

The Impact of Prison Displacement on Apartment Sale Price (A Case Study for Yeongdengpo Old Prison, Seoul)

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Abstract— *Locally unwanted land uses (LULUs) impact differently over time. Prison is one of the LULUs that may influence nearby real estate prices. Yeongdengpo Old Prison is located at the center of Seoul, the capital city of South Korea. After the fast urbanization of Seoul, nowadays that area is covered by apartments with more than 10 stories. Therefore, city planners of Seoul designed a new prison location outside the Seoul city. We assessed the apartment prices before the rumor of prison relocation, during the rumor stage, after the public announcement and after the relocation happens. We used average price of apartment sale in 2000, constant price of apartment sales from 2006 to 2012 and the nominal price and transaction prices of apartments from April 2013 to June 2013 for GIS analysis to determine distance effect of the prison within 500m. We used hedonic regression model to test the effects of area, age, unit, and distance from prison of apartments to its prices. The effect of relocation was not big enough compare to the first announcement of the relocation. Therefore, the distance premium mostly effected by the first public announcement of the relocation and the effect gradually diminished until the relocation happen.*

Index Terms— *displacement of the old prison, apartment price, location, hedonic price method.*

I. INTRODUCTION

Prison is often mentioned as one of the most reviled lands uses besides that of waste repositories, power lines, airports, highways, and mega-shopping complexes of which were defined as Locally Unwanted Land Use (LULUs) by urban planner Frank Popper during the early 1980s [1]. LULUs itself has been widely determined as it related to NIMBY (Not In My Back Yard)'s definition that usually confront local governments with regularity. There are even many examples of LULUs, but there is no definitive list of LULUs, as LULUs are always contextually defined. In other words, LULUs refer to land use that might be perfectly acceptable in one context but could cause some harsh reactions from neighbors in another context [2].

An adverse public perception (stigma) of property values could affect the economy extremely regarding price

fluctuations in the housing market. There are some previous studies concerning the economic effect in property values related to NIMBYs and LULUs location such as nuclear power plants, high voltage power lines, oil, and natural gas facilities, hazardous and non-hazardous disposal sites, airports, subway lines, and others [3]; [4]; [5]; [6]; [7]; [8]; [9]. Nevertheless, prison as a part of the Locally Unwanted Land Uses (LULUs) has still not been widely discussed in so many articles. However, since the cause and impact of the prison existence are complex and problematic, recognizing the complexity of prison as one of the LULUs phenomena is essential in understanding and responding to NIMBY concerns, especially as it relates to property values issue.

This research analyzes how the proximity to old prisons have a significant impact on apartment prices. This hypothesized has also strengthened by the neighborhood views due to the displacement announcement where communities were victorious in influencing the apartment price impact.

II. LITERATURE REVIEW

A. *Locagically Undesirable Land Uses (LULUs) as an Issue*

Locally Undesirable Land Uses (LULUs) was introduced by Rutgers and Princeton University Urban Planning Professor Frank J. Popper in his paper, titled "Siting LULUs", as it published in Planning Magazine. LULUs include facilities that may be socially desirable, obviously needed or legally required but nobody wants in his or her backyard. In most often cases that have been found, LULUs presence has brought much more negative impacts than the positive ones. According to Sandman [10], besides that of the environmental and health risks that emerged in many of LULUs cases, there are also other concerns that relate to the decline of property values, the inability of the community to keep out other undesirable land uses once one has been displaced, the decline in quality of life because of noise, truck traffic, odor and the like, the decline in the image of the community, the overburdening of community services and community budgets, and the aesthetically objectionable quality of the facility. In other words, the impact of LULUs has widely influenced not only on the community environment or social problem but also relates to economic issues as well. There exist previous studies concerning the economic effect in property values related to NIMBYs and LULUs location such as nuclear power plants, high voltage power lines, oil and natural gas facilities, hazardous and non-hazardous disposal sites, airports, subway lines, and others [3]; [4]; [5]; [6]; [7];

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[8]. Those previously mentioned may harm the residential areas, as such, they can be considered as undesirable locations. On the other hand, popular venues that may have a positive economic impact, such as shopping areas, Wal-Marts, theme parks, and sport stadiums are also considered as undesirable locations as they may also intrude the convenience of the residential area [11].

