_between_transactions$_{jt}$				0.0061***	0.0069***	0.0069***	0.0074***	0.0074***	0.0117***
				(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0013)	(0.0006)
transactions$_{kt}$				0.0001**	0.0001*	0.0000	0.0000	0.0000	0.0000
				(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0000)
Year FE	NO	YES	NO	NO	NO	NO	NO	NO	NO
Year-Quarter FE	NO	NO	YES	YES	YES	YES	NO	NO	NO
Property Controls	NO	NO	NO	YES	YES	YES	YES	YES	YES
Time-Varying Parish Controls	NO	NO	NO	NO	NO	YES	YES	YES	YES
Region FE	NO	NO	NO	NO	YES	YES	NO	NO	NO
Region x Year-Quarter FE	NO	NO	NO	NO	NO	NO	YES	YES	YES
Year $\geq$ 2015	NO	NO	YES	YES	YES	YES	YES	YES	NO
Standard Errors	NW	NW	NW	NW	NW	NW	NW	CL	NW
Adj. R-squared	0.0197	0.0690	0.0327	0.0499	0.0573	0.0585	0.0714	0.0714	0.1071
N	41539	41539	25505	25505	25505	25505	25505	25505	41539

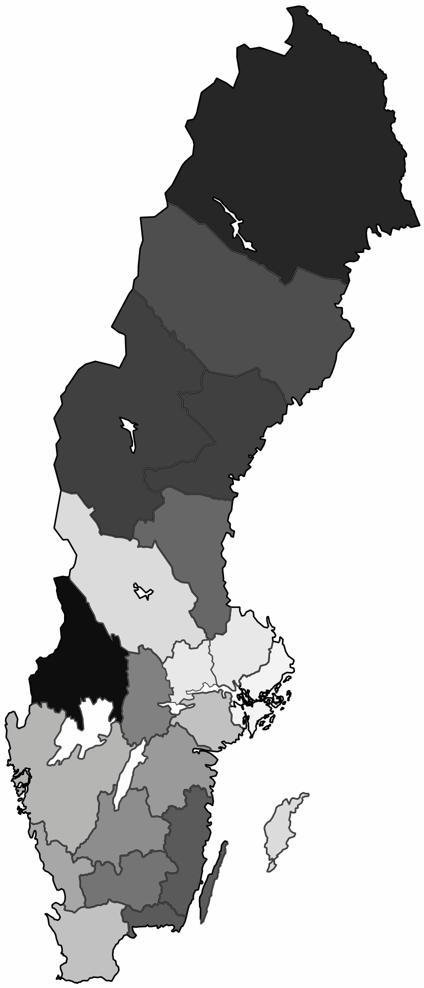
Notes: The dependent variable is the instantaneous, realized Sharpe ratio, S_{jt}. We compute the centroid of a parish as the mean longitude and latitude of properties located within it in our dataset. We then regress S_{jt} on the parish level HHI index. The HHI index is computed using the number of establishments present in a given parish for each of the largest 15 employers in Sweden: Volvo, Ericsson, Electrolux, Svenska Cellulosa, Scania, Atlas Copco, Sandvik, SKF, Assa Abloy, Vattenfall, ICA, Securitas, Telia, Axel Johnson, and H&M. Property level controls include area in square meters, dummies for the number of rooms, dummies for the property type, and the number of months between transaction dates. For columns 3-8, we limit the sample to 2015-2017 to avoid possible issues with endogeneity, since the firm location data is only available for 2017. Columns 5 and 6 include region fixed effects. Columns 7-9 include region-year-quarter fixed effects. Columns 6-9 include additional parish level controls: the average property size, the average distance to the parish's centroid in kilometers, the average distance to the region's centroid in kilometers, the log of the number of properties located in the parish, and the number of transactions that occurred in the same parish (quarterly). Standard errors are either Newey-West (NW) or are clustered at the parish level (CL). Note that k indexes parish. * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 8: Impact of manufacturer share and manufacturer news on volatility (VOL) and the Sharpe ratio (SR)

