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Tax-driven Bunching of Housing Market Transactions: The Case of Hong Kong

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We study the implications of a property market transaction tax. As property buyers are obligated to pay a transaction tax ("stamp duty" or SD) where the rate increases with the value of the transaction, there are incentives to trade at the cutoff points of the tax schedule or just below them. Thus, both "bunching in transactions" and "underpricing" should be observed near those cutoffs. Furthermore, the bunching points should change with the tax schedule. We confirm these conjectures with a rich dataset from the Hong Kong housing market and provide a measure of tax avoidance.

Keywords:

Bunching, Change in Nonlinear Tax Schedule, Housing Market, Tax Avoidance and Tax Evasion, Underpricing

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An increased surcharge the Singaporean government has assessed on most foreign buyers to try to tamp down soaring property prices threatens to rattle Singapore's uneasy relationship with many of its rich foreigners while giving Americans an edge in one of Asia's hottest property markets. This month, the government boosted to 15% from 10% the fee added to the purchase price of residential property bought by many foreign nationals, including the Chinese, who were the second-largest group of foreign buyers last year… The government worries that foreign buying is introducing the risk of a market bubble and making homes less affordable for Singaporeans, which is feeding a growing resentment of foreigners.

– *Wall Street Journal* (2013)

1. Introduction

In this paper, we attempt to contribute to several strands of the literature by studying how a nonlinear tax schedule affects the behavior of property sellers and buyers. As the Wall Street Journal (2013) quotation reflects, there is the belief that introducing a transaction tax on the property market could contribute to "taming the property market bubble". Clearly, the idea can be traced back to the so-called "Tobin tax", as explained by Tobin (1978) himself,[1] or even to Keynes (1936).[2] While this may be a clever policy in response to an "overheated" asset market, it poses challenges for empirical research. In fact, the study of a property market transaction tax, or a transaction tax in other asset markets, needs to address the following questions. Why does the government introduce an asset transaction tax? Why is it introduced at a particular time? Some authors even classify the "Tobin tax" as the *endogenous response* of the government to a potential bubble situation, whether in the foreign exchange market or the property market. The endogeneity issue complicates the identification. As there has already been much discussion of whether a property transaction tax contributes to taming the bubble, our study complements the literature by focusing on the implications of introducing a property transaction tax.

[1] According to Tobin (1978), "currency exchanges transmit disturbances originating in international financial markets. National economies and national governments are not capable of adjusting to massive movements of funds across the foreign exchanges, without real hardship and without significant sacrifice of the objectives of national economic policy with respect to employment, output, and inflation … and my proposal is to throw some sand in the wheels of our excessively efficient international money markets".

[2] According to Keynes (1936, p.104-5), "(s)peculators may do no harm as bubbles on a steady stream of enterprise. But the situation is serious when enterprise becomes the bubble on a whirlpool of speculation … The introduction of a substantial government transfer tax on all transactions might prove the most serviceable reform available, with a view to mitigating the predominance of speculation over enterprise in the United States".

Our hypothesis is simple. Notice that when an unexpected change in the property transaction tax is imposed, the housing stock in the economy cannot adjust in the short run. We further conjecture that the housing units being traded do not appreciably change. The pricing, however, could significantly change. Housing units that are originally sold just above the tax thresholds would bring more tax obligations to the buyers and hence lower their willingness to pay for such properties. Sellers are aware of such tax-driven changes in willingness to pay. To facilitate the transactions, some sellers may be willing to cut prices. Others may even artificially lower the prices to decrease the tax obligations of the buyers. The buyers might also find ways to compensate the sellers "off the record".

The verification of this hypothesis is not straightforward. As in the case of corruption, "off the book compensation" is by definition not accurately recorded and hence related data are not accessible. Furthermore, not every buyer-seller pair can reach such an agreement. After all, such behavior could be categorized as tax evasion and the involved parties would be prosecuted.[3] For these reasons, we indirectly approach the problem.

More specifically, we proceed in several steps. First, we examine whether bunching in transactions (BIT) are observed in the data. We present evidence of BIT in later sections and provide an indirect confirmation of our hypothesis. Second, we examine whether underpricing (UP) near the cutoff points on the tax schedule is observed in the data. We present clear evidence for UP, which also confirms our hypothesis. A possible concern is that model misspecification can also lead to UP. We therefore provide a third piece of evidence that the evolution of the "estimation errors" of our pricing equations near the cutoff points is indeed different from those not near the cutoffs, which provides the third confirmation of our hypothesis.

The Hong Kong market is ideal for testing this hypothesis for several reasons. While more detailed explanations will be provided in later sections, we would like to highlight a few key points. First, a property transaction tax was introduced in Hong Kong long before the global recession occurred in 2008, thus allowing us to avoid the criticism of providing an "endogenous policy response".[4]

Second, the transaction tax schedule in the Hong Kong housing market is highly nonlinear. In Hong Kong, a transaction tax known as the "stamp duty"

[3] In fact, court cases about "stamp duty cheating" demonstrate that the intentional underpricing of property for the purpose of tax avoidance has certain "legal risks". See Legal Appendix for more details.

[4] After circulating the first draft of this paper, we became aware of Fu et al. (2014), which focuses on the case of Singapore. Since the institutional settings of Hong Kong and Singapore are very different, and the sampling periods of the two papers are also very different, we view the two papers as complements.

(SD) is imposed onto the buyer when a property is sold. The tax rate ranges from near-zero to above 3%, depending on the value of the transaction. As we will describe in more detail later, it follows that once the transaction value is above a certain cutoff point, the transaction tax rate increases. Our estimates, based on a flexible econometric framework, show clear evidence of BIT near the cutoff points.

Obviously, clustering at the cutoff prices can occur for a number of reasons. BIT around the cutoff points does not imply that those transactions are induced by the SD schedule. To show that the BIT in our sample is indeed tax-driven, we make use of two major changes in the SD schedules, one in 1997 and the other in 2007. If the tax changes are exogenous, then we can observe how BIT changes with the SD schedule. Our results, which will be explained in detail later, confirm that the BIT is indeed tax-driven.

The third reason for studying the Hong Kong market is the existence of a very rich micro dataset on the housing market transactions that facilitates our analysis. The idea is simple. To confirm the existence of UP, we need to have a reliable model for housing price, which enables us to confirm that there is indeed mispricing, and the direction of such mispricing as well. It happens that Hong Kong exactly provides such a large dataset of housing transactions that contain rich information about the housing attributes. Thus, by fitting a hedonic model to the data, we can obtain a measure of the mispricing of a unit. Not only can we confirm the existence of UP, we can also examine whether UP appears more frequently near the tax rate thresholds, and how it might change with the SD schedule. This addresses the concern that our measure of UP may be model-dependent or due to missing variables or misspecified functional forms. According to our hypothesis, UP is tax-driven. Hence, we should expect (i) the UP to be more clustered near the cutoff points of the tax schedule, and (ii) the clustering of the UP would change along with the tax schedule. As our dataset contains a sufficiently long time series, we can observe how the "estimation errors" near the cutoff points evolve over time, and compare that with the estimations errors that are not near the cutoff. Thus, our research exploits both the cross-sectional and time-series aspects of the dataset.

Clearly, this paper is connected to the literature on tax avoidance (legal) or tax evasion (illegal). While Slemrod and Yitzhaki (2002) provide a helpful survey of that literature, it may nevertheless be instructive to highlight a few contributions here. For instance, Feldstein (1999) shows, both theoretically and empirically, that the deadweight loss of income tax would be much higher when tax avoidance is taken into account. Kleven et al. (2011) conduct a tax enforcement field experiment in Denmark and show that prior audits and threat-of-audit letters can deter tax avoidance. Some authors have documented evidence of bunching at kink points created by nonlinear income tax schedules. Among others, Burtless and Moffitt (1984) and Friedberg (2000) use the Current Population Survey data to document the bunching of elderly

individuals who are receiving Social Security benefits but still working, and thus are subject to the Social Security earnings test. Saez (2010) uses U.S. tax return data to document the bunching behavior of self-employed individuals around the first kink point of the Earned Income Tax Credit. Chetty et al. (2011) present evidence of bunching at kink points through the use of Danish tax records.[5]

While most studies on tax avoidance and tax evasion focus on income and inheritance taxes, there are a few studies that examine the effects of *nonlinear tax schedules on the housing market*. For instance, Best and Kleven (2013) exploit the anticipated and unanticipated changes in the nonlinear SD schedule in Britain and show that the effect of SD on house prices is large (200-500% of the tax itself). Hilber and Lyytikäinen (2013) study the effect of the nonlinearities in the SD schedule of Britain on labor mobility and provide evidence of bunching in the British housing market. Kopczuk and Munroe (2012) study the effect of the 1% "mansion tax" imposed onto properties sold in New York at prices above $1 million. They provide evidence of the bunching of transactions at $1 million, which shows that the incidence of this tax falls on sellers and may exceed 100% of the tax itself.

