

Buiter, Willem H.

**Article**

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## Housing Wealth Isn't Wealth

*Willem H. Buiter*  
*Citigroup, London*

**Abstract** A fall in house prices due to a change in fundamental value redistributes wealth from those long housing (for whom the fundamental value of the house they own exceeds the present discounted value of their planned future consumption of housing services) to those short housing. In a closed economy representative agent model (the special case when the birth rate is zero, of the Yaari-Blanchard OLG model used in the paper), there is no pure wealth effect on consumption from a change in house prices if this represents a change in their fundamental value. When the birth rate is positive, higher fundamental house prices driven by the housing demand of future generations will boost current consumption.

There is a pure wealth effect on consumption from a change in house prices even in the representative agent model, if this reflects a change in the speculative bubble component of house prices.

Two other channels through which a fall in house prices can affect aggregate consumption are (1) redistribution effects if the marginal propensity to spend out of wealth differs between those long housing (the old, say) and those short housing (the young, say) and (2) collateral or credit effects due to the collateralisability of housing wealth and the non-collateralisability of human wealth. A decline in house prices reduces the scope for mortgage equity withdrawal. For given sequences of future after-tax labour income and interest rates, a fall in house prices will then depress consumption in the short run while boosting it in the long run.

**JEL** E2, E3, E5, E6, G1

**Keywords** Wealth effect; house prices; speculative bubbles

**Correspondence** Willem H. Buiter, CBE, FBA, Chief Economist, Citigroup, Citigroup Centre, Canada Square, Canary Wharf, London E14 5LB, UK;

E-mail: [willembuiter@btinternet.com](mailto:willembuiter@btinternet.com),

Web Page: <http://www.nber.org/~wbuiter/>

## 1 Introduction

The bold statement “Housing wealth isn’t wealth” was put to me over a decade ago by Mervyn King, now Governor of the Bank of England, then Chief Economist of the Bank of England. Like most bold statements, the assertion is not quite correct; the correct statement is that, in a representative agent model, a decline in house prices does create a negative wealth effect on aggregate consumption demand. On average, consumers are neither worse off nor better off.

The argument is elementary and applies to coconuts as well as to houses. When does a fall in the price of coconuts make you worse off? Answer: when you are a net exporter of coconuts, that is, when your endowment of coconuts exceeds your consumption of coconuts. A net importer of coconuts is better off when the price of coconuts falls. Someone who is just self-sufficient in coconuts is neither worse off nor better off.

As regards wealth effects, houses are like durable coconuts, or indeed like any consumer durable. The fundamental value of a house is the present discounted value of its current and future rentals, actual or (in the case of owner-occupiers) imputed. Anyone who is ‘long’ housing, that is, anyone for whom the value of their home exceeds the present discounted value of the housing services they plan to consume over their remaining lifetime will be made worse off by a decline in house prices. Anyone ‘short’ housing will be better off. So the young and all those planning to trade up in the housing market are made better off by a decline in house prices. The old and all those planning to trade down in the housing market will be worse off.

Another way to put this is that landlords are worse off as a result of a decline in house prices, while current and future tenants are better off. On average, the inhabitants of a country own the houses they live in; on average, every tenant is his/her own landlord and vice versa. So in a representative agent model, there is no net housing wealth effect. You need a model with heterogeneous agents in which a change in house prices causes redistribution between agents with different marginal propensities to spend in order to get an aggregate consumption effect from a change in house prices.

Most econometric or calibrated numerical models I am familiar with treat housing wealth just like the value of stocks and shares as a determinant of household consumption. Their designers appear to forget that households consume

housing services (for which they pay or impute rent) but not stock or bond services. A prominent example is the FRB/US model (see Brayton and Tinsley, eds. (1996), Brayton, Levin, Tryon, and Williams (1997), and Brayton, Mauskopf, Reifschneider, Tinsley and Williams (1997)). It is used frequently by participants in the debate on the implication of developments in the US housing market for US consumer demand. A recent example is Frederic S. Mishkin's (2008) paper "Housing and the Monetary Transmission Mechanism". The FRB/US model *a-priori* constrains the wealth effects of housing wealth and other financial wealth to be the same. The long-run marginal propensity to consume out of non-human wealth (including housing wealth) is 0.038, that is, 3.8 percent.