B. Urban Development in Locally Undesirable Land Use (LULUs) Case

Prison as a part of the Locally Unwanted Land Uses (LULUs) has still not widely been discussed in so many articles. Nevertheless, during “the prison-construction boom” in America during the 1980s, the role of prisons in rural and economic development has become an interesting topic as it refers to the issue where numbers of rural communities have switched prison from being NIMBYs into YIMBYs (Yes in My Back Yard) concept [12]; [13]. Here prison has two faces, on one hand, it may become an unwanted place but on another, it could be recognized to have a contribution to the local economies’ development.

According to Tootle [13], prisons generally appear to have a negligible or perhaps negative impact on economic development in rural communities. However, during the 1980s, prison was reconsidered to be able to affect the development or attraction of new prison facilities since it was influenced by two trends of reason. The first was the restructuring of the rural economy, driven by dramatic changes in the structure of agriculture and the loss of manufacturing jobs in rural areas, and the second was the subsequent increase in numbers of prisoners and the expansion of the prison industry that came up at that time. Prison may become one of the LULUs examples of this as it recognized to be a place that is arguably efficient in affecting the development process. In the term of urban development issues, prison as a LULUs case may have a different meaning. Prisons which are sited in urban areas may trigger a numerous challenge which is more complicated as it is compared with the rural development perspective, especially when the location of prisons have been moved and changed into another function such as an apartment or commercial area. According to Filippini, Jr [2], the change in use of a property can also give rise to a LULU. In another part Do, et. al. [11], has ever mentioned that LULUs are not always defined as a place that could harm the residential areas, nevertheless other places such as popular venues or shopping malls could produce an inconvenient feeling which can disturb the residents as well. Realizing the dynamic issue that could emerge in urban areas, LULUs need to be fully understood particularly in reshaping the urban development process.

C. Undesirable Land Use and Residential Price Impact

Numerous environment-oriented hedonic analyses which closely relate to the undesirable land use issue have been performed on the residential market price since the early 1980s and widely expanded during the 1990s and 2000s. Some of the previous studies that related to the residential price impact such as air and water pollution ([14]; [15]; [16];[17]), nuclear power plants ([18];[3]), oil and natural gas facilities ([19]; [5]), hazardous and non-hazardous disposal

sites ([20]; [21]; [6]), landfills and waste incinerator ([7]; [22]; [23]), high-voltage transmission lines (HVTL) ([24]; [4]), airport and highway proximity ([8]; [25];[26]), subway lines proximity [9], and the impact of earthquakes ([27]; [28]) have also been studied. Since many of the studies showed that the evidence related to the proximity of LULUs on property values is inconsistent, some of them revealed a significant effect whereas others provided an adverse result.

The issue on residential value has not only emerged in big countries, but also tend to spread in fast-developing countries such as South Korea, Taiwan, Hong Kong, and others. South Korea has experienced a rapid increase in urban land and housing prices during the late 1980s. Real estate prices reached a peak in 1990 and started declining in 1991 and plummeted in 1998 in the aftermath of the economic crisis that broke out in late 1997 [29]. Property stigma is a socially constructed evaluation of a place; it is a sign or mark created and maintained by processes of social communication. The most powerful source of risk and stigma information is the news media, which often reports on dramatic stories involving technological accidents, hazards, and events that have the potential to harm places and people [30].

Most of the conclusions from the previous research described that overall the conclusions are that the siting of public facilities can be complex and contentious and that prisons are among the facilities that regarded as unwanted land use and often equated to landfills and incinerators as LULUs. The reasons against the siting of a prison can be varied and many but the predominant objections to prison facilities are based on issues of the location or proximity of the facility to the local community, and also the potential impact the facility may have on the local community in terms of the local economy, public safety, crime levels, employment, environment [31]. The impact of prison sitings can be both positive and negative but the majority of the research uncovered the negative effects. The difficulty with existing research on property values is the measurement and control of such studies. Inaccurate measurements can obscure the findings and consequently alter the effects a prison may have accordingly [32].

The difficulty of siting LULUs in Seoul (as the representative capital city in South Korea) is aggravated by the physical terrain and small size of the city. The problem occurs since it may not have been discussed widely and freely for the reason of its cultural society.

