Housing Wealth and Consumption Growth: Evidence from a Large Panel of Households

Jie Gan*
Hong Kong University of Science and Technology

*Address: Department of Finance, School of Business and Management, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong. Email: jgan@ust.hk; Tel: 852 2358 7665; Fax: 852 2358 1749.

I thank David Cook, Mike Lemmon, David Robinson, Jeremy Stein, Sheridan Titman, Neng Wang, Mungo Wilson, Wei Xiong, and seminar participants at University of California at Berkeley, University of Texas at Austin, and Hong Kong University of Science and Technology, for helpful comments. Special thanks go to Sudipto Dasgupta for providing constant help and encouragement throughout the project. I am grateful to Eva Siu and Reed Louey for extensive discussions on bank mortgage lending practices and the property market in Hong Kong. I thank Wen Chau and Harry Leung for their able research assistance and Virginia Unkefer for excellent editorial assistance. The financial support from a Hong Kong RGC Research Grant is gratefully acknowledged.

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Abstract

This paper uses a large panel dataset that tracks the housing wealth and spending behavior of 12,793 individuals in Hong Kong to study how housing wealth affects household consumption. Housing wealth is based on the repeated-sales price indices of nine districts in Hong Kong, which are estimated using the government's registry of repeated housing transactions. Consumption is measured by credit card charges provided by the five largest credit card issuers in Hong Kong. These detailed data make it possible to identify consumption responses to housing wealth based on *time-series* variation *within* individual households (through household fixed effects). Further, rich variation across households helps to pin down the mechanism of the observed consumption sensitivity.

I document a significant effect of housing wealth on consumption. A pure wealth effect can explain part of the sensitivity, since households with multiple houses tend to have much stronger consumption responses. Moreover, consistent with the relaxation of credit constraints, households who refinance have significantly greater consumption sensitivities. However, for the majority of the households who do not refinance, the observed consumption sensitivity appears to be on account of a reduction in precautionary savings: (1) consumption sensitivity exists even in the absence of refinancing and occurs only among less leveraged households; (2) consumption responds only to unpredictable changes in housing wealth but not to predictable changes; (3) consumption responses are stronger among younger households who behave more like buffer stock savers than other age groups; (4) discretionary consumption (e.g., dining out and entertainment) responds more strongly to housing returns. Overall, the findings suggest that, even in the absence of refinancing and relaxation of credit constraints, housing wealth can have a substantial impact on consumption growth.

JEL Classification: E21; G21
Key Words: Housing wealth, Consumption, Liquidity constraints, Precautionary saving, Credit cards, Life cycle.

"… Among the factors contributing to the strength of spending and the decline in saving have been developments in housing markets and home finance that have spurred rising household wealth and allowed greater access to that wealth. …gains in net worth help to explain why households in the aggregate do not appear uncomfortable with their financial position even though their reported personal savings rate is negligible."

--Testimony of Chairman Alan Greenspan
Before the U.S. Senate, February 16, 2005

"…The slowing of the housing market may restrain … household spending.… With homeowners no longer experiencing increases in the equity value of their homes at the rapid pace seen in the past few years … increases in household net worth are likely to provide less of a boost to consumer expenditures than they have in the recent past.

--Testimony of Chairman Ben Bernanke
Before the U.S. Senate, July 19, 2006

Introduction

Housing is a dominant source of private wealth in many countries around the world. Housing markets, however, are volatile with large swings in prices. This has raised increasing concerns among both academics and policy makers about the economic consequences of housing price movements. One particular worry in the U.S., for example, is that with the current slow-down in the housing market, consumers cannot continue to borrow against their home value to fuel consumption, which could result in a larger-than-expected economic contraction.

Despite its importance, the relationship between household consumption and housing wealth is not fully understood. The theoretical literature provides only limited guidance on how consumption responds to shocks in housing wealth. A simple formulation of the life-cycle / permanent-income hypothesis (PIH) suggests that the propensity to consume out of all wealth, including real estate, is the annuity value of wealth changes, which suggests a small effect of housing wealth on consumption (Case, Quigley, and Shiller, 2001). On the other hand, theoretical departure from the basic PIH, motivated by its empirical failing at both macro and micro levels,

provides at least two reasons why housing wealth may have a significant impact on consumption. One is the liquidity constraint: increases in housing wealth relax borrowing constraints, resulting in a positive consumption response to housing wealth (Campbell and Cocco, 2006). The other is the precautionary saving motive (e.g. Carroll, 1992; Gourinchas and Parker, 2001, 2002): a higher housing value reduces the need for precautionary saving and thus increases consumption. [1] Both channels of consumption responses are emphasized in Greenspan's testimony quoted above. While they are not mutually exclusive, they have different implications for the *magnitude* of the economic influence of a housing downturn: the liquidity constraint effect is likely to be limited to those who refinance their mortgages whereas the precautionary saving effect can potentially affect *all* households.

On the empirical front, how housing wealth might affect consumption has not been fully examined, primarily due to a lack of data at the household level. The objective of this paper is to use micro data to identify the effect of housing wealth on consumption and, based on a rich set of household characteristics, to examine the mechanism that drives this effect. In particular, I use a large panel dataset that simultaneously tracks the housing wealth and credit card spending of 12,793 individuals. This detailed dataset makes it possible to address some important empirical challenges to identification. First, exploiting a transaction database containing all the 1.5 million housing transactions between 1992 and 2004, I track individual housing wealth over time for nine districts in Hong Kong. Compared to metropolitan-level housing returns used in some previous studies, district-wide housing returns in the *same* metropolitan area are not only a more accurate measure of housing wealth, but they also avoid the endogeneity problem due to metropolitan-level

[1] Bhatia (1972) first points out that, with accrued capital gains, savings in other forms can be reduced and consumption increases as a result.

economic shocks simultaneously affecting both housing prices and consumption.[2] Second, I rely on *time-series* variation *within* individual households to identify the empirical models (through household fixed effects). This ensures that the estimates do not simply pick up unobserved household characteristics, which have been shown to be important concerns (e.g., Deaton, 1992 and Skinner 1989). Finally, I track consumption growth through households' credit card charges provided by five large credit card issuers in Hong Kong, which is arguably a more accurate measure of consumption than is food consumption or its implied total consumption as used in some previous micro studies.

The data also contain a rich set of household characteristics that helps to pin down the mechanism that drives the relationship between housing wealth and consumption. This is not only important in its own right but also further mitigates the endogeneity problem discussed earlier. In particular, some households own more than one house, which allows me to identify the existence of a "pure" wealth effect. Further, some households face more binding liquidity constraints than others, e.g., they are close to their credit limit, or they cannot pay their credit card bills in full, or they may have high housing leverage (i.e., high loan-to-value ratio, or low mortgage affordability defined as outstanding mortgage over annual income). Such variation facilitates a test that distinguishes between the role of liquidity constraints and precautionary saving, two possible explanations for observed consumption responses. The usual story about liquidity constraints is that a rise in housing wealth relaxes borrowing constraints, resulting in increased consumption and that such an effect should be more pronounced in *more* constrained households. However, unless one sells one's house, housing wealth can relax liquidity constraints only through

[2] Unlike some of the metropolitan areas in the U.S. where isolated district-wise shocks may be possible, Hong Kong is a well integrated metropolitan area across different districts. A highly efficient subway system connects most parts of Hong Kong within one hour. Indeed, it is very common for people to work in one district and live in another district, commuting to work by public transportation. In the robustness checks presented later, I provide some additional evidence on this point.

refinancing, which is costly and occurs infrequently (Bennet, Peach, and Peristiani, 1998).[3] Thus, while a stronger consumption response among households who refinance is evidence of credit constraint, a significant consumption response in the absence of refinancing is more consistent with a reduction of precautionary saving. Moreover, since highly leveraged households are not likely to have enough precautionary savings, i.e., they already save less than desired, when increased housing wealth reduces the need for precautionary saving, these households are not likely to increase consumption. In other words, a reduction in precautionary saving should cause stronger consumption responses only in *less* constrained households, opposite to the prediction by the credit constraint hypothesis.