This paper complements the literature by providing an estimate of the magnitude of potential tax evasion based on the transaction prices and housing attributes of the corresponding units. Thus, this paper takes an initial step in estimating (part of) the potential social cost of the "Tobin tax" in the property market context.

The remainder of this paper is organized as follows. The next section provides more details about the Hong Kong housing market and its property transaction tax. We then explain the econometric framework and present the empirical results. The final section concludes the study and additional details can be found in the Appendix.

2. Description of the Data and the Hong Kong Housing Market

This section provides the justifications for employing Hong Kong data. We also provide more background on the Hong Kong housing market, its property transaction tax and the dataset that we use.

[5] Several studies have researched the effect of kink points in situations *other than income tax schedules*. Among others, Blundell and Hoynes (2004) find evidence that individuals who are likely to be eligible for the U.K. family credit, which has a 16-hour minimum working requirement, bunch at exactly 16 hours a week. Koichiro (2012) studies the effect of nonlinear pricing in the electricity market and finds strong evidence that consumers respond to average price rather than marginal price.

There are several features of the Hong Kong data which make them a desirable choice for this research. First, a property transaction tax was introduced in Hong Kong long before the global recession occurred in 2008, which allows us to avoid the criticism of providing an "endogenous policy response". Hong Kong has a long history of depending on property-related taxes. When the British took over the New Territories (a large portion of Hong Kong) from the Qing Dynasty in 1899, they conducted a land survey to clarify the land ownership and facilitate the collection of land taxes (Hase, 2008). Hong Kong is also well known for its low marginal labor income tax rate (capped at around 16%). In fact, at least one-third of the government revenue comes from land and property-related tax (LPT) (Leung and Tang, 2013). The justification for this reliance on property-related tax over labor tax is that tax avoidance or tax evasion is much easier with labor tax. Low enforcement cost is thus a major reason for the preference of the Hong Kong government for LPT. Thus, the Hong Kong government depends more on LPT than many other countries and maintains a relatively low-tax environment. According to the World Bank (2011), Hong Kong is ranked in the top 10 in terms of maintaining a simple tax system and a low corporate profit tax rate among more than 180 economies. This background provides more justifications for considering the property transaction tax in Hong Kong to be "exogenous".

In Hong Kong, a transaction tax known as the "stamp duty" (SD) is imposed onto property buyers. The rate ranges from near-zero to above 3%, and the schedule is highly nonlinear (see Figures 1a and 1b). The idea is that if the property value is too low, the parties to the sale may be relatively poor and hence it may be neither cost-effective nor socially desirable to collect tax from such property transactions. People who trade "high value" properties, however, are considered to be less tax-sensitive and more capable of paying the tax. In general, the tax rate increases smoothly, except near the threshold, before which the tax rate is essentially zero. For example, between April 1996 and March 1997, for a property sold at a price of HK$740,000 (which is below the HK$750,000 threshold), the buyer is subject to an SD of HK$100.[6] If the property is instead sold at a price of HK$760,000 (which is above the threshold), the buyer is subject to an SD of HK$1,100, which is 11 times greater. The tax rate after that particular effectively-zero tax threshold changes much more smoothly.

In later years, the effectively-zero tax threshold continues to contribute to dramatic changes in property tax rates. For instance, between February 2007 and March 2010, a property sold for below HK$2 million may be subject to an SD of HK$200. However, if the property is sold at $2.1 million, the SD would rise to HK$10,100, which is 50 times more. Thus, the SD schedule creates an incentive for BIT such that buyers and sellers tend to transact at or just below the cutoff price to avoid the tax if the market price of the property is only

[6] Since October 1983, the nominal exchange rate between the Hong Kong and U.S. dollars has been fixed at 7.8 HK dollars for one U.S. dollar.

slightly above the cutoff price. By using the same example, we should observe many transactions at $2 million, but relatively fewer at prices slightly above $2 million.

Several of the "free market" features of Hong Kong provide yet further reasons for using Hong Kong data. While the property transaction tax has been in place for more than a decade, there is *neither capital gains tax nor capital control* in Hong Kong. In addition, during our sampling period, the nominal exchange rate between the Hong Kong and U.S. dollars remain constant. Foreign investors are welcome to the housing market and subject to the same SD as the local buyers during our sampling period, which suggests that foreign investors could arbitrage should they see such opportunities arise.

To further analyze the BIT and whether it is tax-driven, we rely on a detailed micro dataset of housing transactions provided by the Economic Property Research Center (EPRC). The dataset includes most of the property transactions from 1996 to 2007 and their various aspects, including price,[7] gross and net areas,[8] address, floor, age, and number of bedrooms and living rooms.

The original data contain 2,059,405 transactions. First, we drop 402,961 observations with a zero or negative age that are either new properties or transactions that involve incomplete units. As the first-hand property market is highly oligopolistic in Hong Kong, we do not want to include those transactions in our analysis. Second, there are various types of transactions in the EPRC data, such as change of owner's name, provisional agreement and other. We only want to keep the final agreement of each transaction and hence, we drop 858,245 observations to keep only the contract assignment type.[9] Third, we drop 19,271 transactions that involve only adding or dropping the names of some of the owners. Most of those transactions are due to ownership changes (e.g., parents who give property to their children, divorce-related transactions) and we do not consider them in our analysis. Fourth, we drop 234,744 observations due to *missing information* on age, floor, gross area, net area and bay window area, or because the property is new or not yet available on the market. Fifth, we drop 12,092 observations for having a zero or negative price. Finally, we drop the top and bottom 2% of the observations according to the real price (deflated by the composite CPI, at the May 2005 value) per squared-feet. The above procedures leave us with a total of 493,054 observations, which seems to be decent for a research that focuses on one city.

[7] Unless otherwise indicated, all prices ($) are in current Hong Kong dollars.

[8] In Hong Kong, a property's gross area includes the area of the common spaces of the housing estate, such as parking space while net area, broadly defined, is the area of the housing unit itself.

[9] In Hong Kong, there are several stages in a property transaction. In each transaction, a different type of contract would be signed. Hence, the same transaction would be recorded several times at different dates in the dataset. To avoid double- or even triple-counting the same transaction, we have carefully cross-checked those trading records.

2.1 Stamp Duty in Hong Kong

Since the transaction tax, or SD in the context of Hong Kong, is the focal point of this paper, this section provides more background on this topic. During our sample period (1996 to 2007), the Hong Kong government modified the SD schedule three times. The first modification happened in April 1997, the second one in April 1999 and the last one in March 2007.[10] Since the second change only involves the changing of the new cutoff price to $6 million and we have very few observations near that price range, we only consider the first and third changes.

The 1997 change in the SD essentially moves the tax schedule to the right, which shifts all of the cutoff price points while keeping the tax rates "unchanged": $0.75 million to $1 million, $1.5 million to $2 million, $2.5 million to $3 million and $3.5 million to $4 million (see Figure 1a).[11] The 2007 change in the SD expands the range of "essentially zero transaction tax" ($100) to any transactions below $2 million, and keeps the rates unchanged (see Figure 1b).

The two modifications were announced in the annual Budget Speech by the financial secretary on March 12, 1997 and February 28, 2007, respectively. They were then implemented within a month after the announcements. We use the news-search software, WiseNews,[12] to conduct keyword searches around the time of the announcements and find no related news before the announcements in the Budget Speech. We are therefore confident that the announcements were unexpected.