III. RESEARCH METHOD

The research paradigm used in this research is mainly focused on a rationalistic paradigm where the deductive-qualitative methodology was adopted as a state of the art of this research. However, in order to satisfy the objectives and to cover the limitation of the data availability, this research was carried out with a combination of two kinds of methods, which were Content Analysis and Hedonic Price Regression Model Analysis. These two kinds of research methods were substantial to each other in framing the complete story of the impact of Yeongdeungpo Old Prison on the sales prices of an apartment unit. With this paradigm, the construction of knowledge was

initialized by a deductive process which strengthened not only by reviewing the journal and mass-media analysis process as the Content Analysis process.

A Descriptive-narrative analysis was conducted in this research as an analysis model that will provide a comprehensive analysis in understanding the phenomena. As mentioned before, in performing deductive tasks, inferential statistical analysis was involved to make scientific-based evidence towards the theory having been developed through the grounded-theory work. The significance between proximity and apartment price has analyzed using Hedonic Price Regression Model Analysis. Hedonic Price Regression Models have been commonly used to analyze the housing market or property values, which derived from structural variables, such as the type of housing, number of bedrooms, living space and presence of fireplace, garage or basement, location variables such as distance to central business district or shopping centers and transportation network [33].

In this research, the Hedonic Price Regression Model was applied to investigate the apartment price fluctuations using the structural variables such as area, the age of the apartment, number of the unit, and the number of floors (story). It also reconsidered the minimum distance value from the old prison to the apartment location to see the significant impact during and after the old prison displacement process. Geo-coding Analysis is also used in this research to create Data Base for apartment location analysis. Geo-coding is a kind of process to enter spatial data onto a geo-referenced map so that this spatial data can be spatially manipulated. The spatial data was determined as an address-matching process of housing transaction data. The information collected here is related to the unit of public facilities distance, such as the information location of the old prison, new baseball stadiums, metropolitan subways, train route railways and ground railways. Using the Near analysis process on ArcGIS Desktop 9, the nearest distance from the old prison, metropolitan subway, train routes railway and ground railway to the apartments are calculated and ready to be joined with the apartment structural database.

The analysis process was conducted by using ArcGIS Desktop 9 for spatial analysis and Stata 12 for Regression Analysis. All the data that consists of the nominal price and the transaction price of the apartment was taken from Ministry of Land Infrastructure and Transport (<http://rt.molit.go.kr/>) during April until June in 2013. The scope area that has been observed in this study has only covered two district areas, which are Gocheok-dong and Gebong-dong. The reason for these two-district areas selection has based on the preview regression modeling, whereas some of the variable analysis has shown to be statistically insignificant since the probability is more than 0.05. However, by shrinking the observation area that mainly focused on 500 meters from the research object, the regression modeling has shown a better result. The number of apartments that observed less in other districts also has influenced the other reason.

IV. RESULT AND DISCUSSION

A. Analysis Model Development

In investigating the apartment or housing price, the first International Journal of Engineering, Technology and Natural Sciences

thing to do is to identify all the desirable and undesirable variables of the apartment that believed to have an impact on apartment price. These features will then be taken as the independent variables in the regression analysis. Miller [34] mentioned that market price is generally determined through an ordinary least square multiple regression model, which generally in the form of:

$$\text{Apartment Price} = a + \beta_1 X_1 + \beta_2 X_2 + \beta_n X_n + \dots + e \quad (1)$$

Where X_1, X_2, \dots, X_n is the housing and locational features that affect the housing price.

a is the housing price intercept

$\beta_1, \beta_2, \dots, \beta_n$ is the estimated regression coefficients

e is the error of the estimate.