A second test that can distinguish between liquidity constraint and precautionary saving is to examine consumption responses to predictable vs. unpredictable housing returns. It is well known that housing returns are predictable (Case and Shiller, 1995 and Poterba, Weil, and Shiller, 1991). If a relaxation of liquidity constraint drives the observed consumption sensitivity, then consumption should respond to the predictable component of housing returns, because only when predictable returns are realized can housing be used as collateral for additional borrowing and thus consumption.[4] However, a reduction in precautionary saving would predict the opposite, to the extent that the predicable change in housing wealth is likely to have already been factored into household consumption/saving plans.

Finally, additional tests on how consumption responds to housing wealth across household age groups, as well as how discretionary spending (such as dinning-out and entertainment)

[3] Bennet, Peach, and Peristiani (1998) estimate that in the U.S. the fixed closing cost alone is 1.5 to 2.5 percent of the household's initial mortgage balance. Additional costs include the costs of searching for a lender, filling out applications, preparing documentation, paying prepayment penalties, and can significantly increase the actual cost of refinancing. The procedure and cost of refinancing has been similar in Hong Kong and in recent years seem to have become lower due to heightened bank competition.

[4] This is a common argument in the consumption literature, which interprets "excess" consumption sensitivity to predictable income shocks as evidence of liquidity constraint.

responds to housing returns, provide further evidence on workings of the housing wealth effect. Specifically, if observed consumption sensitivities are due to a reduction in precautionary saving, then consumption responses should be stronger in relatively younger households who behave more like "buffer stock" savers than do other age groups (Gourinchas and Parker, 2002) and for discretionary spending (e.g., entertainment) as opposed to non-discretionary spending.

I present two sets of results. First, I document a significant effect of housing wealth on consumption. For every 10% change in housing wealth, consumption responds by 1.7%, an economically significant magnitude. Second, I document *how* housing wealth influences consumption. In particular, there exists a "pure" wealth effect in that the consumption-housing wealth sensitivity is much larger among households with more than one house. I also find relaxation of credit constraints plays a significant role in that those households who refinance exhibit significantly larger consumption sensitivity to housing returns. However, the relaxation of credit constraint does not explain the observed consumption responses of the majority of households who do not refinance. For these households, consumption sensitivity seems to be on account of a reduction in precautionary saving: (1) there is significant consumption sensitivity even in the absence of refinancing and such sensitivity is significant only among *less* leveraged households whose borrowing constraints are not binding; (2) consumption responds only to unpredictable housing returns, but not to predictable housing returns; (3) the consumption sensitivity mainly occurs among relatively younger households who have been shown to behave more like "buffer stock" consumers (Gourinchas and Parker, 2002); (4) consumption responses are stronger for discretionary spending (e.g., dining out and entertainment). These findings highlight the importance of precautionary saving in driving consumption responses to housing wealth and suggest that, even in the absence of refinancing and relaxation of credit constraints, housing wealth can have a substantial impact on consumption growth.

This study is related to a growing literature on the consequences of asset market "bubbles" (or large price movements). This literature has identified two channels through which large swings in asset prices may be transmitted into the real economy. One is a collateral channel: the bursting of asset market bubbles is likely to impair collateral values and thus diminish firms' ability to finance investment projects (Bernanke and Gertler 1989, 1990; Gan, 2006a). The other is a lending channel: the bursting of asset market bubbles impairs the financial condition of banks, since they have significant exposure to asset markets either through their real estate lending or through their direct holdings of equity and land (Bernanke, 1983; Bernanke and Gertler, 1995; Gan, 2006b). The results of this paper shed light on an additional impact of asset market bubbles; that is, the bursting of a housing bubble may amplify a downturn through its negative effects on household consumption. The results also confirm that monetary policy, to the extent that it may burst the bubble in the housing market, can have an amplifying impact on economic growth through its influence on consumer spending.

The paper proceeds as follows. The next section lays out my empirical design. Section 2 presents the empirical analysis. In Section 3, I discuss the generality of the findings. Section 4 presents a conclusion.

1. Empirical Design

1.1 Empirical Challenges in Previous Studies

Despite a strong interest in the empirical relationship between housing wealth and consumption, the theoretical literature provides only limited guidance on how consumption may respond to shocks in housing wealth. A simple formulation of the life-cycle / permanent-income hypothesis suggests that the marginal propensity to consume out of all wealth, whether from (lifetime) labor income, stocks, or real estate, is the annuity value of wealth changes, which

should be a small number (Case, Quigley, and Shiller, 2001). The case of real estate wealth, however, is complicated because housing is not only a form of wealth but also a consumption good that can be consumed either by renting or owning. A full-fledged theory thus requires modeling of housing consumption and tenure decisions with uncertain housing returns, which to my knowledge has not been worked out.[5]

Theoretical departures from the basic permanent income hypothesis, motivated by the empirical failings of PIH at both the macro and micro levels, suggest several reasons why housing wealth may influence consumption choices. The first is the liquidity constraint in the sense that households cannot borrow as much as they wish to smooth consumption (e.g., Deaton, 1991). Since housing can be used as collateral for loans, increases in housing wealth relax borrowing constraints, resulting in higher consumption (Campbell and Cocco, 2006). Second, households may have a precautionary saving motive (e.g., Carroll, 1992) and hold a precautionary buffer in liquid assets. A higher housing price reduces the need for buffer stock and increases consumption.

A few other factors, however, suggest that housing appreciation may not have a significant impact on consumption. As Sinai and Souleles (2003) point out, owning a house is a hedge against future rental increases. Thus, as long as one continues to live in the house, an increase in housing prices does not have any *real* wealth effect and thus should not affect household consumption. Moreover, if current home owners have bequest motives and bequeath the housing gain to help their children to afford more expensive houses, housing value appreciation would have little impact on their consumption.

Empirically, the effect of housing wealth on consumption has not been widely explored and the results are far from conclusive. At the aggregate level, an early study by Elliot (1980)

[5] Li and Yao (2006) take a step towards this direction. They explicitly model housing as both consumption and investment goods. However, in their model housing returns are exogenous.

found that variations in non-financial wealth, such as real estate, have no effect on consumption. Using alternative measures of real estate wealth, however, Peek (1983) and Bhatia (1987) reported a significant effect on consumption and savings. Case, Quigley, and Shiller (2001) also found evidence of a significant consumption effect in a panel of 14 countries and U.S. states. More recently, Carroll, Otsuka and Slacalek (2006) incorporate habits into estimation of wealth effect and find differential short-run and long-run housing wealth effects. The interpretation of these results, however, is complicated by the fact that historical housing returns are often associated with macroeconomic changes, e.g., rapid economic growth and / or financial liberalization, which leads to increases in disposable income and / or consumer credit.

At the micro level, the results are also mixed. Skinner (1989) finds a small impact of housing wealth on consumption but this result was not robust to the inclusion of household fixed effects. In contrast, using data from the U.K., Campbell and Cocco (2005) report an economically and statistically significant effect of housing wealth on consumption, especially among older homeowners. Instead of examining consumption spending directly, some researchers studied the relationship between housing gains and saving behavior. Engelhardt (1996) reports a significant negative effect of housing gains on household savings; such an effect, however, is mainly driven by households that experience losses in housing value. Hoynes and McFadden (1997) find that household saving rates do not respond to expectations about capital gains in housing.

The inconsistencies in the findings of these micro-level studies are at least partially due to limitations in data, which poses three main challenges to identification. First, there is not a good measure of consumption. The U.S. studies have relied on household data provided by the Panel Study of Income Dynamics (PSID), which does not record data directly on savings or consumption. Rather, it only reports food consumption, which potentially leads to mismeasurement of savings or consumption.