Relative to the cases in the U.K. (Best and Kleven, 2013) and in New York and New Jersey (Kopczuk and Munroe, 2012), the property transaction tax system in Hong Kong does not feature "dramatic jumps" at the cutoff prices. For example, under the current system in the UK, the proportional tax rate jumps from 1% to 3% at a price of £250,000, so that the SD for a house sold at £249,999 would be £2,499.90 while the SD for a house sold at £250,000 would be £7,500. In contrast, the increase in SD at cutoff prices, except at the "essentially zero tax" cutoff, is gradual in Hong Kong. For example, under the tax system implemented since March 2007, a house sold at a price of $3 million is subject to an SD of $45,000 (1.5%) while a house sold at $3.1 million is subject to an SD of $55,000 (1.83%). As the jumps of the SD at cutoff prices are more gradual in Hong Kong, there should be less incentive to bunch around the cutoff prices. Thus, if we can still find evidence of BIT, this would further strengthen the results.

[10] Note that the Asian Financial Crisis (AFC) did not impact Hong Kong until the end of 1997 and early 1998, and hence the first modification is unrelated to the AFC. Among others, see Leung et al. (2013), and Leung and Tang (2012) for more discussion.

[11] For more details, see the Appendix.

[12] See the Hong Kong news database at http://wisenews.wisers.net.

Figure 1a **Transaction Tax Schedules Before and After the End of March 1997**

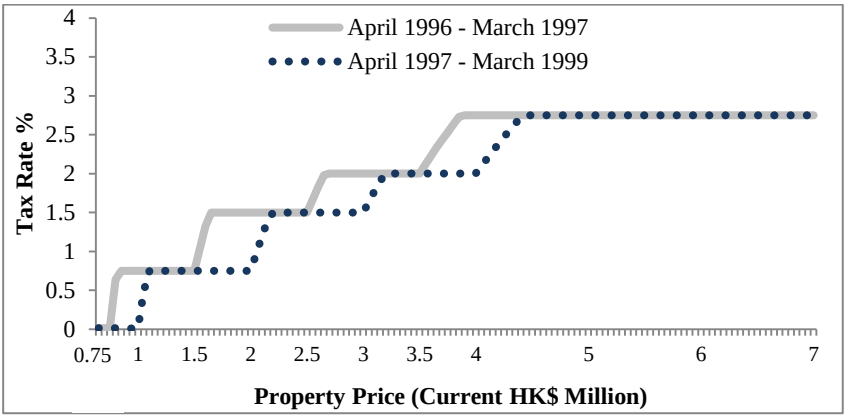
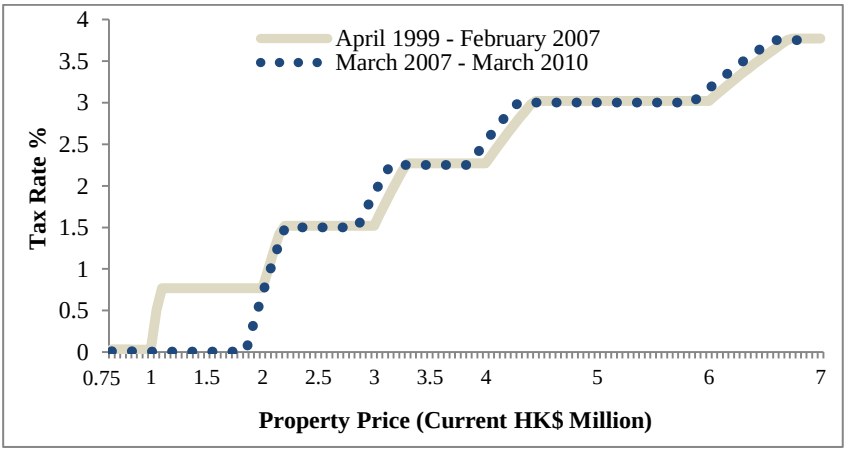


Figure 1b **Transaction Tax Schedules Before and After the End of February 2007**



3. Evidence of Bunching In Transactions (BIT)

To assess whether BIT exists in the Hong Kong housing market, we follow Chetty et al. (2011), Best and Kleven (2013) and Kleven and Waseem (2013) to estimate the amount of bunching at the cutoff prices. Since we do not know how the number of transactions should vary with transaction value a priori, we fit a flexible polynomial into the empirical distribution of transactions to estimate the counterfactual distribution of transactions without bunching, and then compare it with the actual number of transactions. In particular, we group transactions into price bins of $10,000 and estimate the following equation for each cutoff price $\bar{h}_v$:

$$n_i = \sum_{p=0}^{5} \beta_p (d_i)^p + \sum_{r \in R} \eta_r I\left\{\frac{\bar{h}_v + d_i}{r} \in \mathbb{N}\right\} + \sum_{k=\bar{h}_v-2}^{\bar{h}_v+2} \gamma_k I\{i = k\} + \mu_i \quad (1)$$

where n_i is the number of transactions at price bin i, d_i is the distance of price bin i from the cutoff price $\bar{h}_v$, R is the set round numbers of \$50,000 and \$100,000 and lucky numbers of \$80,000 and $\mathbb{N}$ is the set of natural numbers. The first term of (1) is a fifth-order polynomial as a function of the distance from the cutoff price. The second term contains the fixed effects of round and lucky numbers. The third term picks up the fixed effects near the cutoff price (plus or minus \$20,000). The counterfactual distribution $\hat{n}_i$ is simply the fitted version of (1) without the third component.

To measure the amount of distortion near the cutoff price, we use an estimated equation (1) and calculate: a) bunching b as the sum of the three γs at and below the cutoff price, normalized by the counterfactual density in the same region and b) missing m as the sum of the two γs above the cutoff price, normalized by the counterfactual density in the same region.

$$b = \frac{\sum_{k=\bar{h}_v-2}^{\bar{h}_v} \gamma_k}{\sum_{k=\bar{h}_v-2}^{\bar{h}_v} \hat{n}_k}, \; m = \frac{\sum_{k=\bar{h}_v+1}^{\bar{h}_v+2} \gamma_k}{\sum_{k=\bar{h}_v+1}^{\bar{h}_v+2} \hat{n}_k} \quad (2)$$

The magnitude of b describes the amount of bunching as a proportion of the counterfactual number of transactions. For example, $b = 1$ means that the number of bunching transactions is 2,000 if the counterfactual number is 1,000. A larger number means more bunching. The magnitude of m has a similar interpretation, but we expect its sign to be negative. Equation (1) is estimated by using nonlinear least squares with bootstrapped standard errors (2000 times). The standard errors for b and m are calculated by using the delta method.

The statistical results are consistent with the existence of BIT. Recall that there are three sub-periods separated by three different tax schedules. For the first sub-period, which is between April 1996 and March 1997, there are four different cutoff prices (\$0.75 million, \$1.5 million, \$2.5 million and \$3.5 million). Our estimation shows that there is more bunching at lower cutoff prices ($b_{750k} = 0.892, b_{1.5m} = 0.46, b_{2.5m} = 0.259, b_{3.5m} = 0.331$).[13] The estimates of the missing mass, m, are negative as expected. After the first modification of the stamp duty, the four different cutoff prices are \$1, \$2, \$3 and \$4 million. The revised tax schedule was effective during the period between April 1997 and February 2007. During this period, we find that the amount of bunching decreases with the magnitude of the cutoff prices

[13] The corresponding standard errors, which are calculated by bootstrapping, are 0.058, 0.003, 0.006 and 0.015. They are considerably smaller than the point estimates, which suggests statistical significance. For more details on the estimates in all three sub-periods, see the Appendix.

($b_{1m} = 0.436, b_{2m} = 0.197, b_{3m} = 0.188, b_{4m} = 265$). The estimates of the missing mass, m, are negative as expected. After the second SD modification, there are only three different cutoff prices: \$2, \$3 and \$4 million. The revised tax schedule was effective during the period between March 2007 and December 2007. There is again a significant amount of bunching at the cutoff prices, and the amount of bunching is the highest at the lowest cutoff price ($b_{2m} = 0.477, b_{3m} = 0.171, b_{4m} = 294$). The estimates of the missing mass, m, are also negative as expected. In the Appendix, we show that the corresponding standard deviations of all the b are considerably smaller than the point estimates, which suggest that the point estimates of all the b are statistically significant.