However, the above regression equation assumes a linear correlation between independent variables and dependent variables. Even though linear hedonic equations are frequently used in research and property valuation, they do have the unrealistic assumption that each additional unit of the housing and locational features will add exactly the same additional value to the housing price (DiPasquale and Wheaton, 1996). It has been explained that for example, a household may be willing to pay an extra \$50,000 to bring up the number of bathrooms from 2 to 3, they may only be willing to pay an additional \$30,000 to have 4 bathrooms instead of only 3. Here in this reality, the assumed linear relationship between housing prices and housing price determinants (independent variables) is incorrect. So that to fix the law of diminishing marginal utility, another modified regression equation which worked by taking exponential forms on the independent variables has been used by many researchers. Here is the regression equation that has proved superior to the linear regression equation ([34]; [35]):

$$\text{Apartment Price} = a \times X_1^{\beta_1} \times X_2^{\beta_2} \dots \times X_n^{\beta_n} + e \quad (2)$$

To statistically estimate the parameters in the above equation, we can transform the above equation into a linear equation by taking logarithm on both sides:

$$\begin{aligned} \text{Log (Apartment Price)} &= \\ \text{Log } a + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_n \log X_n & \quad (3) \end{aligned}$$

To estimate the coefficient of X_1, X_2, \dots, X_n , a market value of an apartment should be entered into the regression analysis. Since the 'market value' of an apartment is not known unless a transaction happens, the best data to be entered into the regression analysis is the actual apartment transaction data. In this research, the data was collected from the real estate bank data and official data taken from the Ministry of Land and Infrastructure.

Besides the two regression equations, there are still other equations that will be used in this research, which are called semi-log linear regression. A semi-log graphic uses a log scale for one of the axes. A semi-log graphic is better to show both very small and very large values of the axis, and it is well-suited for exponential equations. In a semi-log graphic, the y-axis is logarithmic which means the separation between

the ticks on the graph is proportional to the logarithm of numbers. In other parts, the x-axis has a linear scale which means the ticks are evenly spaced. Compared with the log-log graph (as the earlier equation above), where both the x-axis and the y-axis are logarithmic, it is very useful for determining the power relationship. The semi-log linear regression equation is shown below,

$$\text{Log (Apartment Price)} = a + \beta_1 X_1 + \beta_2 X_2 + \beta_n X_n + \dots + e \quad (4)$$

As it has been reviewed by Lansford and Jones [36], the simplest functional form for the hedonic price function is linear. With this functional form, the marginal implicit price of the character is simply its coefficient. However, the simplicity has some drawbacks of constant marginal implicit prices and assumes the consumer can repackage characteristics. Non-linear functional forms overcome these limitations and provide marginal implicit prices for a characteristic that depends on the level of that particular character and on the level of other characters as well. Potential non-linear models include the semi-log regression of the dependent variable and more generalized Box-cox linear regression.

Semi-log Regression Analysis

$$\text{Log (Apartment Price)} = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n + \dots + e$$

Linear Regression Analysis

$$\text{Apartment Price} = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n + \dots + e$$

Log-log Regression Analysis

$$\text{Log (Apartment Price)} = \text{Log } a + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_n \log X_n + \dots + e$$

The purpose of using this three kind of analysis models is to see the particular characteristic that emerged on the specific distance from the apartment location to the prison and other utilities such subway station as one of the accessibility facilities that has been observed in this study. Here in this study each of the models has divided into two kinds of independent variable analyses, the equation below:

Table 1. Independent Variable Analyses Description

Independent variable	Description
Model "dprison25"	1 The dummy variable for the apartment which located 250 meters to the prison (inside of 250 meter=1; outside of 250 meter=0)
Model 2 "pris"	Distance variable for an apartment located to the prison (for all apartments based on data resource)

Each of the linear regression models has been defined to observe two kinds of apartment location conditions.

The reason for making this model is to find the detail of proximity value in estimating the apartment price as it affected by the presence of prison. Using the independent variable of "dprison25", the apartment which located 250 meters to the prisons were observed. However, in order to see the whole impact (not only inside of 250 meters distance) of the prison, but it would also need to compare the analysis

result with price conditions within all of the apartment located to the prison (as it based on the available apartment data collected from the data resource).

B. Empirical Result

Since the apartment price data that has been collected in here has only cover for one year data before the displacement happened (year of 2000) and annual data that covers six years during and after the displacement process (2006 until 2012), the empirical result of the statistical analysis data might not explain the complete story in estimating the apartment price fluctuation from 2000 until 2012. However, we still can optimize the data using the regression analysis models to calculate the minimum proximity value which is assumed to affect the apartment price.