The second difficulty is related to the measurement of housing wealth. For example, PSID provides only self-reported housing values. While households may base their consumption decisions on their perceived housing returns, the use of self-reported home values potentially leads to a spurious relationship between housing wealth and consumption in the cases where households trade up to larger houses, since these households are likely to also consume more. In some other studies, price indices are available only at the level of metropolitan statistical areas (MSAs). Thus observed consumption sensitivities may be driven by MSA-wide shocks that simultaneously affect housing prices and consumption.

Finally, only short panel data was used in most of the previous studies, which means that the time-series variation that would ideally identify the empirical models has to be replaced by cross-sectional variation. This is an important concern. As Deaton (1992) points out, at least in the U.S. consumption data, cross-sectional averages can vary randomly from time-series averages. In the context of housing wealth, Skinner (1989) also reports qualitative changes in estimates when household fixed effects are added, suggesting the importance of controlling for unobserved individual household characteristics, which can be done only with high-quality panel data.

These limitations in micro data have motivated researchers to explore other possibilities. In particular, Campbell and Cocco (2005) use the UK Family Expenditure survey, which is a time series of independent cross-sections, and constructed synthetic cohorts following the method introduced by Browning, Deaton, and Irish (1985) and Deaton (1985). While this approach mitigates the measurement problem as well as the impact of unobserved individual characteristics, it lacks richness in cross-household variations, which, as I show later, is important in distinguishing among alternative explanations of housing wealth effects.

In sum, there is not yet any well-established theoretical model that can fully describe the relationship between consumption and housing wealth. Empirically, there are several hurdles that

hinder inferences from the observed consumption-housing wealth relationship (or a lack of it). Most importantly, none of the previous empirical studies fully examines the mechanism through which housing wealth affects consumption. Therefore, in this paper, my empirical focus is not on testing one theory against another. Rather, I rely on a very detailed and large panel dataset to deal with the empirical difficulties in identification and focus on documenting robust empirical facts as related to the role of various possible explanations of observed consumption-housing wealth sensitivities.

1.2 Identification Strategy and Hypothesis Development

My identification strategy consists of two parts, both afforded by the richness in the data. First, I explicitly address the three main challenges to identification as discussed earlier, which allows me to answer the question of *whether* housing wealth affects consumption growth. Second, I exploit rich variations across individual households to examine the relative importance of various factors that might drive observed sensitivity, which allows me to answer the question of *how* housing wealth affects consumption growth.

I deal with the three empirical difficulties in identifying consumption responses to housing wealth as follows. First, I track individual housing wealth over time based on the repeated sales price indices for nine districts in Hong Kong. The main source of variation in housing wealth is the nine districts within the *same* MSA area of Hong Kong, which precludes the possibility that the results are driven by MSA-level shocks simultaneously affecting housing prices and consumption. Second, I rely on the *time series* variation *within* individual households to identify the consumption model. Specifically, I include household fixed effects in all estimation, which ensures that my estimates do not pick up biases introduced by unobserved individual household characteristics. Finally, I measure consumption growth using credit card charges, whereas

household-specific preferences in credit card use (as opposed to cash or other means of payment) are controlled for by the household fixed effects. This is arguably a more accurate estimate of household spending, as compared to only food consumption or the implied total consumption used in the previous micro studies, which requires the assumption of constant elasticity of food consumption across households.

It is worth noting that while my identification strategy completely controls for time-invariant household heterogeneity, there are still certain time-varying household-specific characteristics for which I do not have full information. One such variable is income. I only have data on personal income at the time of mortgage application, but not on individual income over time. However, I have detailed information on occupation, with as many as 30 subcategories, from the mortgage application data. To the extent that the variation in income is determined by initial income and occupation-specific growth in income, income over time could be controlled for by a combination of individual fixed effects and interactions between the occupation and (quarterly) time dummies.

Since there has not been any well-established theory that explicitly includes uncertain housing returns in a standard consumption model, it is difficult to specify a structured consumption equation. Moreover, as recently pointed out by Carroll (2001), the structured Euler equation estimation cannot successfully uncover structured parameters with micro data. Therefore, I follow the specification in Campbell and Cocco (2006) and estimate a reduced model as below:

$$\Delta c_{i,t} = a + b\ \Delta \mathrm{p}_{i,t-1} + \sum_{i} \text{Household fixed effects}_{i} + \sum_{t} \text{Quarter fixed effects}_{t} + \sum_{k}\sum_{t} \text{Occupation}_{\mathrm{k}} * \text{Quarter}_{\mathrm{t}} + \varepsilon_{i,t}, \tag{1}$$

where i indexes households and t indexes time periods. $\Delta c_{i,t} = \log(C_{i,t}) - \log(C_{i,t-1})$ and $\Delta p_{i,t} = \log(P_{i,t}) - \log(P_{i,t-1})$, which are real consumption growth and housing wealth growth, respectively, for household i at time t. The individual household fixed effects control for time-invariant individual characteristics, such as household-specific preferences for credit card usage (as opposed to other means of payment), race, and immigration status. The time (quarter) fixed effects ensure that I do not pick up the effect of aggregate shocks to both consumption and housing returns (e.g., changes in interest rates, unemployment, GDP growth, etc.). $Occupation_k$* $Quarter_t$ is the interaction between the occupation dummies and quarter dummies, which, combined with individual household fixed effects, controls for time-varying growth in income. The main coefficient of interest is b, which is the estimated consumption response to housing wealth.

The second part of my identification is to exploit rich variations across individual households to test the predictions of various theories in driving the observed consumption sensitivity (or a lack of it). I first examine the "pure" wealth effect. One argument against a pure housing wealth effect (i.e., an effect due to changes in total life-time resources) is that housing is a hedge again future rental increases and as long as one lives in the house, there should not be any real impact on wealth. This argument suggests that the wealth effect should be stronger if a person owns two houses, since he/she could cash in on the wealth gain of one house, leaving the other house for hedging purposes. Hence, we have the following hypothesis:

Hypothesis 1. *If there is a pure wealth effect, the consumption responses to housing wealth should be stronger among households who own multiple houses.*

I then distinguish between the role of credit constraints and that of precautionary savings, both of which have been shown to affect household consumption. It is usually difficult to distinguish between these two because they have similar implications on the Euler Equation: both lead to steeper consumption profiles. The housing market, however, provides a unique setting to separate their effects. The usual liquidity story is that a rise in housing wealth relaxes borrowing constraints, resulting in increased consumption, and that this effect should be stronger in *more* constrained households. However, housing wealth relaxes liquidity constraints only through refinancing, which is costly and occurs infrequently. Thus, credit constraint predicts a greater consumption-housing wealth sensitivity for households who actually refinance, whereas a significant consumption response among households who did not refinance is more consistent with a reduction of precautionary saving. More importantly, I identify households whose credit constraints are likely to be binding, based on credit card borrowing (i.e., how close a household is to its credit limit and whether it pays its credit card bills in full) and on housing leverage (the loan-to-value ratio and mortgage affordability defined as the outstanding mortgage over annual household income). These highly leveraged households are not likely to have enough precautionary saving, i.e., they already have saved less than desired. Thus, when housing wealth increases and the need for precautionary saving is reduced, they are not likely to consume more since they already save less than desired. In other words, precautionary saving predicts that consumption responses should mainly occur in *less* constrained households. Therefore, we test the following two hypotheses:

Hypothesis 2.

(2a) Credit constraint: To the extent that a relaxation of credit constraint drives the observed consumption-housing wealth sensitivity, consumption responses should be stronger among households who refinance.

(2b) Precautionary saving: If a reduction in precautionary saving drives the consumption-housing wealth sensitivity, there should be significant consumption responses even among households who do not refinance.

Hypothesis 3.

(3a) Credit constraint: To the extent that a relaxation of credit constraint drives the observed consumption-housing wealth sensitivity, consumption responses should be stronger among more leveraged households.

(3b) Precautionary saving: If a reduction of precautionary saving drives the consumption-housing wealth sensitivity, consumption responses should be stronger among less leveraged households.

