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Quantifying Real Estate Externalities:
Evidence on the Whole Foods Effect

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ABSTRACT

Real estate amenities can create both benefits and costs to local community, which economists call externalities. Quantification of externalities is challenging because of potential endogeneity problems that render simple statistical analyses inaccurate, necessitating the use of a more rigorous econometric technique. Exploiting store expansion activities of Whole Foods Market to infer the causal impact of the Whole Foods Effect using the difference-in-differences strategy, we find that property prices within 0.5 mile of a new Whole Foods Market store increase on average by 6.7% after a new store opens.

Keywords: *externalities, hedonic prices, supermarket, Whole Foods Market*
JEL Classification Code: R20

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INTRODUCTION

The fundamental determinant of a property's value is its location, which provides access to amenities such as workplace, stores and services. Because community members share the same location, independent changes brought about by an action of one agent (for example, an opening of a supermarket) will inherently affect the property value of others in the same vicinity. Economists often refer to this effect as "externalities", which can be positive or negative, and the idea encompasses a range of measures other than property value. One of the most studied real estate amenities is supermarket (particularly, Wal-Mart), due to its role in the modern lifestyle and potential influences it may bring. For example, the entry of Wal-Mart superstores has been linked to reductions in retail jobs and earnings (Basker, 2005a; Neumark et al., 2008) and increased crime (Wolfe and Pyrooz, 2014), but at the same time increased competition leads to improved product quality (Matsa, 2011), lower prices (Basker, 2005b; Hausman and Leibtag, 2007), accessible cheap drugs and reduced hospitalization (Borrescio-Higa, 2015), improved food security (Courtemanch et al., 2019) and higher property values (Pope and Pope, 2015). Other externalities that could affect local residents include pollution and traffic, which are also of great concern for urban planners.

In this article, we focus on property price rather than other outcomes for two reasons. First, as motivated by the microeconomic theory, price reflects willingness to pay, which depends on the utility derived from consumption. In other words, the impact of all relevant amenities should be capitalized into prices. Second, property price has many economic ramifications. Because default and foreclosure can be contagious (Agarwal et al., 2012; Guiso et al., 2013), the increase in property prices can reduce the likelihood of foreclosure. Property is part of household wealth, so higher property prices can spur local consumption (Mian and Sufi, 2011). One of the challenges of entrepreneurship is lack of access to finance (Fairlie and Krashinsky, 2012; Robb and Robinson, 2014) and housing collateral from increasing property prices has been shown to spur local entrepreneurial activities (Black et al., 1996; Adelino et al., 2015).

Understanding the causal effect of amenities on local community is an important policy question, as policymakers are often in the position to influence the provision of amenities, whether directly through public facilities or indirectly through urban planning tools and financial incentives such as grants or subsidies. Consider the "Whole Foods Effect", "Starbucks Effect", or "Waitrose Effect", which have long been casually used by real estate professionals to describe an idea that these amenities can increase property value in their proximity. To put it into context, Whole Foods Market is an upscale supermarket that purveys natural produce, local delicacies and environmentally friendly products based in the United States. It had more than 460 stores across Northern America and Britain and $16 billion in sales before it was acquired by Amazon for $13.4 billion in 2017. Every country has their own version of Whole Foods Market; for example, for the U.K., it is Waitrose & Partners.

There are several reasons why such amenities may increase property value. For example, they could be part of a neighborhood revitalization program that alter the real estate landscape, making the whole area more desirable. Slade (2018) finds that land prices increase by 39% over 4-year development of a Wal-Mart supercenter, while Pope and Pope (2015) showed that property prices increase by 2-3%.[1] In this article, we focus on Whole Foods Market because it is relevant to the ongoing discussion of gentrification. Upscale supermarkets and trendy coffee shops are appealing to wealthier residents who tend to be more concerned about safety, so they could serve as a sign of quality to potential residents (or an anchor), attracting more affluent residents and alter the economic landscape, which in turn drives up property value. This gentrification effect has been shown to reduce crime rate theoretically by O'Sullivan (2005) and empirically (the Starbucks Effect) by Papachristos et al. (2011). The notion of gentrification by Whole Foods Market has even entered popular media. For example, in an episode of South Park (the American satirical cartoon show) season nineteen which aired in 2015, one of the residents at the City Hall meeting proposes the idea of getting a Whole Foods Market to open as it would "instantly validate us as a town that cares about stuff". Local authorities often give concessions to private businesses to open in their community as the