Table 2. Yeongdeungpo Old Prison Displacement Time Description

Announcement and Date	Information
Announcement 1, December 20, 2002	The first announcement for the displacement plan (as it mentioned in '4 years Guro-Gu District Development Plan')
Announcement 2, July 7, 2004	Detail explanation of the Yeongdeungpo Old Prison development plan by City Planning Commission of Seoul Metropolitan City in 12 th round meeting
Announcement 3, June 30, 2005	An announcement related to the new 'Parking Lot-Plan' was published and it has reported to give some influences on the apartment price
Announcement 4, November 2006	A formal agreement between Ministry Law and Justice and Guro-Gu municipality regards to the old prison displacement plan were signed
Announcement 5, October 29, 2011	Old prison has no longer being used anymore and all of the prisoners have transferred to the new prison.

Resources: Selected online newspaper, 2000-2011

It is important to be noted that in 2000, the data had also some weaknesses, which are shown in the absence of stories (number of floors) information. The year of 2000 data was collected from a different information source than 2006-2012 data, and it has a different variable component than the main variables such as the average price, lot size, age, and unit of apartments available. Since the available data that could be found before the first announcement in 2002 has only cover for one year analysis (transaction data on October 2000, collected from real estate bank data magazine/www.neonet.co.kr).

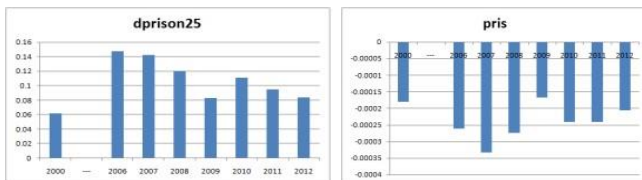
The year of 2000, adjusted R² serves a good measure for the goodness of fit of the model. The regression analysis yields an adjusted R² of Semi-log for Model 1 of 0.92, which can be interpreted as that the multiple regression equation explains 92% of the variation in the log of apartment price.

The other models were also showed high values on adjusted R^2 which mean the models are served as a good measure for the goodness of fit. During the year of 2006 until 2012, the coefficient that has calculated using the regression models showed not too much difference, especially on observing the coefficient of distance to prison. From the results of this model, the estimated coefficient of apartment attributes (area and number of the unit), distance (for the apartment located 500 m to the subway station) are generally match the expected impact on apartment price.

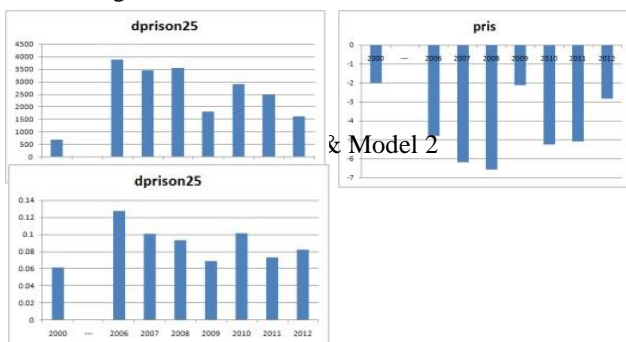
As the result of the first modeling (Model 1) from each of the hedonic regression models, it is shown that the positive coefficient on a distance to the prison variable indicates that the closer from the prison, the apartment price is estimated to be higher or getting more expensive. However, as the result of the second modeling (Model 2) from each of the hedonic regression models, it is shown that the negative coefficient on the distance to prison variables indicate that the further from the prison, the cheaper the apartment price. Here, we should notice that by the time this regression was analyzed the announcement for the displacement of the prison was already spread out and people were already expecting the new public development projects to replace the old image of the Yeongdeungpo old prison. However, the price conditions before the announcement (the year 2000 data) might be difficult to be interpreted since the conditions also showed no difference in determining the coefficient on the distance to the prison variable.

C. Discussion

From the regression modeling above, we can observe the fluctuation of the coefficient, which related to the distance of the prison in order to see its impact on the apartment price. Semi-log Regression Model 1 & Model 2



Linear Regression Model 1 & Model 2



Since the apartment prices are assumed to have increased a long time before the displacement actually happened, the positive coefficient on the distance to the prison variable indicates that the closer to the prison then the higher apartment price is. These results show that people have put some expectations on the future of the ex-Yeongdeungpo old prison area since the new replacement plans were announced. From the above graphics, it is recognized that the smaller the

distance coefficient value, the cheaper the apartment price is. So that, as we see in the graphics of model 2, as the observation of the apartment is not only focused inside of 250 meters to prison but also the apartment which located in the administrative area, it is shown that the further from the prison, the cheaper the apartment price.