A second test that can distinguish between liquidity constraint and precautionary saving is to look at consumption responses to predictable vs. unpredictable housing returns. It is well known that housing returns are predictable (Case and Shiller, 1995 and Poterba, Weil, and Shiller, 1991). A relaxation of liquidity constraint implies that consumption should respond to the predictable component of housing returns, because only when predictable returns are realized can housing be used as collateral for additional borrowing and thus consumption. However, a reduction in precautionary saving would predict the opposite, to the extent that the predicable change in housing value has already been factored into household consumption/saving plans.[6] Hence we have the following hypothesis:

Hypothesis 4.

(4a) Credit constraint: If a relaxation of credit constraint drives the observed consumption-housing wealth sensitivity, consumption should respond to both predictable and unpredictable components of housing returns.

[6] It should be noted that insensitivity of consumption to predictable housing returns is also consistent with PIH. However, PIH does not predict the earlier results that consumption sensitivity varies with household leverage and age profiles or my later findings that consumption sensitivity to unpredictable housing return exists only among households with low leverage. Thus, I mainly use this test to distinguish between liquidity constraint and precautionary saving.

(4b) Precautionary saving: If a reduction of precautionary saving drives the consumption sensitivity, consumption should only respond to unpredictable component of housing returns.

Finally, I examine how consumption responds to housing wealth across household age groups, as well as how housing wealth affect discretionary spending (such as dinning-out and entertainment). Specifically, if a reduction in precautionary saving drives the observed consumption sensitivities, then consumption responses should be stronger in relatively younger households who have been shown to behave more like "buffer stock" savers than other age groups (Gourinchas and Parker, 2002). Additionally, when people feel less need to save, they might increase their discretionary spending, such as on vacations and dining out. Then discretionary consumption should be more sensitive to housing wealth. I thus further test the following two predictions of precautionary saving:

Hypothesis 5. If a reduction of precautionary saving drives the observed consumption-housing wealth sensitivity, consumption should be stronger among younger household who act more like "buffer stock" savers than other age groups.

Hypothesis 6. If a reduction of precautionary saving drives the consumption-housing wealth sensitivity, discretionary spending (e.g., entertainment) should respond more to changes in housing wealth than should non-discretionary spending.

1.3 Data and Key Empirical Measures

There are three main sources of data. The first is a proprietary dataset of mortgage applications from a large bank in Hong Kong from 1988 to 2004, including mortgage amount, house value, mortgage interest rates, individual characteristics of the applicant (most of which were manually verified by the bank), such as age, occupation, and marital status. It also contains

individual identification codes[7] and property addresses. The latter allows me to link the mortgage data to the second main data source, namely the government registry of housing transactions and mortgage loans. This dataset is obtained through EPRC, a commercial real estate information company in Hong Kong. It contains all the 1.5 million housing transactions and 2.1 million mortgage loan originations during 1992-2004. Housing transaction records not only allow me to track whether an individual subsequently sells the property, but they also allow me to construct disaggregated housing price indices in different districts in Hong Kong, which is subsequently used in calculating housing wealth over time for each individual (the method is described in the next section). Mortgage origination records allow me to identify those individuals who refinance their houses.

The third main source of data is a proprietary credit card dataset containing monthly credit card statements from five of the largest issuers in Hong Kong during 2000-2002. These issuers have a combined market share of 75%. This dataset contains information on monthly spending, finance charges, total balances, and repayments, as well as credit limits. By linking credit card data with mortgage application data based on the individual identification codes, I obtain a panel dataset of household consumption, housing wealth, and household characteristics (at the time of mortgage applications) for 12,369 homeowners over 12 quarters during 2000-2002.[8]

Since I construct the sample based on the mortgage borrowers of one bank, there is an issue of how representative the sample is. The bank has a large network of branch offices

[7] These individual identification codes are based on "scrambled" Hong Kong ID numbers provided by the bank – for obvious confidentiality reasons, the bank does not reveal the real Hong Kong IDs. In this research, these scrambled IDs are used to link the mortgage data with the credit card data (described in detail later) in which the ID numbers are scrambled in the same way.

[8] While buying a house is a family event for married couples, the mortgage application only records the primary applicant's identification code, which is used to link to the credit card data. Since many couples get supplementary cards for spouses, this would not introduce much noise in the consumption measure. However, if the couple has separate credit cards, consumption would be under-recorded. Consistent estimates thus require the under-recording to be random noise, or uncorrelated with household-specific housing returns.

throughout Hong Kong and represents about 8% of the market share of new loan origination across all districts and property types in Hong Kong. My conversations with the bank officials did not reveal any particular specialization in the bank's mortgage lending which may lead to a selected sample.

Measuring Consumption

I measure consumption using credit card spending. Credit cards are widely used in Hong Kong, one of the world's financial centers. In 2002, out of total consumer spending of US$90 billion, about 22% (US$20 billion) was paid for by credit cards, which is similar to the 20% that is reported in the U.S. (Chimerine, 1997). In Hong Kong, people use credit cards for food, clothing, entertainment, home appliances, and electronic products, etc., but not for housing, cars, and tuition (China Unionpay, 2005). Thus, credit card spending is a good proxy for non-durable consumption as commonly used in the literature, except for home appliances and some electronic products. Moreover, the five banks in my credit card sample have a combined market share of 75% in Hong Kong, which ensures that I am able to track total credit card spending closely. I aggregate monthly spending across all the credit cards (many people have multiple cards) and then within each quarter to form a quarterly consumption measure for each individual.

Admittedly, I do not observe consumption that is not paid for with credit cards. However, for the unobserved spending to systematically bias my findings, it has to be the case that households that prefer to use credit cards for purchases also happen to have greater housing returns. More importantly, as is discussed in more detail later, my identification strategy relies on within-household variations in consumption and housing returns through household fixed effects. This further mitigates the concern that household-specific preferences in credit card usage may drive the results.

Measuring Housing Wealth

Using the comprehensive transaction database from the Hong Kong government registry, I construct housing indices for each of the nine districts based on the repeated sales method first suggested by Case and Shiller (1987). Housing wealth for each individual household is then constructed by applying district-level price indices to the initial purchase price. District-wide housing returns within the *same* MSA have an important advantage. In the studies using data from U.S. or the U.K., since typically only MSA-level housing returns are available, the inference would be complicated by MSA-level shocks to both housing price and consumption. However, Hong Kong is a single integrated economy that spans nine residential districts. A highly efficient subway system connects most parts of the city within a one-hour ride. Many people live and work in two different districts, commuting to work by public transportation. Thus, it is not likely that district-wide shocks simultaneously drive local housing prices and consumption. Later, in the robustness checks, I provide further evidence on this point.

Repeated sales price indices use data on properties that have actually been sold more than once and thus more accurately control for the characteristics of properties than does an alternative hedonic approach. This method, however, is data intensive and requires a sufficient number of units to reappear. Hong Kong data are suitable for this purpose: out of the 1.5 million housing transactions during 1992-2004, close to 900,000 were repeated sales across all nine districts. The repeated sales price indices for each district are plotted in Figure 1. There are significant variations in housing returns across the nine regions in Hong Kong, which provides an important source of variation in identifying consumption responses to housing wealth.

Measuring Liquidity Constraint

The data provide a rich set of measures of liquidity constraints that households face. The first is housing leverage. I used two commonly used leverage variables in the literature: the loan-to-value (LTV) ratio, defined as the amount of mortgage loans over housing value, and mortgage affordability, defined as the amount of outstanding mortgage over annual household income. The correlation among these two variables are not high (0.27%) and thus they seem to capture different aspects of leverage.

I also construct leverage measures based on credit card records. One is how close the individual is to the credit limit. Gross and Souleles (2002) provide evidence that people near their credit limits face binding credit constraints. The other credit-card-based liquidity measure is whether or not the individual pays credit card advances in full. Given that credit card debt is an expensive source of credit, drawing upon this line of credit is an indication of being constrained. As shown in Table 1, in the sample, close to 5% of households reach the 75% of their credit limit, whereas about 20% of households do not pay their credit card bills in full.