In Figures 2 to 5, we provide a compact visualization of the bunching phenomenon. At each price bin of \$10,000, we define the *"estimation error"* to be the actual amount of transactions minus the counterfactual based on the estimation of (1). If there is no bunching of transactions, we would expect a very uniform distribution of the "estimation error". This is not what we observe. For instance, Figure 2 shows that the amount of the "estimation error" is unusually high near the \$0.75 million threshold over the April 1996-March 1997 period (blue solid line), which suggests BIT at that cutoff. As we discussed before, the BIT by itself may not be due to the tax schedule. We thus repeat the calculation for the period between April 1997 and February 2007 and plot the distribution on the same graph to facilitate the comparison (red dotted line). As the cutoff point moves from \$0.75 to \$1 million after the 1997 tax change, the BIT also disappears near \$0.75 million. In fact, the value of b changes from 0.892 (with a standard deviation of 0.06) to about -13 and is statistically insignificant.

Consistent with that, Figure 3 shows that there is no BIT near \$1 million during April 1996 to March 1997, in the sense that the amount of "estimation error" around \$1 million is not particularly higher than around the other price bins (blue solid line). However, for the period between April 1997 and February 2007 where the "essentially zero tax" cutoff becomes \$1 million, the "estimation error" near \$1 million experiences a "quantum jump". The estimate of b changes from negative to positive (both statistically significant). A similar pattern happens at other cutoff points that are not reported here. Putting all of these together provides a strong case that the BIT is indeed tax-driven.

The interpretations and comparison of Figures 4 and 5 are analogous. Figure 4 shows that the amount of the "estimation error" is unusually high near \$1 million (which is the "essentially zero tax threshold") between April 1997 and February 2007 (blue solid line), thus suggesting BIT at that cutoff. After the second tax reform, i.e. during the March 2007-December 2007 period, the BIT near \$1 million drops to about one-third of the previous value (red dotted line). The estimate of b also drops from 0.61 to 0.219 after March 2007, and

the standard deviation is around 0.003 in both cases, which suggests that both point estimates are statistically significant. The dramatic change in the BIT is consistent with our tax-driven hypothesis.

Figure 2 Bunching Around $0.75 Million for Apr 1996-Mar 1997 and Apr 1997-Mar 1998

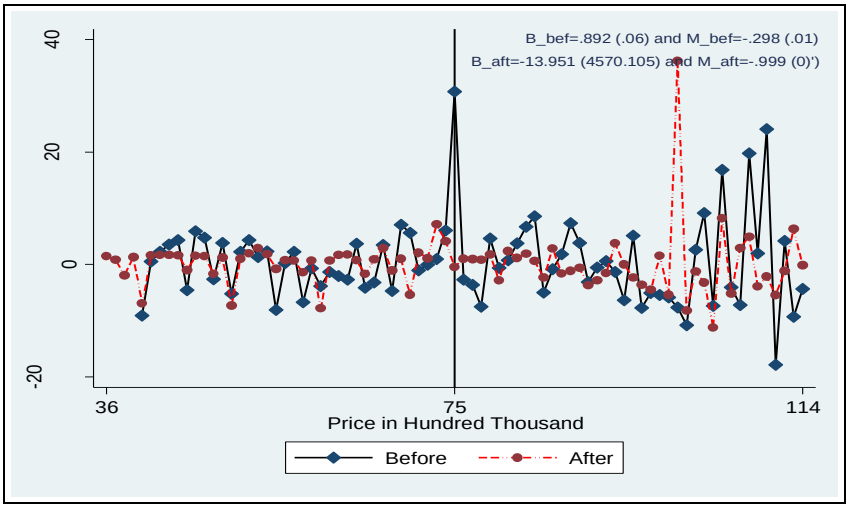
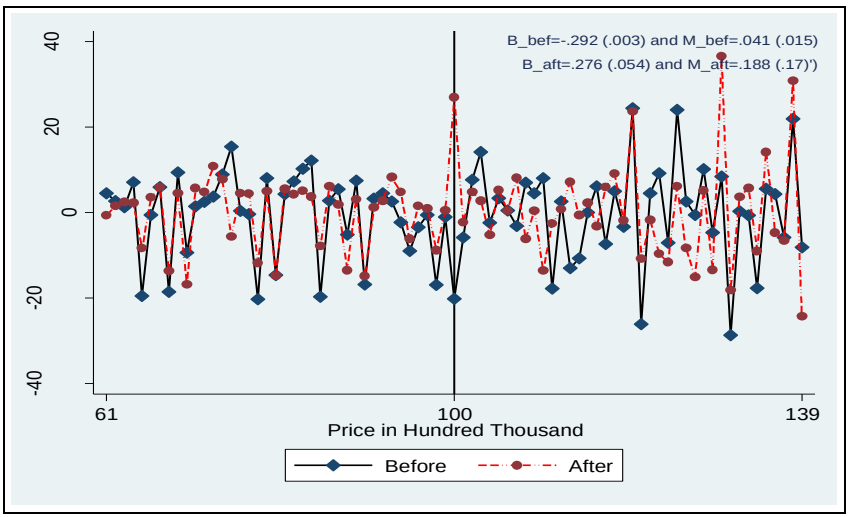


Figure 3 Bunching Around $1 Million for Apr 1996-Mar 1997 and Apr 1997-Mar 1998



Note: A flexible polynomial is fitted on the same months of the year before and after the change in the SD schedule. We subtract the counterfactual from the actual distribution to calculate the amount of bunching, and in the graph, we compare the amount of bunching before and after the change.

Figure 4 Bunching Around $1 Million for Mar 2006-Dec 2006 and Mar 2007-Dec 2007

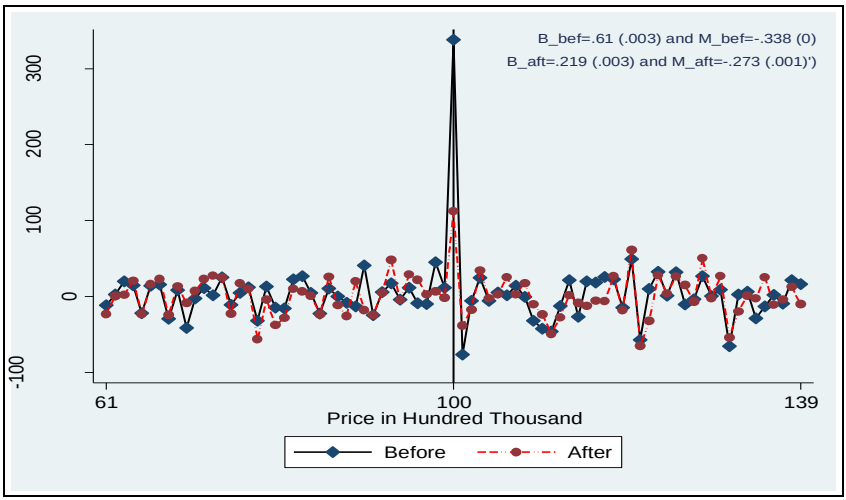
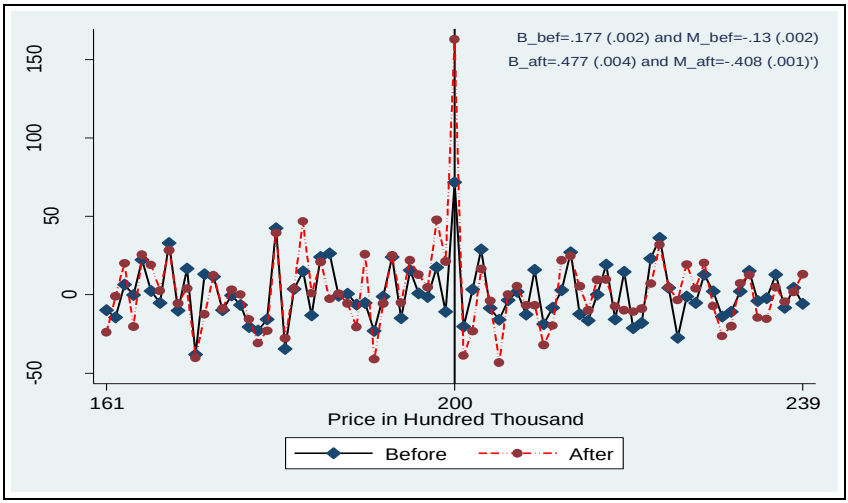


Figure 5 Bunching Around $2 Million for Mar 2006-Dec 2006 and Mar 2007-Dec 2007



***Note*:** A flexible polynomial is fitted on the same months of the year before and after the change in the SD schedule. We subtract the counterfactual from the actual distribution to calculate the amount of bunching, and in the graph, we compare the amount of bunching before and after the change.