[1] The methodologies used by the two articles are different and the focus of Pope and Pope (2015) is on property prices, while Slade (2018) focuses on land prices. Our approach is similar to Pope and Pope (2015), but our contribution lies in the linkage between Whole Foods Market and gentrification.

increased business activities and economic activity translate into local employment opportunities and tax income. For example, the Whole Foods Market Store in Detroit which opened in June 2013 received $4.2 million in direct incentives[2], while the Engelwood store (one of the poorest neighborhoods of Chicago) indirectly benefited from more than $10 million of public infrastructure improvements[3].

To illustrate why causality is important, imagine an analyst tasked with estimating the Whole Foods Effect. She conducts a simple analysis of proximity and prices, finds that properties near Whole Food tend to have higher prices, and use the result as the extent of effect.[4] But to an econometrician, one cannot conclude from the result that Whole Foods Market stores *cause* property prices to increase. Rather, it could be that Whole Foods Market chooses to locate where wealthy customers live, which also happen to be where property prices tend to higher; in other words, the direction of causality is reversed. Proximity and high prices could be due that fact that Whole Foods Market stores tend to be located near other amenities, such as public transport, a park or a Starbucks, so high property prices could be due to those amenities rather than supermarkets; in other words, the comparison omits the real cause. Economists refer to these challenges in causal inference as endogeneity problem, which implies that the outcome of a simple statistical analysis may not reflect the true effect of the phenomenon. Consequently, a more rigorous empirical methodology is required to identify the causal impact. In this article, we use the difference-in-differences strategy which involves comparing prices of properties before versus after store opening (the first difference) and closer versus further away (the second difference). The double comparison makes the distinction between the "control" group versus "treatment" more apparent and easier to argue that the effect is causal. More details of this strategy is provided in Section 2.2.

DATA AND EMPIRICAL STRATEGY

We investigate the causal impact of the Whole Foods Effect by exploiting the expansion of Whole Foods Market between 2004 and 2010 and a micro dataset with very precise geographical identification of properties, thus allowing the calculation of distance to store (rather than proximity based on ZIP code). Using store openings as an event, we can address the potential endogeneity issues by using the difference-in-differences strategy that compares prices of properties closer and further away the stores (the first difference) before and after store openings (the second difference).

To motivate this strategy, consider Figure 1, which shows the average log prices at varying distances to stores around their opening dates. By considering prices of properties closer to the stores relative to properties further away, we are able to address the concern about other amenities in the neighborhood that could influence property value; the closer a property is to a store, the more benefit it derives. The relative log price allows us to interpret the values as multiples of the baseline, which in this case is average prices of properties 2 to 4 miles away from a store (which is used as the reference/control group) at the store opening date. The second point to look out for in this figure is that, if the effect were to be causal, we expect to find the relative log prices follow similar trends prior to store openings at all distances from the store (here, within 1 to 2 miles, 0.5 to 1 mile and 0 to 0.5 mile). This is the "parallel trend" assumption required by the difference-in-differences strategy to limit potential concern that the rise in price is caused by factors other than store openings. Figure 1 provides reassurance that the strategy to identify the Whole Foods Effect is valid.[5]

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[2] https://www.crainsdetroit.com/article/20110727/FREE/110729897/4-2-million-in-incentives-key-to-whole-foods-deal, accessed on March 5, 2020.

[3] https://www.chicagotribune.com/business/ct-detroit-whole-foods-met-20150316-story.html, accessed on March 5, 2020.

[4] A 2007 study by a consulting firm Johnson Reid use similar methodology and find that special grocers such as Whole Foods Market increase property values in Oregon by 17.5%. http://www.reconnectingamerica.org/assets/Uploads/JohnsonGardner-Urban-Living-Infra-Research-Report.pdf, accessed on March 5, 2020.

[5] However, we caution the readers that Figure 1 is intended as motivation only, as the prices are unadjusted for property characteristics such as size and age. Our result relies on a more rigorous multivariate analysis to be later described in Section 2.2.