2. Empirical Analysis

In this section, I conduct two sets of analyses. First, I examine *whether* there is any significant effect of housing wealth on consumption. Second, exploiting a rich set of household characteristics, I document the workings of such an effect.

The summary statistics of variables used in analysis are presented in Table 1. Notably, the sample period coincides with a period of deflation in Hong Kong. Thus, housing returns and consumption growth rates are generally negative.

2.1 Does Housing Wealth Affect Consumption?

Table 2 reports the baseline estimates of consumption responses to housing wealth. Column (1) includes the quarter dummies and individual household dummies. It shows a significant positive impact of housing wealth on consumption. The estimated consumption sensitivity is 0.171. In column (2), I further include in the estimation the interactions between the individual occupation dummy and the quarter dummy to control for occupation-related income shocks. The estimate is very similar to that in column (1). These estimates imply that for every 10% (marginal) change in housing wealth, consumption changes by 1.7% - a clearly substantial impact of the housing market on the level of economic activity.[9]

2.2 How Does Housing Wealth Affect Consumption?

2.2.1 Testing for a "pure" wealth effect

To test Hypothesis 1, I divide the sample into those with more than one house and those with only one house and re-estimate Equation (1). To identify those with multiple houses, I rely on the mortgage application data from the local bank, which means that I can classify an individual owning two houses only if both houses are purchased with mortgages from this local bank. Thus, I tend to under-estimate the number of families with multiple houses, which biases against finding significant differences between those with multiple houses and those without.

[9] Some studies report marginal propensity to consume (MPC), which is the estimated sensitivity multiplied by the consumption-to-housing-wealth ratio. The computed MPC, however, may not be comparable across time and country since the average consumption-to-housing-wealth ratio can vary significantly across time and country. In the Hong Kong data, with the average house value of HK$1.73 million (US$220K) and average annual credit card spending of HK$35.8K which on average is 22% of total spending, the consumption-to-housing-wealth ratio is 9.4%, implying a MPC of 1.6 cents out of one dollar. This relatively low MPC is due to the low consumption to housing wealth ratio – housing is expensive in Hong Kong. Thus, with expensive housing it does not take a large MPC in order for the housing market to have a substantial impact on the level of economic activity.

Consistent with a pure wealth effect, the point estimate of consumption sensitivity to housing wealth is much higher for those with more than one house (columns (3)-(4) of Table 2)[10]. To further test the statistical difference between the two estimates, I create a dummy variable indicating multiple houses and let it interact with housing returns. The interaction term is statistically significant at the 10% level (column (5) of Table 2).

2.2.2 The effect of refinancing and household leverage

I now test the relative importance of liquidity constraints and precautionary saving motives (Hypotheses 2 and 3). The government registry of mortgage originations records two types of mortgages as related to refinancing. One is refinancing with a new loan from another bank to replace the existing loan, which can be rate refinancing (to get a lower loan rate) or cashing-out refinancing. Both have consumption implications: rate refinancing through reduced monthly payments and cash-out refinancing through a one-time (bigger) cash awards. Anecdotal evidence suggests that in Hong Kong a majority of refinancing cases are for rate refinancing due to increased competition among banks (almost all mortgages are adjustable-rate mortgages).[11] The other type of refinancing is second mortgage on top of the existing (first) mortgage. In Hong Kong, first mortgages have a maximum loan-to-value ratio of 70% and a "second mortgage" can reach a maximum of 90% loan-to-value ratio but at a substantially higher rate. Thus, a second mortgage can be for refinancing in the usual sense or they are highly leveraged loans, which are typically taken out of desperation (e.g., to pay medical bills or other high-interest debt).[12] Therefore, I consider only the first form of refinancing. Since much of refinancing is rate

[10] It turns out that in the sample, the maximum number of houses is two.
[11] The Surveys of Consumers from January through June 2002 described in Canner, Dynan, and Passmore (2002) also suggest that rate refinancing is the dominant type in the U.S.: about 44.8% of refinancers cashed out.
[12] Indeed, when I experiment with second mortgage cases, I do not find the consumption sensitivity to be different for these households.

refinancing, it depends the initial loan terms and competition from other banks. In my sample, I have 116 refinancing cases.[13]

To examine the consumption behavior of those households who actually refinance, I include in Equation (1) a dummy variable, *Refinance*, indicating whether refinancing takes place the within previous eight quarters and let it interact with the housing return ($\Delta p_{i,t-1}$). Relaxation of credit constraint predicts the interaction term to be positive (Hypothesis (2a)). Since liquidity-constrained households may be more likely to refinance, I also explicitly control for liquidity constraints. The impact of the liquidity variables derived from credit card records (i.e., whether 75% of the credit limit is reached and whether an individual pays his/her credit card bill in full), however, may be hard wired, because when households are near their credit card limits or that they borrow more from their credit cards may indicate that they incur more credit card expenses during that period. Thus I do not include them in the estimation. But the results on refinancing do not change if I include these variables.

Consistent with Hypothesis (2a) about credit constraints, in column (1) of Table 3, the interaction term between *Refinancing* and housing returns is significantly positive at the 10% level. Refinancing itself is not significant, suggesting that the impact of refinancing on consumption depends on housing return which in turn determines how much cash can be obtained in refinancing. Meanwhile, the point estimate of the coefficient on housing wealth itself and its significance level are very similar to the baseline model, suggesting that there is significant consumption sensitivity even for households who do not refinance. In columns (2)-(4), I include various measures of housing leverage. Their coefficients are significantly negative (at the 10%

[13] Hong Kong mortgage lenders typically impose a substantial penalty for refinancing within the first three years of loan origination. In my sample, there is a significant proportion of recently originated loans. A lower incidence of refinancing is actually advantageous in the current setting in pinning down the impact of precautionary saving.

level for the LTV ratio and the 1% level for mortgage affordability). Meanwhile, the effect of refinancing on the consumption-housing wealth sensitivity remains qualitatively unchanged.

To examine the effect of precautionary saving, I *exclude* households that refinance in the previous eight quarters and re-estimate the baseline model (Equation (1)). Consistent with Hypothesis (2b) about precautionary saving, consumption sensitivity exists even without refinancing (column (1) of Table 4). I further divide the sample based on whether liquidity constraints are binding where binding liquidity constraints are defined as housing leverage above the top quartile (columns (2) – (5) of Table 4). Inconsistent with Hypothesis (3a) or credit constraints, changes in housing wealth do not have any significant impact on consumption among highly leveraged households. Rather, the observed consumption sensitivity is driven by those *less* leveraged households, supporting Hypothesis (3b) about precautionary saving. Similar results are obtained if I measure leverage using credit card records. In columns (6)-(7) and (8)-(9) of Table 4, the consumption sensitivity is only significant for those less leveraged households that are below 75% of their credit limits or that pay their credit card bills in full[14]. Finally, since Hong Kong experienced a sharp price drop during the Asian financial crisis in 1998, which left households who bought at the peak with negative housing equity, I divide the sample into those with and without positive equity in columns (10)-(11) of Table 4. The effect of housing wealth is significant only if the household has positive equity.[15]

[14] I experiment with alternative cutoffs of 50% and 100% of the credit limit and the results (both the point estimates and their significance levels) remain qualitatively the same.

[15] I explore how this home equity effect interacts with my earlier leverage effects. It turns out the leverage effects only exist among positive-equity households. This suggests that households with negative equity, even if they are not highly leveraged (based on the above measure except for the LTV ratio), might have saved less than they would like to, considering the negative equity. Thus an increase in housing value does not prompt them to spend more or liquidate more of their buffer stock, again indicating that precautionary saving is the main driver for consumption-housing wealth sensitivity. In the interest of brevity, these tests are not reported but they are available upon request.