In several simulations, Mishkin increases the value of the long-run marginal propensity to consume out of housing wealth to 0.076, that is, 7.6 percent, while keeping the long-run marginal propensity to consume out of non-housing financial wealth at 0.038.

The argument for an effect of a change in house prices on consumption other than the pure wealth effect, is that housing wealth is collateralisable. Households-consumers can borrow against the equity in their homes and use this to finance consumption. If they are credit-constrained, a boost to housing wealth would relax the credit constraint and temporarily boost consumption spending. Of course, the increased debt will have to be serviced, and eventually consumption will have to be below the level it would have been at in the absence of the mortgage equity withdrawal (MEW). So even if the *impact effect* or short-run effect on consumption of a change in house prices can be represented adequately through a higher marginal propensity to consume out of collateralisable housing wealth than out of non-collateralisable (human) wealth, in the long run, the lower net financial assets of the household will reduce consumption compared to what it would have been if the change in wealth had been due to a change in non-collateralisable wealth.

Ben Bernanke (2007), Donald Kohn (2006), Fredric Mishkin (2008), Randall Kroszner (2005, 2008) and Charles Plosser (2007) all have made statements to the effect that the credit effect, collateral effect or MEW effect of a change in house prices is on top of, that is, in addition to, the 'normal' wealth effect.<sup>1</sup> The

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<sup>1</sup> Bernanke (2007): "If the financial accelerator hypothesis is correct, changes in home values may affect household borrowing and spending by somewhat more than suggested by the conventional

message of this paper is that in the simplest benchmark model (the representative agent model) there is no aggregate wealth effect from a change in house prices (it is purely redistributive), and even if there were a redistributive effect from changes in house prices, this would not impact aggregate consumption because winners and losers have the same marginal propensities to consume. Richer OLG models suggest the possibility of either positive or negative net effects on aggregate consumption from a change in house prices when the young are both short housing and liquidity- or collateral-constrained. By overestimating

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*wealth effect because changes in homeowners' net worth also affect their external finance premiums and thus their costs of credit.*"

Kohn (2006): *"Between the beginning of 2001 and the end of 2005, the constant-quality price index for new homes rose 30 percent and the purchase-only price index of existing homes published by the Office of Federal Housing Enterprise Oversight (OFHEO) increased 50 percent. These increases boosted the net worth of the household sector, which further fueled (sic) the growth of consumer spending directly through the traditional "wealth effect" and possibly through the increased availability of relatively inexpensive credit secured by the capital gains on homes."*

Kroszner (2005): *"As some of the "froth" comes off of the housing market – thereby reducing the positive "wealth effect" of the strength in the housing sector -- and people fully adjust to higher energy prices, I see the growth in real consumer spending inching down to roughly 3 percent next year."*

Kroszner (2008), *" falling home prices can have local and national consequences because of the erosion of both property tax revenue and the support for consumer spending that is provided by household wealth."*

Mishkin (2008, p.363): *"By raising or lowering short-term interest rates, monetary policy affects the housing market, and in turn the overall economy, directly and indirectly through at least six channels: through the direct effects of interest rates on (1) the user cost of capital, (2) expectations of future house-price movements, and (3) housing supply; and indirectly through (4) standard wealth effects from house prices, (5) balance sheet, credit-channel effects on consumer spending, and (6) balance sheet, credit channel effects on housing demand."* Mishkin (2008a, p. 378): *"Although FRB/US does not include all the transmission mechanisms outlined above, it does incorporate direct interest rate effects on housing activity through the user cost of capital and through wealth (and possibly credit-channel) effects from house prices, where the effects of housing and financial wealth are constrained to be identical."*

Plosser (2007): *" changes in both home prices and stock prices influence household wealth and therefore impact consumer spending and aggregate demand."*

Plosser (2007): *"To the extent that reductions in housing wealth do occur because of a decline in house prices, the negative wealth effect may largely be offset for many households by higher stock market valuations. "*

the effect on consumer demand of a change in house prices, the monetary authority may be led to move its rates too aggressively.