Similarly, Figure 5 displays the amount of the "estimation error" near $2 million. It is not a cutoff in the tax schedule for the period between April 1997 and February 2007 (blue solid line), and the amount of bunching is limited.

However, after the second reform, i.e. for the period that covers March 2007 to December 2007, the amount of BIT near $2 million increases to almost three times the original value (red dotted line). The estimate of b goes up from 0.177 to 0.477 after March 2007, and the corresponding standard deviations are 0.002 and 0.004, respectively, thus suggesting that the point estimates are indeed statistically significant. Again, these dramatic changes in BIT are difficult to explain without attributing them to the property transaction tax reform.

4. From Tax-Driven Bunching to Tax-Driven Underpricing

We have shown that both the existence of BIT and the "locations" of the bunching depend on the tax schedule. However, one might argue that the housing units being traded before and after the tax reform could be different and hence a direct comparison of those BIT might not be completely satisfactory. A merit of this paper is our access to a rich dataset that contains all of the attributes of the properties sold. Equipped with that dataset, we can conduct a more in-depth analysis of how the property transaction tax may have distorted the housing market.[14]

As we have explained in the introduction, we conjecture that the BIT is related to bunching in the UP near the cutoff points of the tax schedule, whether because the sellers are willing to voluntarily cut prices, or there are unobserved, off-the-book side payments. The former behavior is a kind of tax avoidance while the latter is a kind of tax evasion, which is against the law.

As we cannot directly observe those side-payments, we instead focus on whether the housing units being traded just below the cutoff points are "underpriced". To achieve that goal, we first estimate a hedonic regression for the sample from March 1996 to December 2007. The first two months of 1996 are dropped, as the SD schedule that ended in March 1997 only began in March 1996. Real housing price (which is equal to the nominal housing prices deflated by composite CPI, at the May 2005 value) is used for the hedonic regression,[15] and the explanatory variables include floor, age, squared gross area and its squared net-gross area ratio and its squared dummy for clubhouse, bay window size, dummy for swimming pool and 59 district dummies. In fact, we fit the hedonic regression for each month separately, and the average adjusted R^2 is around 0.9. The coefficient estimates all have the correct signs. The addition of more explanatory variables or interaction terms in the

[14] In Hong Kong, as in New York City, most people live in condominium units, which have less heterogeneity than single-family homes in the United States. This further facilitates the comparison.

[15] A merit of using the housing price level instead of log house price is that we can obtain both positive and negative "pricing errors". In other words, our formulation allows for both "overpricing" and "underpricing". That is important because we need to know the extent of underpricing in this and the following sections.

regression could further improve the fit, but the results we present below are robust to changes in the specification.[16]

Since our goal is to determine whether the nonlinear SD schedules affect property prices near the cutoff prices, we drop observations that are at \$0.01 million or \$0.02 million below the cutoff prices from the hedonic regression, depending on the SD schedule in effect. For example, from March 2007 until the end of the sample, we drop observations at or within \$0.02 million below \$2, \$3, \$4 and \$6 million. With over 400,000 observations, and as the number of observations near the cutoff prices is small, the hedonic regression is not affected much by this procedure.

Based on the hedonic regression, we calculate the residuals for properties that are at the cutoff points or within \$0.02 million below.[17] With the assumption that the hedonic regression is adequate, the residual should tell us if a property is overpriced or underpriced relative to the hedonic price. For instance, if a property is underpriced at or right below a cutoff price, the residual should be substantially more negative than otherwise. We next test if the mean of the residuals is different near or away from the cutoff prices.

In Table 1, we regress the hedonic residuals (in millions) on a constant and a dummy for transactions at or no more than \$0.02 million below the cutoff prices. We consider two samples: one that includes all transactions in all periods, and the other that includes transactions at or no more than \$0.02 million below the old and the new cutoff prices. As Table 1 shows for both samples, transactions near the cutoff prices have significantly more negative residuals. In the first sample, the difference is about 0.13 million and in the second sample, about 0.07 million. Transactions at or slightly below the cutoff prices are clearly "underpriced".

5. An Empirical Assessment for Potential Tax Avoidance or Tax Evasion

We have shown evidence of UP near the cutoff prices induced by a change in the tax schedule. While we are not able to distinguish tax avoidance from tax evasion, it is in a sense noticeable that such tax-driven UP would occur in

[16] Robert van Order suggested that we should use repeated sales as a robustness check. Unfortunately, we could not gather enough repeated sales transactions at the cutoff points. We are, however, grateful for the suggestion.

[17] The sample is too small if we only consider housing units that are exactly at the cutoff points. We also use \$0.01 and \$0.05 million below the cutoff points for estimation, and find that the results are similar.

Hong Kong, where intentionally underpricing a property transaction to avoid taxes may be subject to "legal risk".[18]

Table 1 Residual Regression

	All Transactions	Old and New Cutoff Prices
Constant	0.007***	-0.051***
	(0.008)	(0.029)
Dummy Cutoff Price	-0.125***	-0.068***
	(0.008)	(0.004)
Number of Observations	486129	47315
Adjusted R-squared	0.003	0.006

Note: We regress the hedonic residuals (in millions) on a constant and a dummy variable that is one when the transaction is at or slightly below the cutoff price for the relevant period. The first sample considers all transactions, and the second sample only includes the new and old cutoff prices (rounded numbers)

In this section, we attempt to quantify the potential amount of transaction tax avoidance or evasion by summing up the mispricing at or below the cutoff prices. Based on our hedonic regression in the previous section, we compare the "pricing errors" near and away from the cutoff points. The idea is that if the UP is tax-driven, the difference between the residual near the cutoff and that which is away from the cutoff should provide a measure of the tax evasion. Once again, we only consider prices at the cutoff up to $20,000 below the cutoff price. As a comparison, we also calculate the sum of residuals at prices that are away from the cutoff. For example, during most of the sample when $1, $2, $3 and $4 million are the cutoff prices, we also calculate the sum of residuals at $0.75, $1.5, $2.5 and $3.5 million. For the earlier period before April 1997, $0.75, $1.5, $2.5 and $3.5 million are the cutoff prices and $1, $2, $3 and $4 million are the comparison group.

We plot the two series of means of residuals in Figures 6a and 6b. There is clearly more mispricing for the group with the cutoff prices. The mean of the residual over the sample period is about $220,000,000 per month, which translates into about $260 million per year in 2005 dollars.[19] The amount of tax avoidance rises with the housing boom between 2004 and 2006, as the total amount of trading volume increases. Our measure could underestimate the amount of potential tax evasion for two reasons: 1) we only consider transactions at or at most $20,000 below the cutoff prices, and 2) we do not

[18] In the Legal Appendix of this paper, we provide a real court case in which tax evasion is being persecuted. The working paper version of this paper, which contains that legal appendix, can be downloaded from http://ideas.repec.org/e/ple96.html.

[19] On average, there are 188 transactions at or near the cutoff prices per month, thus implying, on average, about a $100,000 underpricing.

consider more luxurious properties.[20] In contrast, the mispricing is close to zero on average for the comparison of the non-cutoff price group.