Overall, the results indicate that relaxation of liquidity constraints through refinancing plays an important role in increasing the consumption sensitivity to housing wealth. However, for the majority of households who do not refinance, the observed consumption responses to housing wealth are more consistent with a reduction in the need for precautionary saving.

2.2.3 Predictable vs. unpredictable changes in housing wealth

This section examines consumption responses to predictable and unpredictable components of housing returns to further distinguish between the role of credit constraints and that of precautionary saving. I follow the previous literature and use lagged housing returns, real interest rates, and variables related to housing demand including rental growth, affordability (defined as median housing price over median income), housing stock, and real GDP growth) as instruments for housing returns. I include two lags of these variables in the estimation.

Inconsistent with Hypothesis (4a) or credit constraints, column (1) in Panel A of Table 5 shows that consumption does not respond to the predictable component of housing wealth. In columns (2)-(11), I divide the sample based on the liquidity measures as in Table 4. None of the sub-samples exhibits any significant consumption sensitivities to predicable housing returns. Thus, the results are inconsistent with the relaxation of liquidity constraints but consistent with a reduction in the precautionary saving (Hypothesis (4b)).

Panel B of Table 5 shows that consumption responds significantly to unpredictable shocks to housing returns, again consistent with Hypothesis (4b) or precautionary saving. While this is also consistent with PIH, PIH does not predict differential responses among households with different leverage. When I divided the sample based on whether the household is liquidity constrained, the consumption responses to unpredictable housing returns are driven by less

constrained households (columns (2) – (11)), which is inconsistent with PIH but consistent with precautionary saving.

2.2.4 The life-cycle pattern of the consumption responses

In this section, I explore how the effect of housing wealth on consumption changes during the life cycle. The life-cycle pattern of consumption sensitivities, however, is not clear cut ex ante. On the one hand, younger home owners may have lower sensitivity to housing wealth than older households since they may move up to a larger house in the future and thus are "short" in housing (Campbell and Cocco, 2005).[16] On the other hand, there are several reasons why young owners may have greater sensitivity to housing wealth gain. First, as demonstrated by Gourinchas and Parker (2002), consumers younger than 40 years old behave (optimally) as buffer-stock savers, which potentially results in greater consumption responses to housing returns if the reduction in precautionary saving is the driver of such responses. Second, if older homeowners have a bequest motive, they may not spend more in response to increases in housing wealth.

These opposing factors are likely to have different impacts on different age groups, resulting in a non-monotonic relation between age and consumption sensitivities. As a first cut, I divide the sample into young (aged below 40) and old groups – a cutoff that follows Gourinchas and Parker (2002) and Cocco and Campbell (2005). In the sample, the median age is 37 in the sample and 70% of people are below 40.

As shown in columns (1) and (2) of Table 6, the effect of housing wealth is significantly positive for younger households (at the 10% level). For older households, the estimate is positive but only slightly more than half of that for the younger households and it is not statistically

[16] There is anecdotal evidence suggesting that young owners in Hong Kong are less likely to trade up to larger houses. People typically live in small houses and it is not uncommon for young people to buy houses only after they have

significant. My earlier findings that liquidity-constrained households have less consumption sensitivity suggest that to identify the driving force responsible for the differential sensitivities between the two age groups, one nees to compare the liquidity constraints that they face. Table 1 suggests that young households are generally more leveraged than older households (by two out of three leverage measures), although the differences between these two groups appear to be small. Thus, it is not likely that younger households being less leveraged are responsible for the results. When I sub-divide the younger sample based on the liquidity measures as in Table 3, the impact of liquidity is similar: the less-constrained sub-samples exhibit significant consumption responses to housing wealth (unreported). Thus, liquidity constraints do not explain the differential consumption sensitivities between young and old groups.

These results suggest that (1) saving to move into a larger house is not particularly important; (2) precautionary saving and bequest motives discussed above are empirically significant. To further understand the relative importance of these two motives, I examine the subgroup of people above 60 for whom the bequest motive may be more important but not necessarily precautionary saving. It turns out that this group exhibits a strong and significant consumption sensitivity to housing wealth, which at least suggests that the bequest motive is not empirically significant (column (3) of Table 6). This, again, points to the importance of precautionary saving in consumption decisions.

2.2.5 Discretionary v. non-discretionary consumption

This section estimates the response of discretionary consumption to housing wealth (Hypothesis 6). In the data, two out of five card issuers keep records of one particular type of

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children (which in the U.S. justifies moving to a larger house). This further helps to isolate the effect of precautionary saving.

discretionary consumption, namely amount spent in restaurants and on entertainment. As shown in column (1) of Table 7, housing wealth has a significant impact on entertainment spending. More importantly, consistent with precautionary saving, the point estimate is 0.332, about twice as large as the baseline estimate of 0.171 (Table 2). The difference is statistically significant (*p* value = 0.057).[17] There is an issue, however, in that those people who use the two cards that record entertainment spending may have other cards. Thus, their entertainment spending is possibly under-recorded. It is useful, however, to note that for this measurement error to systematically drive the results, it has to be the case that those with lower housing returns somehow tend to charge more of their entertainment spending to other cards. The test in column (2) of Table 7 further mitigates the concern of charges in other cards: when I restrict the sample to those individuals who use the two cards with entertainment spending data as their "main cards," i.e., the two cards account for at least 75% of their total credit card bills during the sample period, the main coefficient estimate remains similar. When I further divide the sample based on household leverage, consistent with the earlier findings, sensitivity of discretionary spending is driven by households with low leverage.

2.3. Robustness Checks

2.3.1 District-wide shocks and stock-market wealth effects

There are two possible alternative explanations of the observed consumption sensitivity to housing wealth. First, although compared to MSA-level housing returns, district-level housing returns within the same metropolitan area mitigate the concern that MSA-level shocks simultaneously drive housing prices and consumption, there still might be district-wide shocks

[17] In testing for the statistical significance, I estimate seemingly unrelated regressions based on the sample for which entertainment expense is available.

that affect both housing prices and consumption in that district. The bay area of San Francisco is a good example. The technology boom raised the income of high-tech workers, who consume more and at the same time drive up local housing prices. Second, since I do not observe households' stock holdings, it is possible that housing returns may pick up information on household exposure to the stock market. However, since stock returns are at the Hong Kong level but housing returns are at the district level, for this hypothesis to drive my results, it has to be the case that those with more stock market exposure happen to live in districts where housing returns are more correlated with the stock market.

I believe that these hypotheses do not explain my earlier results, for two reasons. First, as noted, Hong Kong is a metropolitan area well integrated across different districts and a highly efficient subway system connects most parts of Hong Kong within one hour. Indeed, it is very common for people to work in one district and live in another district, commuting to work by public transportation. Second and more important, I do not simply draw conclusion about the housing wealth effect based on regressions of consumption on housing returns: rather I identify the mechanism through which housing wealth affects consumption, which is probably the most powerful way to deal with endogeneity.

Nevertheless, since district-wide housing returns are a key part of my identification strategy, I propose the following tests to further address the concern about district-wide shocks. Note that they also address the concern about stock market exposure. First, I include interaction terms of income categories and quarter dummies as additional controls. If district-wide shocks indeed drive the results, it is likely to work through an income effect. While the occupation and quarter dummy interactions already at least partially control for this effect, this is a more direct test. This test also addresses the concern of stock market exposure, to the extent that such exposure depends on income. As reported in column (1) of Table 8, where income categories are

defined based on the four quartiles of income plus a fifth category of the top ten percentile to "fine tune" the high-income category, adding interactions between income and quarter dummies neither changes the main coefficient of interest nor improves the overall fit of the model.

In the second test, I address the concern that different districts may have different exposures to overall economic conditions. For example, Hong Kong West (HK West) has the highest paid jobs, as well as the highest housing prices. If high-income people (e.g., investment bankers and senior IT workers) who both work and live in this district are more sensitive to overall economic shocks, they may drive the observed consumption sensitivity. Note that this is also the district where residents are likely to have greater stock holdings. It turns out that, as shown in column (2) of Table 8, dropping this district has little impact on the coefficient estimates.