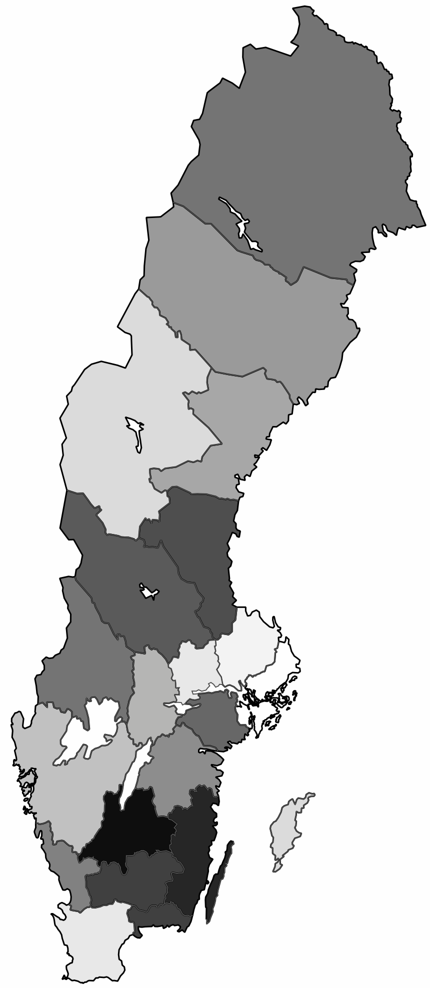
	(1) (OLS) (VOL)	(2) (OLS) (VOL)	(3) (OLS) (VOL)	(4) (OLS) (SR)	(5) (OLS) (SR)	(6) (OLS) (SR)
manufacturer_news$_{kt}$	0.1546**	0.1546***	0.0873**	-0.0123	-0.0123	-0.0036
	(0.0632)	(0.0450)	(0.0396)	(0.0124)	(0.0104)	(0.0067)
manufacturer_share$_k > 0$	1.7810**	1.7810***	2.1654***	-0.1189	-0.1189	0.0943
	(0.8235)	(0.4520)	(0.6422)	(0.1649)	(0.0995)	(0.1271)
log(parish_size$_{kt}$)	0.2282	0.2282	0.2204	0.0637	0.0637	0.0966***
	(0.1928)	(0.5178)	(0.1571)	(0.0405)	(0.0799)	(0.0315)
mean_distance_to_region_center$_{kt}$	-0.0041	-0.0041	-0.0032	-0.0019**	-0.0019	-0.0022***
	(0.0040)	(0.0100)	(0.0032)	(0.0008)	(0.0017)	(0.0006)
mean_distance_to_parish_center$_{kt}$	-0.0106	-0.0106	-0.0133**	0.0038**	0.0038	0.0035***
	(0.0075)	(0.0132)	(0.0061)	(0.0015)	(0.0026)	(0.0012)
distance_to_region_center$_j$	0.0126***	0.0126***	0.0142***	-0.0048***	-0.0048***	-0.0038***
	(0.0033)	(0.0013)	(0.0028)	(0.0006)	(0.0003)	(0.0004)
distance_to_parish_center$_j$	0.0006	0.0006	0.0008	-0.0002	-0.0002	-0.0002*
	(0.0011)	(0.0014)	(0.0009)	(0.0002)	(0.0002)	(0.0001)
months_between_transactions$_{jt}$	-0.1209***	-0.1209***	-0.1326***	0.0129***	0.0129***	0.0114***
	(0.0035)	(0.0100)	(0.0032)	(0.0007)	(0.0028)	(0.0006)
transactions$_{kt}$	-0.0003	-0.0003	-0.0005***	0.0001	0.0001	0.0001
	(0.0002)	(0.0003)	(0.0002)	(0.0000)	(0.0001)	(0.0000)
Property Controls	YES	YES	YES	YES	YES	YES
Time-Varying Parish Controls	YES	YES	YES	YES	YES	YES
Region x Year-Quarter FE	YES	YES	YES	YES	YES	YES
Year $\geq$ 2015	YES	YES	NO	YES	YES	NO
Standard Errors	NW	CL	NW	NW	CL	NW
Adj. R-squared	0.1158	0.1158	0.1029	0.0767	0.0767	0.1076
N	25503	25503	40435	25503	25503	40435