The failure to treat a change in fundamental house prices as a distributional and credit constraint/collateral issue for consumers and, through Tobin's  $q$ , as a residential investment issue rather than as the source of a net aggregate wealth effect continues to plague even the most recent literature. An example is an NBER working paper by Casey Mulligan and Luke Threinen, "Market Responses to the Panic of 2008", that appeared in October 2008.<sup>2</sup> In their paper, Mulligan and Threinen "... model the panic of 2008 as part of the wealth and substitution effects deriving from a housing price crash that began in 2006. The dissipation of the wealth effect stimulates a reorganization of the banking industry and increases in employment, GDP, and unemployment." (Mulligan and Threinen (2008)). Casey and Mulligan also don't take the 'escape route' stressed in the present paper, that there is a pure wealth effect from a change in house prices that reflects a speculative bubble instead of a change in economic fundamentals (the present discounted value of future rentals): "The expected capital losses in the long run are not necessarily reflective of a "bubble," but may rather have served to ration housing." (Mulligan and Threinen (2008)).

The insight that housing wealth isn't wealth has the status of a folk theorem in macro consumer demand theory and empirics (see e.g. Buchanan and Fiotakis (2004), Edelstein and Lum (2004), Case, Quigley, and Shiller (2005) and Carroll, Otsuka, and Slacalek (2006)). A rigorous statement and formal model of the proposition is not, as far as I know, available. The representative agent special case of the model presented in this paper can be found in the Appendix to Buiter (2008a).

The paper does not develop a complete general equilibrium model, although it would be trivial to add a simple version of the missing components, especially if I am permitted the luxury of a small open economy with perfect international mobility of financial capital. To establish the conditions under which there is no pure wealth effect on consumption from a change in the fundamental value of a unit of housing capital, or the proposition that a housing bubble does have a pure wealth effect, all that is required is the aggregate consumption function and a

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<sup>2</sup> An earlier version of the present paper (Buiter (2008b)) had appeared in the NBER Working Paper series in July 2008.

subset of the economy-wide equilibrium conditions – in particular the housing autarky assumption that the housing stock is owned only by domestic consumers. The determination of the equilibrium real wage, the real interest rate, the production of non-housing consumption goods and the relative price of housing services and other consumption goods is irrelevant from the point of view of establishing the three main propositions of the paper.

## **2 The Model**

### **2.1 Individual Household Behaviour**

For sake of brevity, I consider an integrated household-consumer-home owner-construction firm owner and worker, rather than the separate household and business entities. The structure of preferences is irrelevant to the result, as long utility is increasing in consumption of housing services and consumption of non-housing goods and services. What matters for the strong proposition that a change in house prices does not change aggregate consumption is (1) the assumption of housing autarky for the economy under consideration and (2) the absence of distributional effects from house price changes. Specifically, the absence of life-cycle-related effects of house price changes on the demand for housing services is central.

Housing autarky means that there are no foreign owners of domestic housing. As regards age-related variations in the demand for housing services, in the Yaari-Blanchard OLG model used in what follows (for expositional simplicity), every surviving household has the same remaining life expectancy, regardless of the age of the household (see Yaari (1965), Blanchard (1985) and Buiters (1988)). In addition, the current housing stock and all future contributions to the flow of rental income from housing are fully owned by those currently alive. This is in contrast to human capital, where the future wages earned (net of taxes on labour income paid) by the unborn are not owned by any private agent currently alive today. This is a consequence of the implicit assumption of the absence of hereditary slavery. When combined with the assumption of no (operative) intergenerational gift and bequest motive, a positive birth rate generates absence of debt neutrality in the Yaari-Blanchard OLG model as in the Allais-Samuelson OLG model.

A positive birth rate also introduces the only economically significant form of household heterogeneity into possessed by the Yaari-Blanchard model: that between those currently alive and the unborn (future generations). The unborn don't own any of the non-human assets currently in existence, including the housing stock. Forward-looking asset markets will, however, anticipate the consumption demand, including the demand for housing services of future generations.

As regards those generations currently alive (the current generation plus the survivors from all past generations) there is no heterogeneity due to age, accumulated financial wealth or human capital. The usual life-cycle property that those with a shorter remaining life-span will have a larger marginal propensity to consume out of a windfall, is absent because life expectancy is the same, regardless of age: the marginal propensity to consume out of comprehensive wealth (financial assets and human capital) is independent of age.