Finally, I compute standard errors clustered at the district level. If there are systematic district wise time-varying shocks, the error terms for individuals in the same district are likely to be corrected. As reported in column (3) of Table 8, clustered standard errors are even lower for the main coefficient of interest and are lower for many other control variables. This indicates that the errors within districts are completely random, which is not very surprising given that many people work and live in different districts and that I already have individual household dummies in the regressions.

2.3.2 Renting v. owning choice

Another concern in this type of study is the endogenous tenure choice. The literature has identified several factors that may affect the owning vs. renting choice, including income, tax incentives (which are largely a function of income), the correlation between income and housing returns, race, immigration status, marital status, and the number of children (e.g., Haurin, Hendershott, Wachter, 1996; Painter, Gabriel, and Myers, 2001; Davidoff, 2006). Since many of

these factors are largely time invariant, especially in my sample period of three years, they are already controlled for by individual fixed effects. The only obvious time-varying factor is perhaps income, which is at least partially controlled for by the interaction between occupation and the quarter dummies as discussed above. Further, even if there exist some unmeasured time-varying factors (e.g., a big inheritance or the birth of a new baby) that increase the incentive to buy a house, for these factors to systematically drive the results, they have to be related both to increased consumption *and* an ability to buy a house with greater returns. Therefore, I do not believe endogenous tenure choice is a big concern.

Nevertheless, I propose the following test that further addresses unobserved time-varying individual factors that may affect tenure choices. To the extent that such factors exist, their impact on the estimation should be stronger among those individuals who bought houses during my sample period (e.g., because they got married or had another baby). Thus, if I restrict the sample to those households who have already bought a house at the beginning of the sample period, then my results should be weaker. When I perform this test (column (4) of Table 8), my earlier results remain exactly the same, further confirming that endogenous tenure choices do not drive the results.

2.3.3 Other robustness checks

I perform the following additional robustness checks: (1) I check for non-linearity of the effect of housing wealth by adding a squared housing return in the baseline model. It turns out the squared term is insignificant whereas the linear term stay unchanged (column (5) of Table 8). (2) I check the timing of consumption responses by adding the contemporaneous housing returns and the second lag of housing returns in the estimation (column (6) of Table 8). These two additional

terms are not statistically different from zero, whereas the coefficient on the lagged housing returns remains qualitatively unchanged.

3. Generality of the Empirical Findings

While the unique dataset from Hong Kong provides an excellent setting to examine the relationship between housing wealth and consumption, it is useful to discuss, at this point, how the findings may apply to the U.S. and other countries. I believe several factors make the findings in Hong Kong quite general. First, credit cards are widely used in Hong Kong (22% of total consumer expenditure v. 20% in the U.S.) and credit card spending is a good proxy for non-durable consumption. Second, Hong Kong's mortgage markets are well developed, which encourages home ownership. According to the Population Census 2001, half of the households lived in owner-occupied accommodations. Within these households, about half of them have outstanding mortgages. By law, people can mortgage up to 70% of the house value and, with a second mortgage, can borrow up to 90%. Third, the precautionary saving motive, which is the main driver of the consumption responses to housing returns, has been documented to affect consumption in the U.S. and other countries. For example, in the U.S., late-in-life medical expenses and/or medicaid aversion is a crucial factor motivating precautionary saving and can explain the observed low spending rate of many retirees (Palumbo, 1999 and DeNardi, French, and Jones, 2006). More generally, Gourinchas and Parker (2002) estimate that precautionary wealth accounts for 65% of U.S. household liquid wealth.

Hong Kong, however, may differ in a few dimensions from other countries and the U.S. in particular. First, refinancing is not as common in Hong Kong as in the U.S. Since refinancing and the resulting relaxation of liquidity constraints increases consumption sensitivity, my results probably *under-estimate* the magnitude of the effect of housing wealth on consumption. Second,

households in the East typically save more than households in the West, which may strengthen the effect of precautionary saving. Thus, while the findings from Hong Kong are useful to predict a directional impact of housing wealth, the exact magnitude should not be simply extrapolated.

4. Conclusion

Based on a rich panel dataset of individual housing wealth and consumption, this paper identifies a significant effect of housing wealth on consumption growth. A pure wealth effect can explain part of the sensitivity, since households with multiple houses tend to have much larger consumption responses. Moreover, consistent with the relaxation of credit constraints, households who refinance have significantly greater consumption sensitivities. However, for the majority of the households who do not refinance, the main driver of observed consumption sensitivity appears to be a reduction of precautionary saving. This is based on the following findings: (1) there exists significant consumption responses to housing wealth even in the absence of refinancing and such responses on account of less leveraged households whose borrowing constraints are not binding; (2) Consumption responds only to unpredictable changes in housing wealth but not to predictable changes; (3) Consumption responses are stronger among younger households who behave more like buffer stock savers than other age groups; (4) Discretionary consumption (e.g., dining out and entertainment) responds more strongly to housing returns. Overall, the findings point to the importance of precautionary saving as a cause for the effect of housing wealth on consumption and suggest that, even in the absence of refinancing and relaxation of credit constraints, housing wealth can have a substantial impact on consumption growth.

These findings have important implications for other countries including the U.S. The property markets around the world have enjoyed unprecedented price increases in the last a few years. There has been hot debate on what will happen to the economy with the current

"correction" in the property markets. The results in this paper illustrate a powerful channel through which housing price movements can be transmitted into the economy. In particular, they suggest that the current slowdown in the housing market in the U.S. may have an amplifying effect on economic growth due to reduced consumer spending.

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Table 1. Summary Statistics

This table presents summary statistics of main variables in the analysis. LTV ratio is the ratio of mortage loan to housing value. Mortgage affordability is the outstanding mortgage balance over annual income. Total number of individual households for the two age groups do not add up since age information is missing for some households. Significance levels are based on two-tailed tests of differences between the two age groups; significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Whole Sample			Age<=40			Age>40		
	Mean	Median	s.d.	Mean	Median	s.d.	Mean	Median	s.d.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ΔLog(Consumption)	-0.121	-0.070	1.428	-0.125	-0.078	1.443	-0.113	-0.061	1.400
ΔLog(Housing Wealth)	-0.036	-0.034	0.087	-0.034	-0.034	0.086	-0.038	-0.034	0.089
Age	37.832	37.000	7.020						
Leverage related variables									
LTV ratio	0.850	0.799	0.451	0.876***	0.815	0.449	0.804	0.764	0.450
Mortgage affordability	2.819	2.788	1.114	2.930***	2.901	1.086	2.626	2.579	1.135
% Households reaching 75% of credit limit	0.043			0.042***			0.043		
% of Households not paying credit card debt in full	0.200			0.210***			0.184		
% of Households with positive home equity	0.745			0.730***			0.769		
Total Number of Observations	76,206			48,188			28,018		
Total Number of Individual Households	12,793			7,950			3,232		

Table 2. Housing Wealth and Consumption

This table presents OLS estimates of the effect of housing wealth on consumption. The dependent variable is the change in log of consumption. ΔLog(Housing Wealth)$_{t-1}$ is the lag of the change in log housing value. Other variables definitions are the same as those in Table 1. Robust standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Whole sample	Whole sample	With one house	With more than one house	Whole sample
	(1)	(2)	(3)	(4)	(5)
ΔLog(Housing Wealth)$_{t-1}$	0.171**	0.172**	0.168**	2.997**	0.169**
	(0.077)	(0.077)	(0.077)	(1.472)	(0.077)
ΔLog(Housing Wealth)$_{t-1}$* Multiple Houses					1.420*
					(0.847)
Multiple Houses					-0.158
					(0.262)
Controls					
Quarter Dummies	Yes	Yes	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes	Yes	Yes
Occupation * Quarter Dummies		Yes	Yes	Yes	Yes
R-squared	0.13	0.13	0.13	0.39	0.13
Number of Observations	76,206	76,206	75,936	270	76,206