The price conditions that found to rebound during 2007 and 2010 are assumed to be influenced by the real estate market condition that ever dropped since the world recession on the issue of sub-prime mortgage financial crisis in 2007 and hit the Korean economy during 2008 and 2009 [37]. Sub-prime mortgage financial crisis was triggered by the advent of the sub-prime mortgage crisis in the United States that became apparent in mid-2007. Europe was the first area affected, thereafter its contagion spread to the rest of the world, including East Asia. The nature of the current global financial crisis is unprecedented in terms of (1) the scale of the problems in the financial sector (particularly in the United States and Europe), (2) the depth and speed of contagion worldwide (through financial sector and trade linkages), and (3) the severity of the recession (particularly in emerging market economies, small countries, and East Asia). Lee et. al., (2007) have observed in their research that after the sub-prime mortgage crisis began, the increase of DJIA (Dow Jones Industrial Average) and KOSPI (Korea Composite Stock Price Index) leads to the decrease of IRD (Interest Rate Differential) in the short run. This result implies that both stock the market collapsed but the U.S short term interest rate decreased with the effort of the FRB (Federal Reserve Bank) after the sub-prime mortgage crisis.

However, as observed by Yu and Lee (2010), that during the Roh Mu Hyun Administration (2003–2008) the governmental announcements of housing stability policies have shown no observable impact on housing price instability. Yu and Lee [38] concluded that housing price instability was strongly affected by macroeconomic variables such as the money supply and the number of orders received for building construction. This finding has also indicated that macroeconomic variables (such as money supply, the construction of new housing, and interest rates) are strong explanatory factors for housing market instability. Real estate and housing policies during the Roh Administration were comprised of three parts, (1) an increase in the housing supply; (2) a decrease in housing demand, and (3) a decrease in housing prices. However, because of the complexity of housing processes, housing-related issues cannot always be dealt with centrally of policy decision. Inaction may lead to unintended

The other result of this model is that the coefficient of apartment area the higher the apartment price, as also the negative coefficient of distance variables showed that it has expected not to impact the apartment price. From the results of this model, the estimated coefficient of apartment attributes (area and number of a unit), distance (for the apartment located 500 meters to the subway station) generally match the expected impact on apartment price.

The displacement of the old prison was actually completed in October 2011. Before that, it was hypothesized that high expectations on the old prison site that will soon be replaced

by new apartment, culture and business complex facilities increases the prices of apartment units close to the prison site. The findings from this research show that such expectation actually increased the location premium for apartment units located within 250 meters from the old prison site a long time before the displacement actually happened, and the location premium was lowered when the displacement process was over. It determines that the displacement of the prison and the proposed functions of new public development projects could benefit from the nearby apartment market itself but it happened in eventual time only.

The neighborhood reactions and perspectives due to the displacement announcement also show that communities were victorious in influencing the apartment price impact. It is corresponding with Agyeman theory about the environmental justice argument, where communities tend to respond to a threat against community health [40]. Since Yeongdengpo as the old prison has become locally unwanted land use by the community, and also since the expectation of the new apartment, culture and business complex, the community tends to fight against environmental amenities so that the old prison can be displaced from their district area.

V. CONCLUSION

Regarding to the impact of the displacement process on the apartment market, the findings from this research show that such expectations actually increased the location premium for apartment units located within 250 meters from the old prison site a long time before the displacement actually happened, and the location premium was lowered when the displacement process was over. It can be concluded that in this study case, the distance or proximity does significantly impact the apartment prices. As it showed from the regression modeling that the apartment which was located within 250 meters of the old prison showed a positive sign, while in other parts, the apartment located varies and spread not only inside of the 250 meters distance to the prison has shown a negative impact to the apartment price. It determines that the displacement of the prison and the proposed functions of new public development projects could successfully give some benefits for the nearby apartment market itself, even though it happened in eventual time only.

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