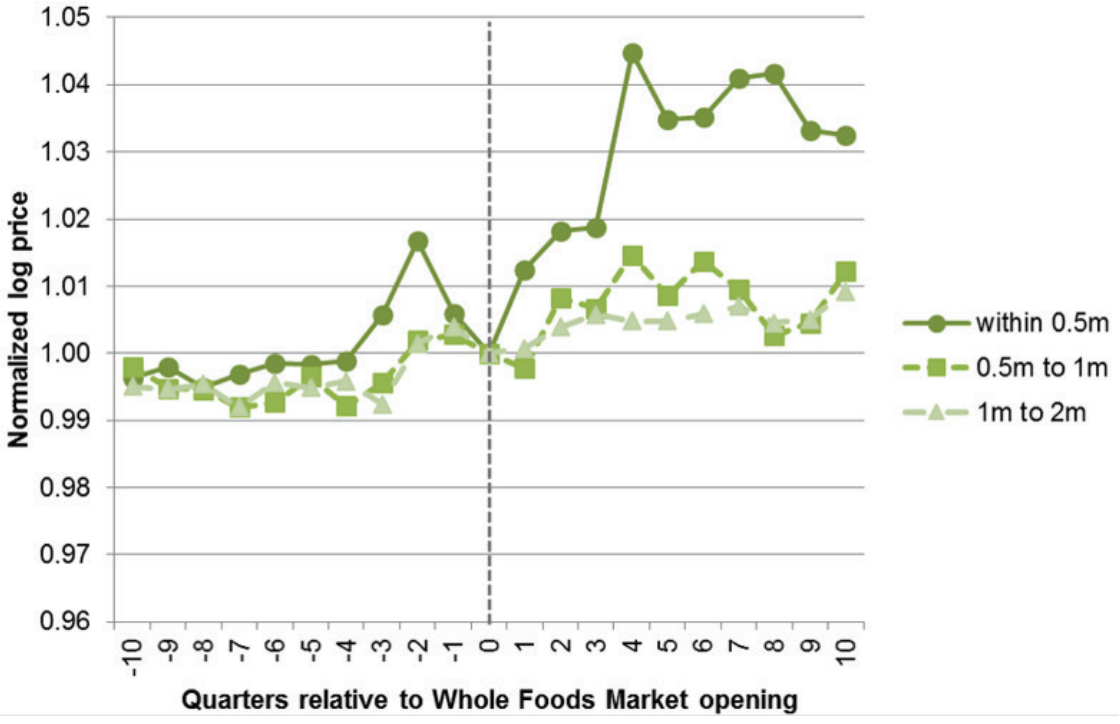

Figure 1:
Average Log Prices of Properties around Whole Foods Market Opening Dates

The above graph plots the average log prices of single-family residences and condominiums near Whole Foods Market stores around opening dates. Only openings between 2007 and 2008 are included. During this time period, there are 37 stores openings in Arizona, California, Connecticut, Florida, Hawaii, Illinois, Michigan, Missouri, New Jersey, Nevada, New York, Ohio, Oregon, Rhode Island and Virginia. Quarter is defined relative to opening dates. Averages are taken by quarter for each proximity categories: 0 to 0.5 mile, 0.5 to 1 mile, 1 to 2 miles and 2 to 4 miles, then normalized by values of the 2 to 4 miles category. Distance is calculated based on geographical latitudes and longitudes of street addresses. Prices are normalized in each proximity category by the level of opening quarter (t=0)

Data

This article employs two datasets containing store opening dates and housing transactions in the vicinity. The opening dates are hand-collected from the corporate website, map websites, local newspapers, weblogs, and review websites. There is a total of 100 new stores in 27 states opened between 2004 and 2010 that can be successfully linked to housing transaction data (to be described later). The locations and opening dates are matched to transactions of single-family residences and condominiums between 2002 and 2012 from CoreLogic, who aggregates public records from assessor's offices and recorders of deeds in individual towns and counties. For each arms-length transaction, where property ownership is transferred to unrelated buyer, data on price, sale date and property characteristics, such as the living area in square feet, lot size, number of bedrooms and bathrooms, and building age is recorded. One key characteristic of the dataset is the geographical coordinates of the property, which allows computation of straight-line distance to the store. We restrict the analysis to properties that are within 4 miles radius of stores and 10 quarters surrounding the opening dates to limit the influences of other spatial and temporal factors.