Notes: The dependent variable in columns 1-3 is volatility and the Sharpe ratio in columns 4-6. We compute the centroid of a parish as the mean longitude and latitude of properties located within it in our dataset. We regress the dependent variable on news about manufacturing firms located within the parish, as well as the share of manufacturing establishments in the parish. The share of manufacturing establishments is computed from data for each of the largest 15 employers in Sweden: Volvo, Ericsson, Electrolux, Svenska Cellulosa, Scania, Atlas Copco, Sandvik, SKF, Assa Abloy, Vattenfall, ICA, Securitas, Telia, Axel Johnson, and H&M. Manufacturing news is computed as the share of all newspaper articles that contain a reference to a manufacturing firm located within that parish. Property level controls include area in square meters, dummies for the number of rooms, dummies for the property type, and the number of months between transaction dates. For columns 3 and 6, we use the full sample. For the remaining columns, we restrict the sample to the years 2015-2017 to avoid possible issues with endogeneity, since the firm location data is only available for 2017. All columns include region-year-quarter fixed effects and the following parish level controls: the average property size, the average distance to the parish's centroid in kilometers, the average distance to the region's centroid in kilometers, the log of the number of properties located in the parish, and the number of transactions that occurred in the same parish (quarterly). Standard errors are either Newey-West (NW) or are clustered at the parish level (CL). Note that k indexes parish. * $p < .1$, ** $p < .05$, *** $p < .01$.