Once born, each household has a constant, age-independent instantaneous probability of dying,  $\mu \geq 0$ . The birth rate,  $\beta \geq 0$ , is constant. With  $\beta = 0$  the model reduces to the representative agent model, regardless of whether  $\mu$  is positive or zero. At time  $t$  a surviving household born at time  $v \leq t$  earns an exogenous wage income  $w(t, v) \geq 0$  (for simplicity, each household's labour supply is assumed inelastic and scaled to unity), pays lump-sum taxes  $\tau(t, v)$ , consumes an amount of non-housing goods and services  $z(t, v) \geq 0$ , and an amount of housing services  $\rho(t, v) \geq 0$ . The rest of its income is either saved in the form of real financial assets earning the instantaneous risk-free real interest rate  $r(t)$  plus a competitive annuity rate (to be discussed) or spent on acquiring housing equity at a price  $p^k(t)$  for an ownership claim to one unit of installed physical housing capital. Here  $k(t, v)$  is the number of housing shares owned by generation  $v$  at time  $t$ . A unit of real housing capital earns real rental income or dividend  $x(t)$ . Real financial wealth held by the household, excluding the value of the stock of housing it owns, is denoted  $f(t, v)$ . Non-housing goods and services are the numéraire. The price of a unit of housing services in terms of non-housing goods and services is  $p(t)$ .

There are efficient competitive annuities markets. Surviving households earn an annuity premium rate  $r^l$  on their non-human wealth (including housing wealth). When a household dies, all its non-human wealth (which can be negative)



accrues to the life-insurance company that has sold them the annuity. There is free entry into the annuities market; therefore  $r^{\ell} = \mu$ .

A utility-maximising competitive representative household born at time  $v \leq t$  and having survived until time  $t$ , maximizes the time-additive objective function in (1) subject to the instantaneous budget identity (2) and the solvency constraint (3). The expectation operator conditional on information at time  $t$  is  $E_t$ ,  $\theta$  is the subjective rate of pure time preference and  $\sigma$  is the reciprocal of the intertemporal substitution elasticity.

$$U(t, v) = E_t \int_t^{\infty} e^{-\theta(s-t)} u(\rho(s, v), z(s, v)) ds, \quad \theta > 0$$

$$u(\rho, z) = \frac{1}{1-\sigma} (\rho^{\eta} z^{1-\eta})^{1-\sigma}; \quad 0 < \eta < 1; \quad \sigma > 0, \quad \sigma \neq 1 \quad (1)$$

$$= \ln(\rho^{\eta} z^{1-\eta}); \quad \sigma = 1$$

$$\frac{df(t, v)}{dt} + p^k(t) \frac{dk(t, v)}{dt} = (r(t) + \mu) f(t, v) + (x(t) + \mu p^k(t)) k(t, v) + w(t, v) - \tau(t, v) - z(t, v) - p(t) \rho(t, v) \quad (2)$$

$$\lim_{s \rightarrow \infty} e^{-\int_t^s (r(u) + \mu) du} (f(s, v) + p^k(s) k(s, v)) \geq 0 \quad (3)$$

We assume that the (expected) rates of return on housing equity and on other financial assets are the same, so

$$r = \frac{x}{p^k} + \frac{\dot{p}^k}{p^k} \quad (4)$$

It follows that the instantaneous budget identity can be rewritten as:

$$\begin{aligned} \frac{d}{dt} \left( f(t, v) + p^k(t)k(t, v) \right) &= (r(t) + \mu) \left( f(t, v) + p^k(t)k(t, v) \right) \\ &+ w(t, v) - \tau(t, v) - z(t, v) - p(t)\rho(t, v) \end{aligned} \quad (5)$$

The only uncertainty in the model is uncertain life expectancy, if the probability of death  $\mu$  is positive. The objective functional  $U(t, v)$  in (1) can therefore be rewritten as

$$U(t, v) = \int_t^{\infty} e^{-(\theta+\mu)(s-t)} u(\rho(s, v), z(s, v)) ds \quad (6)$$

Let the present discounted value of current and future after-tax labour income or human capital of a household of generation  $v$  at time  $t \geq v$  be denoted  $h(t, v)$ :

$$h(t, v) = \int_t^{\infty} e^{-\int_t^s (r(u)+\mu)du} (w(s, v) - \tau(s, v)) ds \quad (7)$$