Table 1 shows the summary statistics of housing transactions. In the first column, we report the summary statistics for all properties. The second to fifth column report the summary statistics for properties within different proximity category per the empirical strategy.

Table 1: Summary Statistics

Summary statistics for single family residence and condominium transactions located near Whole Foods Market stores within 10 quarters of event dates are presented here. The statistics are provided separately for transactions prior to and after the opening. Standard deviations are presented in parentheses.

Panel A: pre-opening

Distance to store	All properties	0m-0.5m	0.5m-1m	1m-2m	2m-4m
Distance in miles	2.50				
	(0.99)				
Transaction price	415,337	411,767	454,465	441,861	403,019
	(294,853)	(306,829)	(314,860)	(308,313)	(286,902)
Living area in square feet	1,601	1,341	1,575	1,600	1,614
	(815)	(635)	(852)	(826)	(811)
Lot size in acres	0.23	0.30	0.22	0.23	0.23
	(0.50)	(0.75)	(0.53)	(0.47)	(0.49)
Number of bedrooms	2.61	2.25	2.52	2.63	2.63
	(0.92)	(0.84)	(0.92)	(0.94)	(0.91)
Number of bathrooms	1.97	1.71	1.94	1.99	1.98
	(0.97)	(0.84)	(0.96)	(0.98)	(0.97)
Building age	41.66	42.02	40.94	41.29	41.84
	(30.02)	(29.50)	(30.62)	(30.48)	(29.82)
Recently renovated	13.3%	16.6%	15.3%	15.9%	12.2%
Has garage or carport	50.0%	33.8%	44.1%	51.9%	50.5%
Has fireplace	29.4%	21.8%	29.1%	33.2%	28.5%
Has pool	5.7%	3.9%	5.2%	6.1%	5.7%
Property is a condominium	36.6%	66.7%	52.8%	40.9%	32.5%
N	622,491	15,694	40,607	140,088	426,102
% of total transactions	100.0%	2.5%	6.5%	22.5%	68.5%

Table 1: Summary Statistics (continued)

Panel B: post-opening

Distance to store	All properties	0m-0.5m	0.5m-1m	1m-2m	2m-4m
Distance in miles	2.51				
	(0.98)				
Transaction price	433,610	502,221	504,141	473,573	411,764
	(329,290)	(363,342)	(355,250)	(343,835)	(318,084)
Living area in square feet	1,594	1,339	1,558	1,592	1,607
	(810)	(643)	(816)	(841)	(803)
Lot size in acres	0.25	0.33	0.26	0.25	0.24
	(0.51)	(0.75)	(0.57)	(0.50)	(0.50)
Number of bedrooms	2.58	2.26	2.50	2.59	2.60
	(0.91)	(0.83)	(0.93)	(0.93)	(0.90)
Number of bathrooms	1.96	1.77	1.98	1.96	1.96
	(0.97)	(0.85)	(0.95)	(0.99)	(0.97)
Building age	42.78	42.09	42.65	43.54	42.58
	(30.73)	(31.65)	(31.98)	(30.80)	(30.55)
Recently renovated	12.7%	16.0%	16.0%	15.1%	11.5%
Has garage or carport	47.1%	30.7%	42.2%	47.8%	47.9%
Has fireplace	27.4%	19.4%	26.8%	29.2%	27.2%
Has pool	5.6%	3.6%	4.4%	5.7%	5.8%
Property is a condominium	38.9%	68.1%	53.1%	42.8%	35.3%
N	466,354	11,442	29,433	104,093	321,386
% of total transactions	100.0%	2.5%	6.3%	22.3%	68.9%

Empirical Strategy

Looking at raw prices is uninformative as each housing unit is different. To uncover the values of such amenities, economists have relied on hedonic price regression developed by Rosen (1974), which regresses log prices on attributes that could influence their prices such as size, age and quality. Because consumers' marginal willingness to pay for a particular amenity is reflected in transaction prices, analysis of changes in property prices provides a market-based approach to quantify one dimension of externalities. The coefficients of log price regressions are conveniently interpreted as percentage change in housing price in relation to a unit change in an attribute. The simple cross-section regression is vulnerable to endogeneity issues described earlier, so the difference-in-differences strategy is preferred and has been used widely to document the extent of externalities capitalized into housing prices. For example, using cleanups of hazardous waste sites, measures of air quality, and openings and closings of toxic plants, Greenstone and Gallagher (2008), Bajari et al. (2012) and Currie et al. (2013) document that housing prices are negatively affected by pollution.