Table 3. The Effect of Refinancing

This table presents the effect of refinancing on consumption-housing wealth sensitivity. The dependent variable is the change in log of consumption. ΔLog(Housing Wealth)t-1 is the lag of the change in log housing value. Refinancing is a dummy variable indicating refinancing in the previous eight quarters. LTV ratio is the ratio of mortage loan to housing value. Mortgage affordability is the outstanding mortgage balance over annual income. Robust standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)
ΔLog(Housing Wealth)$_{t-1}$	0.172**	0.171**	0.171**	0.173**
	(0.077)	(0.077)	(0.078)	(0.078)
ΔLog(Housing Wealth)$_{t-1}$ * Refinancing	21.914*	21.929*	21.980*	21.990*
	(12.279)	(12.283)	(12.408)	(12.408)
Refinancing	0.105	0.106	0.108	0.109
	(0.292)	(0.292)	-0.292	(0.292)
LTV ratio		-0.032*		-0.029*
		(0.017)		(0.017)
Mortgage affordability			-0.211***	-0.204***
			(0.072)	(0.072)
Controls				
Quarter Dummies	Yes	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes	Yes
Occupation * Quarter Dummies	Yes	Yes	Yes	Yes
Observations	76,206	76,070	75,657	75,655
R-squared	0.13	0.13	0.13	0.13

Table 4. Housing Wealth and Consumption in the Absence of Refinancing

This table presents consumption sensitivity to housing wealth for those households who do not refinance. The dependent variable is the change in log of consumption. ΔLog(Housing Wealth)t-1 is the lag of the change in log housing value. Refinancing is a dummy variable indicating refinancing in the previous eight quarters. LTV ratio is the ratio of mortage loan to housing value. Mortgage affordability is the outstanding mortgage balance over annual income. Robust standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Sample	Dropping Refinancing	LTV ratio		Mortgage affordability		Reaching 75% of credit limit		Not paying credit card in full		Housing net worth	
		High	Low	Low	High	Yes	No	Yes	No	Positive	Negative
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ΔLog(Housing Wealth)$_{t-1}$	0.171**	0.107	0.191**	0.038	0.198**	-0.115	0.173**	0.095	0.191**	0.190**	0.089
	(0.077)	(0.166)	(0.090)	(0.150)	(0.091)	(0.450)	(0.079)	(0.179)	(0.091)	(0.091)	(0.161)
Controls											
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation * Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.13	0.17	0.14	0.15	0.14	0.38	0.13	0.3	0.16	0.14	0.17
Number of Observations	76,135	19,043	56,956	18,908	56,678	3,259	72,876	15,265	60,870	56,673	19,355

Table 5. Consumption Responses to Predictable and Unpredicable Changes in Housing Wealth

This table presents consumption responses to predictable vs. unpredictable housing returns. In Panel A, the models are estimated using instrumental variables. Instruments include two lags of housing returns, real interest rates, rental growth, affordability (defined as median housing price over median income), housing stock, and real GDP growth). The models are estimated using two-stage least square regressions. Robust standard errors are in parentheses. In Panel B, Unpredicted housing return is the residual from the first stage regression in Panel A. Other variables definitions are the same as those in Table 4. Standard errors are obtained through bootstrapping to account for the sampling variations in generating unpredicted housing returns. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Sample	Whole sample	LTV ratio		Mortgage affordability		Reaching 75% of credit limit		Not paying credit card in full		Housing net worth	
		High	Low	Low	High	Yes	No	Yes	No	Positive	Negative
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A: Predictable Changes in Housing Wealth											
Predicted ΔLog(Housing Wealth)$_{t-1}$	0.111	0.322	0.162	-0.091	0.167	-0.959	0.136	-0.105	0.193	0.196	0.286
	(0.139)	(0.342)	(0.143)	(0.307)	(0.157)	(0.712)	(0.142)	(0.347)	(0.159)	(0.143)	(0.339)
Controls											
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation * Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.13	0.17	0.14	0.15	0.14	0.38	0.13	0.3	0.16	0.14	0.17
Number of Observations	71,451	19,043	57,027	18,931	56,726	3,259	72,947	15,278	60,928	56,744	19,355
Panel B: Unpredictable Changes in Housing Wealth											
Unpredicted ΔLog(Housing Wealth)$_{t-1}$	0.190*	0.082	0.195*	0.145	0.289*	0.259	0.208*	0.195	0.213*	0.188*	0.064
	(0.099)	(0.189)	(0.125)	(0.186)	(0.132)	(0.675)	(0.126)	(0.219)	(0.132)	(0.119)	(0.184)
Controls											
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation * Quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.13	0.16	0.14	0.15	0.14	0.38	0.13	0.3	0.16	0.14	0.16
Number of Observations	71,451	18,863	52,479	17,204	53,725	2,998	68,453	14,315	57,136	52,209	19,162

Table 6. Housing Wealth and Consumption: Life Cycle Patterns

This table presents consumption sensitivity to housing wealth for different age groups. The dependent variable is the change in log of consumption. ΔLog(Housing Wealth)t-1 is the lag of the change in log housing value. Robust standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Age below 40	Age above 40	Age above 60
	(1)	(2)	(3)
ΔLog(Housing Wealth)$_{t-1}$	0.166*	0.099	1.499*
	(0.101)	(0.139)	(0.846)
Controls			
Quarter Dummies	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes
Occupation * Quarter Dummies	Yes	Yes	Yes
R-squared	0.13	0.15	0.48
Number of Observations	48,188	26,037	277

Notes: Variables definitions are the same as those in Table 1. Robust standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Table 7. Responses of Discretionary Consumption

This table presents the sensitivity of discretionary spending to housing wealth. The dependent variable is discretionary expenses including restraurant and entertainment spending. Only 2 out of 5 card issuers report this category of expense. In column (2) the sample is restricted to those who charge at least 75% of their total credit card spending to these two cards. Variables definitions are the same as those in Table 4. Robust standard errors are in parentheses. . Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Sample	Whole sample	>75% Usage	LTV ratio		Mortgage affordability		Reaching 75% of credit limit		Not paying credit card in full		Housing net worth	
			High	Low	Low	High	Yes	No	Yes	No	Positive	Negative
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ΔLog(Housing Wealth)$_{t-1}$	0.332**	0.340*	0.36	0.304*	0.313	0.338*	-0.46	0.305*	-0.34	0.335*	0.300*	0.495
	(0.161)	(0.196)	(0.444)	(0.178)	(0.346)	(0.184)	(1.792)	(0.167)	(0.583)	(0.186)	(0.178)	(0.445)
Controls												
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation * Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.19	0.15	0.25	0.2	0.24	0.19	0.61	0.19	0.44	0.21	0.2	0.26
Number of Observations	12,291	6,147	3,263	9,016	3,012	9,168	347	11,944	2,276	10,015	8,980	3,301

Table 8. Robustness Checks

This table presents robustness checks. Robust standard errors are in parentheses. Significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

	Whole sample	Dropping HK West	Whole sample	Already bougth house at t=0	Whole sample	Whole sample
	(1)	(2)	(3)	(4)	(5)	(6)
ΔLog(Housing Wealth)$_{t-1}$	0.172***	0.162**	0.194***	0.189**	0.181**	0.206**
	(0.053)	(0.078)	(0.080)	(0.092)	(0.078)	(0.087)
[ΔLog(Housing Wealth)]^2					0.169	
					(0.128)	
ΔLog(Housing Wealth)$_t$						0.067
						(0.046)
ΔLog(Housing Wealth)$_{t-2}$						0.030
						(0.039)
Controls						
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Household Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Occupation * Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Income * Quarter Dummies	No	Yes	No	No	No	No
District-Clustered Standard Errors	Yes	No	No	No	No	No
R-squared	0.13	0.13	0.13	0.1	0.13	0.13
Number of Observations	76,204	75,675	74,229	54,290	76,206	74,088