Figure 6a Mean of Hedonic Residuals at or near the Cutoff Prices

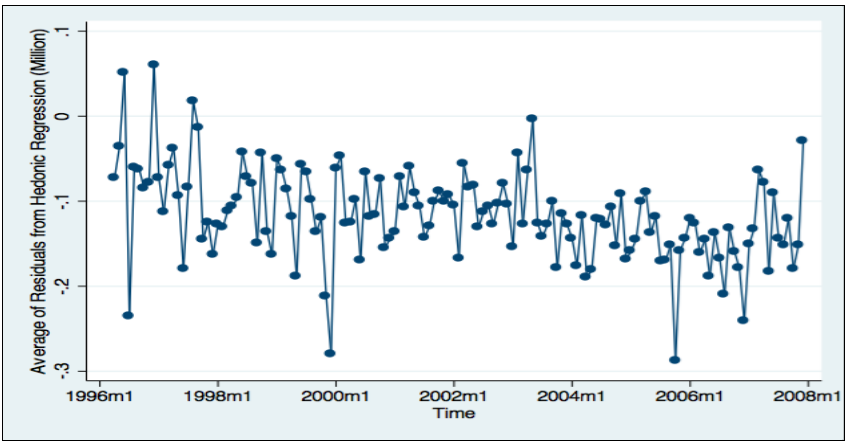
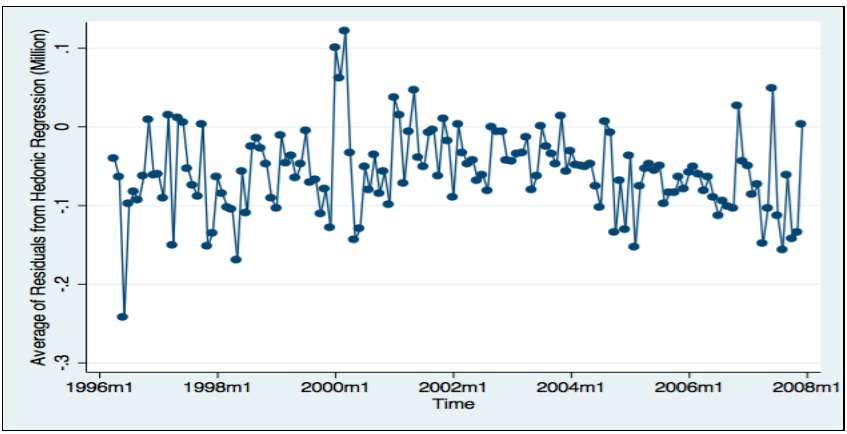


Figure 6b Mean of Hedonic Residuals at or near the Non-Cutoff Round-Number Prices



Note: We run the hedonic regression by using real house price. We calculate the mean of the residuals in each month at the cutoff prices (up to $20,000 below the cutoff price) in the first graph. As a comparison, we calculate the mean of the residuals at the non-cutoff but rounded number prices in the second graph. All amounts are at May 2005 value, in millions.

[20] One of the reasons is that such properties are few in number and not frequently sold. Our hedonic pricing equation has difficulty in accurately measuring the extent of mispricing.

6. Conclusion

Can asset market transaction taxes "stabilize" the corresponding asset markets? Perhaps so. Many authors have contributed to that discussion.[21] This paper attempts to complement the literature by addressing a different but related question: Can asset market transaction taxes stabilize the markets without cost? Our study of the Hong Kong housing market suggests a negative answer. Several observations are immediate from our research. First, although the SD schedule in Hong Kong does not feature "discrete jumps" like those in New York and New Jersey and in the U.K., there is still strong evidence that property transactions bunch at the cutoff prices of the SD schedules (BIT). We show clearly that once the tax schedule changes, those "clustering points" of transactions change accordingly. Second, properties sold at and right below certain cutoff prices are underpriced, based on the analysis of a rich dataset of property transactions. In other words, both the trading volume and the transaction prices are distorted. In addition, we find that the total amount of tax avoidance (or evasion) moves with the housing market cycle. Our estimate suggests that it is about $260 million in 2005 Hong Kong dollars annually. As luxurious properties that are subject to higher transaction tax rates are excluded from our sample, we believe that the true amount of tax avoidance could be even higher.

Clearly, there are many possibilities for future research. First, we can extend the analysis to other sampling periods and countries. Second, future studies could also consider how banks, which have much at stake in the housing market, would react to such tax-driven distortions. Third, future research may also extend to the discussion of optimal tax design.[22] In some of the theoretical literature, it is often assumed that the price of wealth or capital (relative to the consumption of goods) is constant over time. In practice, a significant amount of inheritance could come in the form of real estate, or antiques. Their prices are endogenously determined in the market and can significantly change over business cycles. Our results here further suggest that *agents would have incentive to misreport or even underprice their assets*. How would that affect the asset market at equilibrium? What would be the optimal tax, given these "distortions"? We expect that future research will provide more satisfactory answers.

[21] Note that "stabilization" of the asset markets might be welfare-improving if agents are not completely rational. The literature is too large to be reviewed here. Among others, see Leung and Tsang (2013a, b) and the reference therein.

[22] Clearly, it is beyond the scope of this paper to survey that literature. Among others, see Kocherlakota (2010) for a review.

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Appendix

Tables A1-a and A1-b will reproduce the details on the SD imposed on a property transaction. Figures 1a and 1b are plotted based on the information.

Figures A-1 to A-6 show the graphs of the actual number of transactions versus the counterfactual at different cutout points during different periods of time.

Table A1-a First Change in SD Schedule

Apr 1, 1996 - Mar 31, 1997

Amount or value of the consideration		Rate
Exceeds	Does not exceed	
	$750,000	$100
$750,000	$809,730	$100 + 10% of excess over $750,000
$809,730	$1,500,000	0.75%
$1,500,000	$1,632,350	$11,250 + 10% of excess over $1,500,000
$1,632,350	$2,500,000	1.50%
$2,500,000	$2,656,250	$37500 + 10% of excess over $2,500,000
$2,656,250	$3,500,000	2.00%
$3,500,000	$3,862,080	$70,000 + 10% of excess over $3,500,000
$3,862,080		2.75%

Apr 1, 1997 - Mar 31, 1999

Amount or value of the consideration		Rate
Exceeds	Does not exceed	
	$1,000,000	$100
$1,000,000	$1,080,010	$100 + 10% of excess over $2,000,000
$1,080,010	$2,000,000	0.75%
$2,000,000	$2,176,480	$15,000 + 10% of excess over $2,000,000
$2,176,480	$3,000,000	1.50%
$3,000,000	$3,187,520	$45,000 + 10% of excess over $3,000,000
$3,290,320	$4,000,000	2.00%
$4,000,000	$4,413,830	$80,000 + 10% of excess over $4,000,000
$4,413,830		2.75%

Note: The tables are reproduced from the Hong Kong Government website at http://www.gov.hk/en/residents/taxes/stamp/stamp_duty_rates.htm

Table A1-b Second Change in SD Schedule

Apr 1, 1999 – Feb 28 2007 (10:59 am)

Amount or value of the consideration		Rate
Exceeds	Does not exceed	
	$1,000,000	$100
$1,000,000	$1,080,000	$100 + 10% of excess over $1,000,000
$1,080,000	$2,000,000	0.75%
$2,000,000	$2,176,470	$15,000 + 10% of excess over $2,000,000
$2,176,470	$3,000,000	1.50%
$3,000,000	$3,290,320	$45,000 + 10% of excess over $3,000,000
$3,290,320	$4,000,000	2.25%
$4,000,000	$4,428,570	$90,000 + 10% of excess over $4,000,000
$4,428,570	$6,000,000	3%
$6,000,000	$6,720,000	$180,000 + 10% of excess over $6,000,000
$6,720,000		3.75%

Feb 28, 2007 - Mar 31, 2010

Amount or value of the consideration		Rate
Exceeds	Does not exceed	
	$2,000,000	$100
$2,000,000	$2,351,760	$100 + 10% of excess over $2,000,000
$2,351,760	$3,000,000	1.50%
$3,000,000	$3,290,320	$45,000 + 10% of excess over $3,000,000
$3,290,320	$4,000,000	2.25%
$4,000,000	$4,428,570	$90,000 + 10% of excess over $4,000,000
$4,428,570	$6,000,000	3%
$6,000,000	$6,720,000	$180,000 + 10% of excess over $6,000,000
$6,720,000		3.75%

Note: The tables are reproduced from the Hong Kong Government website at http://www.gov.hk/en/residents/taxes/stamp/stamp_duty_rates.htm

Figure A-1 Bunching Around $0.75 Million and $1.5 Million from Apr 1996 to Mar 1997