The difference-in-differences strategy involves estimating a linear regression equation with fixed effects as specified in Equation (1). The inclusion of fixed effects allows potential factors that influence property prices not observed by the econometrician (omitted variables) but does not require explicit explanation to be accounted for. We include location-time fixed effects, which allows housing price trends within 4 miles radius of each store to be unique. The advantage of including these fixed effects is that they represent local housing price trends around each store, so any price differences will be driven by proximity to store. In other words, the Whole Foods Effect will be estimated as deviations from unique local housing price trends, which gives more comfort to the econometrician about the true extent of the effect.[6]

$$y_{ist} = \alpha_{st} + \beta_0' R_i + \beta_1' R_i \cdot post_i + \gamma' X_i + \varepsilon_{ist} \quad (1)$$

The dependent variable is the log transaction price of property that is within 4-mile radius of store at time. Since the time unit used for this analysis is monthly, the fixed effects are defined for each store-year-month. For the first difference, we create an indicator variable which takes value of 1 for transactions that occur after the store has opened. This is the first difference as described in the Introduction section. The proximity categories for the baseline analysis are (1) within 0 to 2 miles and (2) within 2 to 4 miles. The proximity categories are implemented as an indicator variable which take value of 1 for properties closer to the store, while the 2 to 4 miles category is omitted as control group for this experiment. In further analyses, we divide the 0 to 2 miles category into three sub-categories (0 to 0.5 mile, 0.5 to 1 mile, 1 to 2 miles) to allow for greater flexibility in estimating the Whole Foods Effect. Proximity is the second difference in the strategy. The control variables are living area in square feet, lot size in acres, number of bedrooms, number of bathrooms, property age in years at the time of transaction, age-squared, indicator variables for whether the property was recently renovated, has garage or carport, has fireplace or has pool. The coefficient of interest is, which represents the average log price difference (interpretable as percentage difference) after store opening relative to the control group. Standard errors are clustered at the store level.

RESULTS

Column 1 in Table 2 reports the result for the baseline analysis. Controlling for observable property characteristics and unobserved heterogeneities that are allowed to vary monthly within 4 miles of a store, properties within 2 miles radius command 3.9% higher prices than properties that are further

[6] However, the econometrician has to tradeoff this "identification" with the ability to investigate other factors that could also influence property prices in the area.

away. A natural question to ask is whether the price externality varies over distance. Rossi-Hansberg et al. (2010) find that the positive effect of the urban renewal program decays with distance from the impact area. In column 2, we divide the proximity indicator into three subcategories and estimate the same regression. As expected, the effect declines with distance, with the closest properties (within 0.5 miles) experiencing more than 6.7% increase in price. An average property within half-mile radius sells for $410,000, so the impact of a Whole Foods Market store opening for a homeowner who lives nearby is approximately $27,000.

The analyses in column 1 and 2 are both based on the restriction that transactions must be within 10 quarters before and after the opening, thus the estimated coefficients represent average increases over a 2.5 years period. By altering the width of the post-opening window, one could examine how price externality propagates over time. Column 3 reduces the window to 4 quarters while Column extends the window to 20 quarters. The magnitudes of the coefficients are similar to the earlier result, suggesting that the amenity value is incorporated quickly and the price effect of externalities is not transient. The monotonicity of the price externality in all specifications is consistent with the view that externalities are closely related to proximity.

CONCLUSION

In this article, we quantify the causal effect of a Whole Foods Market's store opening on the value of nearby residential properties. The average increase in price is 6.7% for properties within 0.5 miles of a new store, less than half of the less rigorous method that of Johnson Gardner (2007), and twice the effect found for Wal-Mart's store openings by Pope and Pope (2015), equivalent to approximately $27,000 increase in home equity for an average homeowner. Given its role in modern lifestyle, supermarket is an active research topic. From urban planner' perspective, the issue of negative externalities such as road congestion and urban trip generation have long been at the center stage. We hope that this article adds another dimension to the urban planning dialogue.