Figure 1: Manufacturing share and house price growth volatility by region



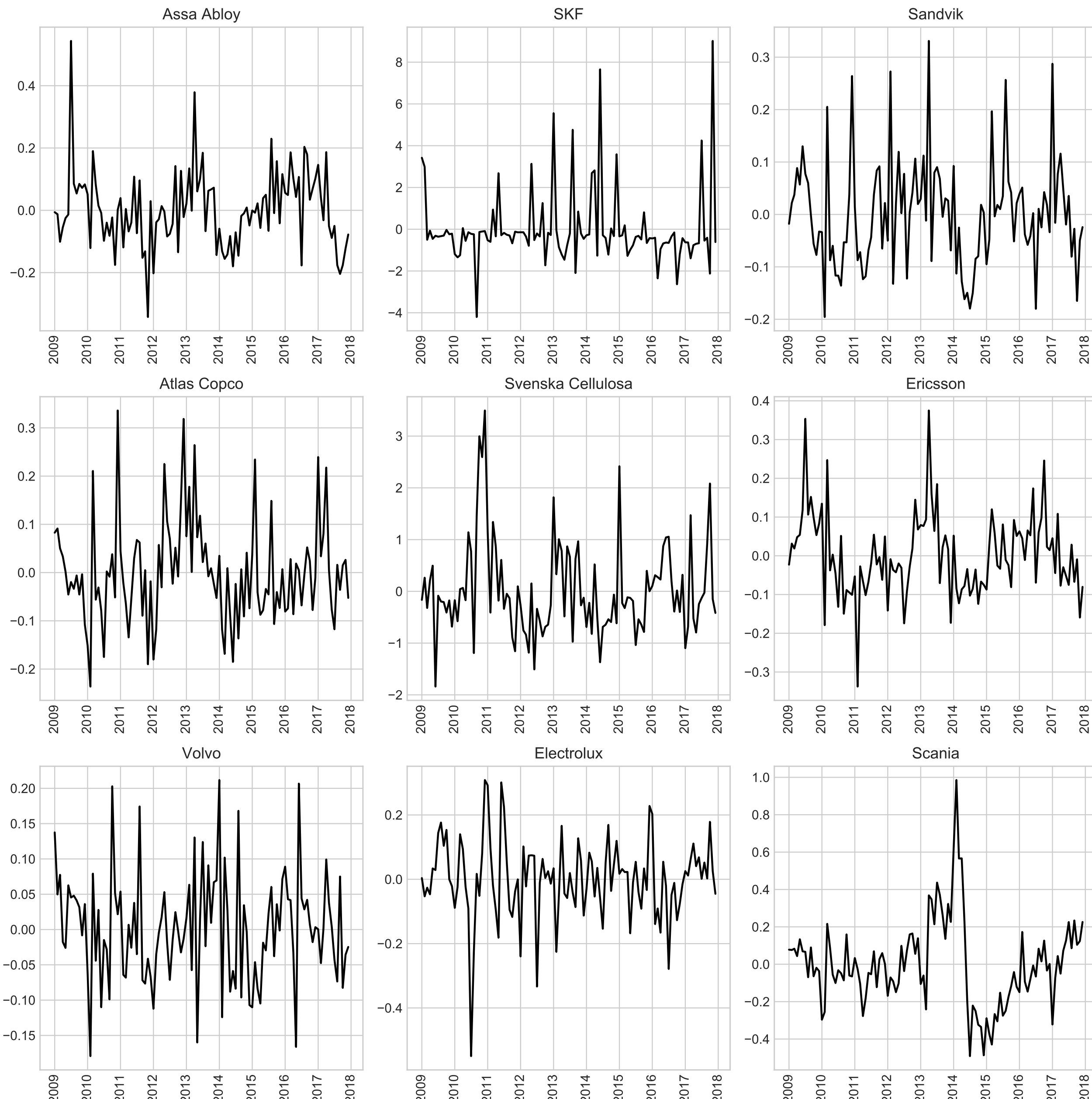
(a) House Price Growth Volatility



(b) Manufacturing Share

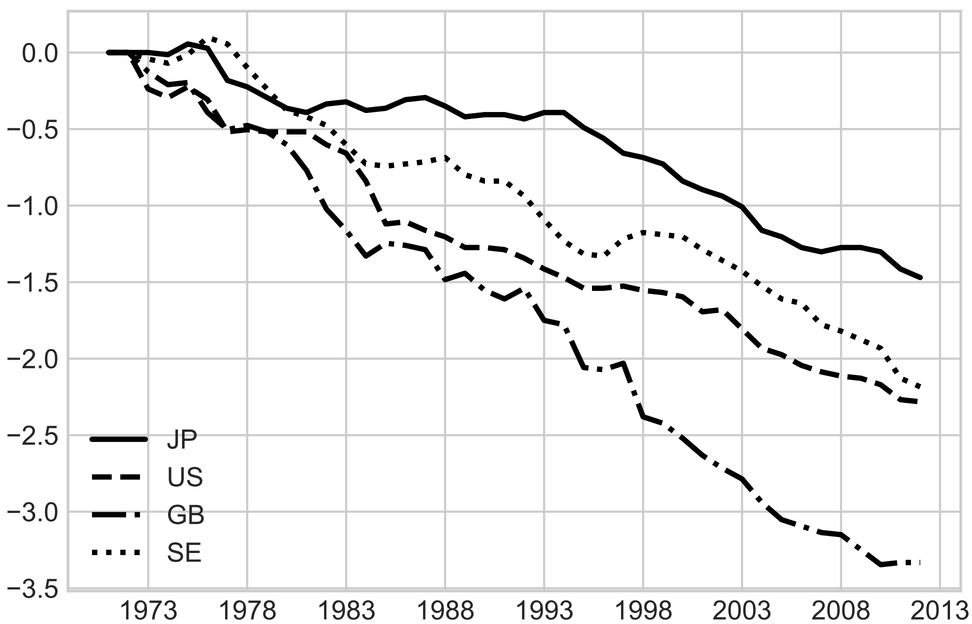
Notes: A darker shade indicates a higher level of house price growth volatility in subfigure (a) and a higher manufacturing employment share in subfigure (b). House price growth volatility is computed at the property level and is averaged across properties over the 2009-2017 period. Manufacturing share is computed by Statistics Sweden and is averaged over the 2009-2015 period.

Figure 2: News by manufacturing firm



Notes: The plots above show deseasonalized and filtered news share series for the largest manufacturing firms in Sweden by employment. We scraped all newspaper articles from an archive over the 2009-2017 period for Dagens Industri, the largest Swedish business newspaper. We then counted all references to each firm and normalized the counts by the total number of articles. Finally, we deseasonalized the firm time series using the X-13 ARIMA SEATS method and then applied a Hodrick-Prescott filter with $\lambda = 129,600$.

Figure 3: Impact of manufacturing share decline on house price volatility (ppts)



Notes: This plot shows the simulated partial declines in house price volatility for Japan, the United States, the United Kingdom, and Sweden since 1970. Each series is constructed using the manufacturing employment share for each country, computed by the U.S. Bureau of Labor Statistics, as well as the estimated relationship between employment share change and house price volatility for Sweden. Note that this captures only the partial contribution of manufacturing share to house price volatility and should not be interpreted as a total volatility series. Notably, there are increases in house price volatility around the Great Recession that are unrelated to exposure to regional microeconomic shocks and, thus, are not included in the simulation. There was also a substantial increase in house price volatility in Sweden in the 1990s that was unrelated to movements in manufacturing's share.

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Sveriges Riksbank
Visiting address: Brunkebergs torg 11
Mail address: se-103 37 Stockholm

Website: www.riksbank.se
Telephone: +46 8 787 00 00, Fax: +46 8 21 05 31
E-mail: registratorn@riksbank.se