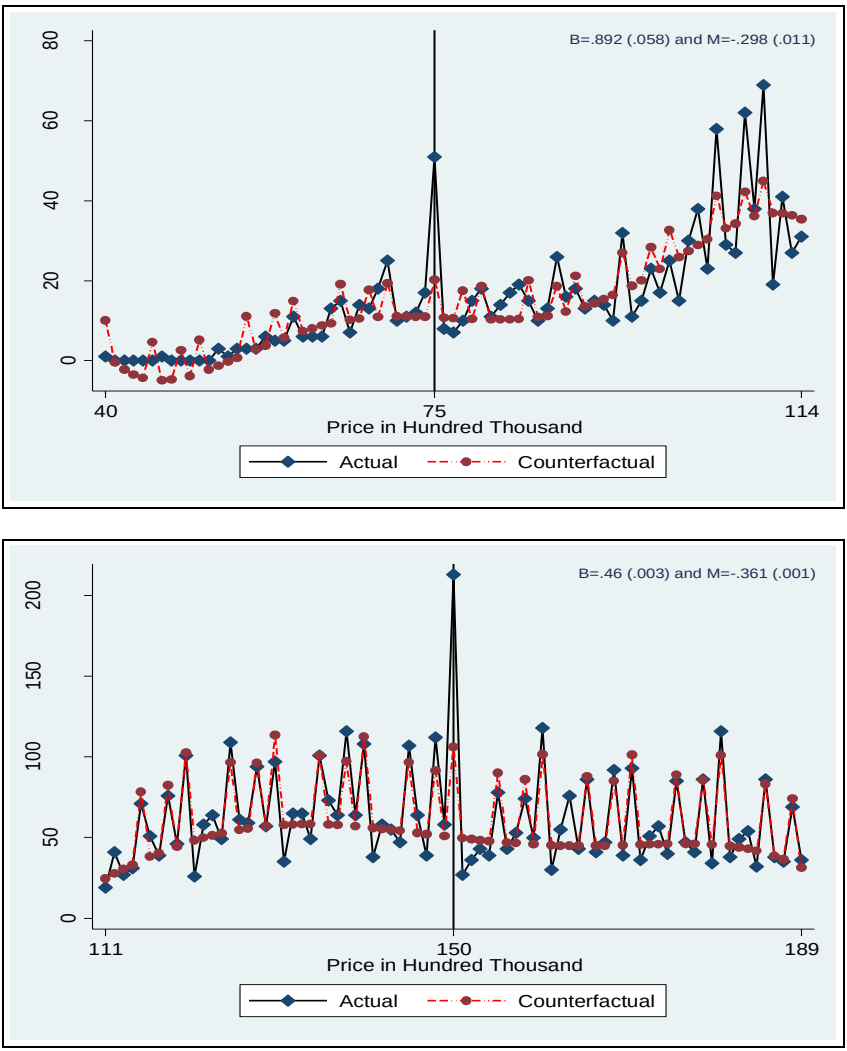
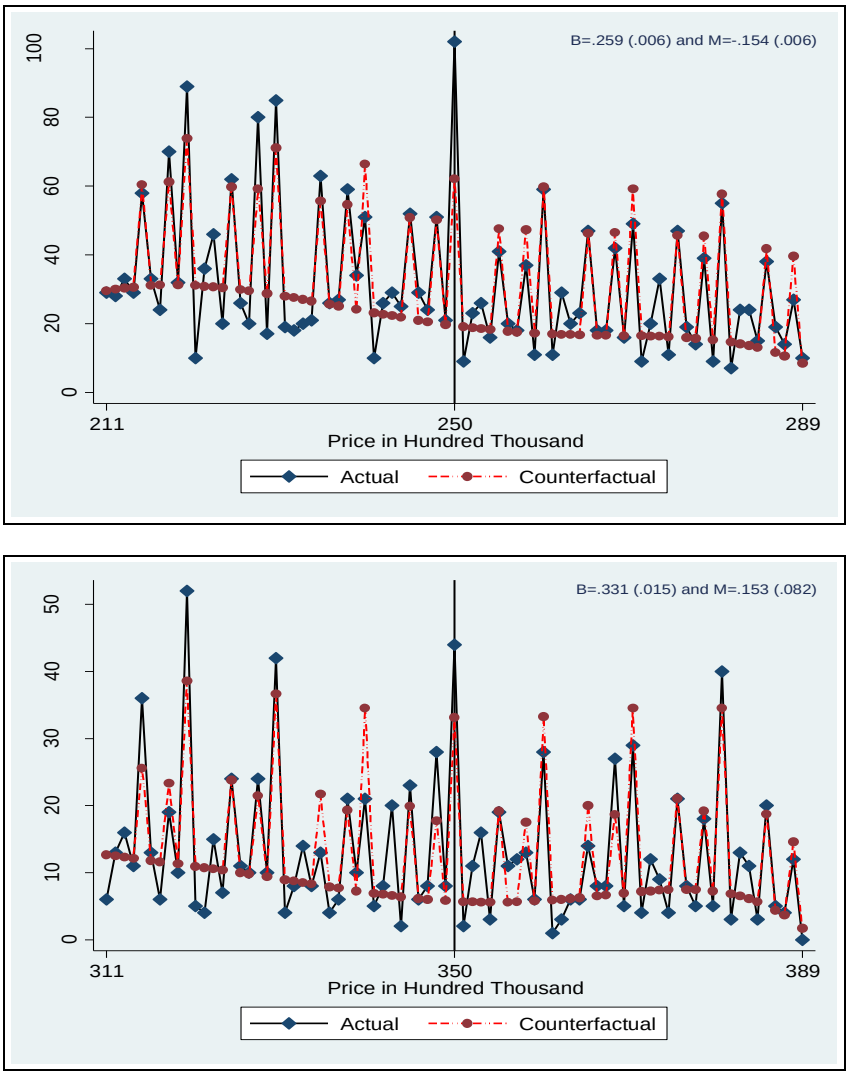


Figure A-2 Bunching Around $2.5 Million and $3.5 Million from Apr 1996 to Mar 1997



Note: The number of transactions for each price bin are fitted as a flexible polynomial. The red line is the fitted polynomial without fixed effects near the cutoff price. The blue line is the actual distribution of transactions. *B* and *M* are measures of the amount of bunching and missing information near the cutoff price. Please refer to Section 4 for details.