The objective of this article is not to pinpoint the mechanism(s) that lead to price increases, but we establish that the Whole Foods Effect is not a myth and highlights the role of rigorous econometric technique in identifying the magnitude and causality of the effect. The Whole Foods experience here can be viewed more broadly as an urban revitalization program, where policymakers often provide public support, both directly and indirectly. As the result is based on analysis of openings between 2004 and 2010, it should not be interpreted as how big the price uplift the next Whole Foods store would be; rather, it serves as a reminder that policy discussions should be based on estimates that do not suffer from endogeneity issues.

While the magnitude of the Whole Foods Effect is substantial, property price is only one of the multifaceted real estate externalities. It is worth noting that such price effect is intertwined with gentrification, which, despite positive externalities to the local economy by increasing entrepreneurs' borrowing capacity through higher collateral value (Black et al., 1996; Adelino et al., 2015) and reducing crime (O'Sullivan, 2005; Papachristos et al., 2011), such benefits are not captured by everyone and some community members may even be adversely affected. Weller and Hulten (2012) document an erosion of housing standards of lower-income household as a result of gentrification, as well as the dissolution of their local communities, highlighting the importance of affordable housing policies in urban planning.[7]

[7] Planners have long recognized the importance of affordable housing policies. For example, the Atlanta Beltline – a project that connects 45 neighborhoods via a loop of trails, tracks and parks in – set up a ring-fenced trust fund and advisory board for the of affordable housing (Immergluck and Balan, 2018). But the question of how the policies should be instituted, such as whether it should be mandatory or incentive-based (Karki, 2015) remains a topic of debate.

Table 2: Effect of Whole Foods Market Openings on Nearby Property Prices

The following table reports the results from estimating difference-in-differences OLS of hedonic pricing regressions. The main explanatory variable is the log price. Proximity categories are defined based on the distance between the geographical coordinates of the store and property street addresses in miles. The model in column 1 is estimated based on two proximity categories: 0 mile to 2 miles and 2 miles to 4 miles. The model in column 2 refines the first proximity category into 0 mile to 0.5 mile, 0.5 mile to 1 mile, 1 mile to 2 miles. Properties 2 miles to 4 miles from stores are used as control group. All models restrict transactions to occur at most 10 quarters before the event. Column 1 and 2 also restrict transactions to occur at most 10 quarters after the event. Columns 3 and 4 vary the post-opening window to 4 quarters and 20 quarters. Controls in all regressions include property characteristics and store-year-month fixed effects. Standard errors, clustered at the store level, are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Post-opening window (quarters)	10	10	4	20
VARIABLES	lnprice	lnprice	lnprice	lnprice
Within 2m radius	0.0846***			
	(0.0185)			
Within 0.5m radius		0.1195**	0.1189**	0.1225***
		(0.0462)	(0.0468)	(0.0454)
Within 0.5m to 1m radius		0.1158***	0.1170***	0.1157***
		(0.0328)	(0.0330)	(0.0322)
Within 1m to 2m radius		0.0725***	0.0731***	0.0724***
		(0.0154)	(0.0154)	(0.0152)
Within 2m radius * Post-opening	0.0391**			
	(0.0157)			
Within 0.5m radius * Post-opening		0.0675**	0.0761**	0.0740**
		(0.0328)	(0.0350)	(0.0354)
Within 0.5m to 1m radius * Post-opening		0.0506**	0.0432**	0.0567**
		(0.0206)	(0.0200)	(0.0235)
Within 1m to 2m radius * Post-opening		0.0330**	0.0276*	0.0299*
		(0.0150)	(0.0149)	(0.0160)
Housing characteristics as controls	Yes	Yes	Yes	Yes
Store ID * year * month fixed effects	Yes	Yes	Yes	Yes
Observations	1,088,845	1,088,845	863,682	1,272,169
Adj R-squared	0.614	0.614	0.607	0.627
Number of stores	100	100	100	100

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