Figure A-3 Bunching Around $1 Million and $2 Million from Apr 1997 to Feb 2007

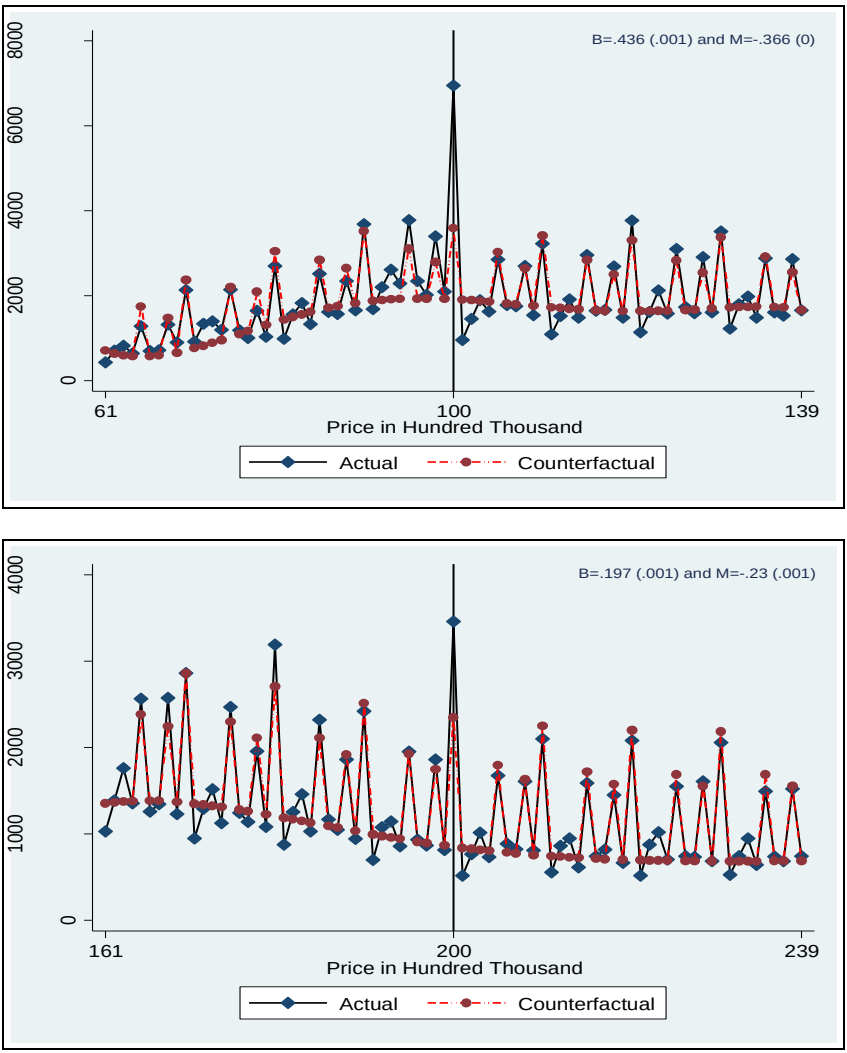
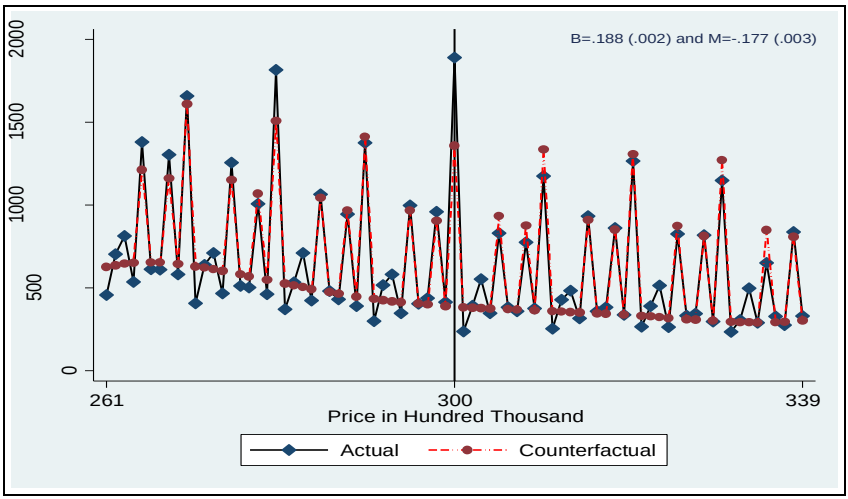
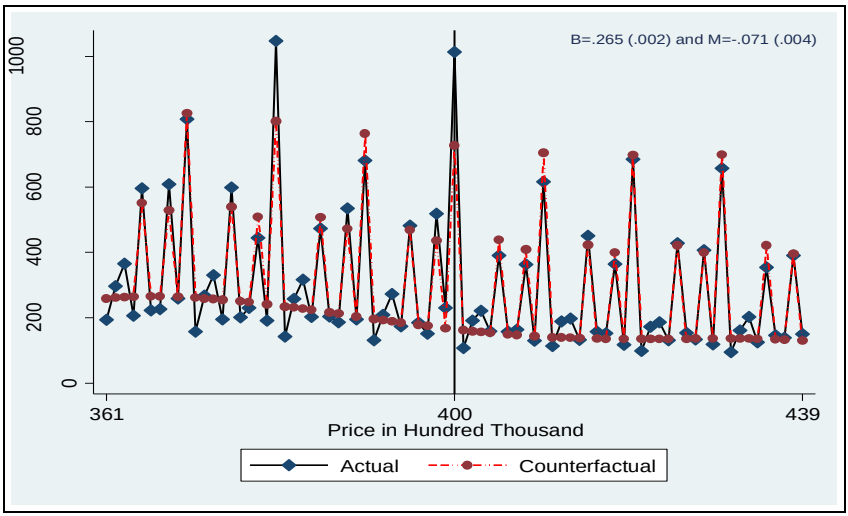


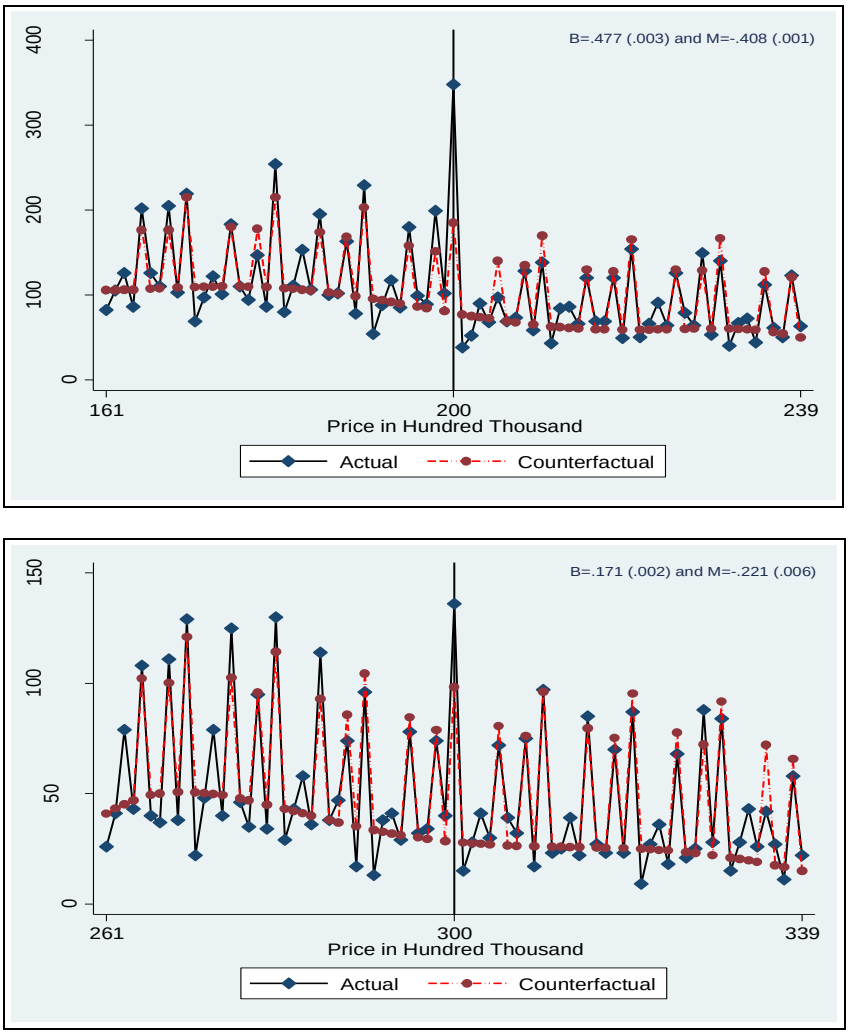
Figure A-4 Bunching Around $3 Million and $4 Million from Apr 1997 to Feb 2007





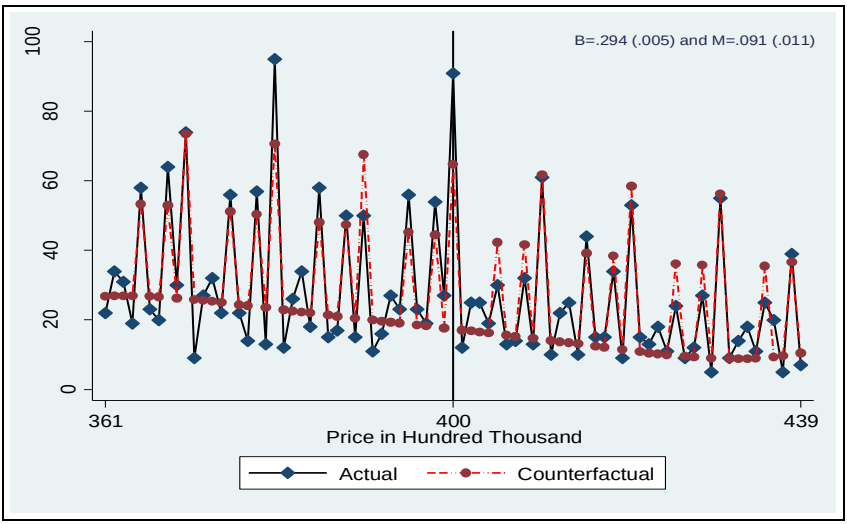
Note: The number of transactions for each price bin are fitted as a flexible polynomial. The red line is the fitted polynomial without fixed effects near the cutoff price. The blue line is the actual distribution of transactions. B and M are measures of the amount of bunching and missing information near the cutoff price. Please refer to Section 4 for details.

Figure A-5 Bunching Around $2 Million and $3 Million from Mar 2007 to Dec 2007



Note: The number of transactions for each price bin are fitted as a flexible polynomial. The red line is the fitted polynomial without fixed effects near the cutoff price. The blue line is the actual distribution of transactions. B and M are measures of the amount of bunching and missing information near the cutoff price. Please refer to Section 4 for details.

Figure A-6 Bunching Around $4 Million from Mar 2007 to Dec 2007



Note: The number of transactions for each price bin are fitted as a flexible polynomial. The red line is the fitted polynomial without fixed effects near the cutoff price. The blue line is the actual distribution of transactions. B and M are measures of the amount of bunching and missing information near the cutoff price. Please refer to Section 4 for details.