The solvency constraint (3), the instantaneous budget identity (2) and (7) permit us to write the intertemporal budget constraint of the household as follows:

$$f(t, v) + p^k(t)k(t, v) + h(t, v) \geq \int_t^{\infty} e^{-\int_t^s (r(u)+\mu)du} [z(s, v) + p(s)\rho(s, v)] ds \quad (8)$$

The first-order conditions for housing and non-housing consumption imply that, for all  $s \geq t$ :

$$\frac{\rho(s)}{z(s)} = \left( \frac{\eta}{1-\eta} \right) p(s)^{-1} \quad (9)$$

$$z(s, v) = z(t, v) e^{\int_t^s \left( \frac{r(u)-\theta}{\sigma} \right) du} \left( \frac{p(s)}{p(t)} \right)^{\eta \left( \frac{\sigma-1}{\sigma} \right)} \quad (10)$$

$$\lambda(t, v) = (1 - \eta) \left( \frac{\eta}{(1 - \eta)p(t)} \right)^{\eta(1 - \sigma)} z(t, v)^{-\sigma} \quad (11)$$

$$\dot{\lambda} = -(r + \mu)\lambda \quad (12)$$

Here  $\lambda(t, v)$  is the co-state variable of real private non-human wealth at time  $t$  for a household born at time  $v$  (measured in units of utility), whose equation of motion is given in (2) or (5), that is, the present value shadow price for a household of generation  $v$  of private financial wealth and housing wealth.

From equations (8) to (12), we can obtain the following individual decision rules for consumption or consumption functions. Total consumption of both housing services and non-housing goods and services is denoted  $c = p\rho + z$ :

$$z(t, v) = (1 - \eta)c(t) \quad (13)$$

$$\rho(t, v) = \frac{\eta}{p(t)} c(t) \quad (14)$$

$$c(t, v) = \xi(t) \left[ f(t, v) + p^k(t)k(t, v) + h(t, v) \right] \quad (15)$$

where  $\xi(t)$ , the marginal propensity to consume out of comprehensive wealth, is independent of generation-specific parameters and variables.

$$\xi(t) = \left[ \int_t^\infty e^{-\int_t^s \left[ \left( \frac{\sigma-1}{\sigma} \right) r(u) + \mu + \frac{\theta}{\sigma} \right] du} \left( \frac{p(s)}{p(t)} \right)^{\eta \left( \frac{\sigma-1}{\sigma} \right)} ds \right]^{-1} \quad (16)$$

Equations (5), (7), (8) (holding with equality) and (15) imply:

$$\frac{dc(t, v)}{dt} = \left( r(t) + \mu + \frac{\dot{\xi}(t)}{\xi(t)} - \xi(t) \right) c(t, v) \quad (17)$$

For the logarithmic instantaneous felicity function  $\sigma = 1$ , this simplifies to

$$\xi(t) = \xi = \theta + \mu \quad (18)$$

and the familiar consumption Euler equation

$$\frac{dc(t, v)}{dt} = (r(t) - \theta)c(t, v) \quad (19)$$

## 2.2 Aggregation

For any individual household flow or stock variable  $y(t, v)$  we define the population aggregate  $Y(t)$  as follows: for  $\beta > 0$ ,

$$Y(t) = \int_{-\infty}^t y(t, v)S(t, v)dv \quad (20)$$

where  $S(t, v)$  is the number of households born at time  $v$  that are still alive at time  $t$ . Let  $O(t) > 0$  be the size of the population (the size of the labour force or the number of households) at time  $t$ .

$$S(t, v) = \beta O(v)e^{-\mu(t-v)} \quad (21)$$

and

$$O(v) = O(0)e^{(\beta-\mu)v} \quad (22)$$

Without loss of generality let  $O(0) = 1$ . So

$$S(t, v) = \beta e^{-\mu t + \beta v} \quad \text{if } \beta > 0 \quad (23)$$

and

$$Y(t) = \beta e^{-\mu t} \int_{-\infty}^t y(t, v) e^{\beta v} dv \quad (24)$$

We cover the case of a zero birth rate as follows:

$$\begin{aligned} \text{When } \beta &= 0, \\ y(t, v) &= y(t) \\ \text{and} \\ Y(t) &= e^{-\mu t} y(t) \end{aligned} \quad (25)$$

I also assume that each consumer is born just with his endowment of human wealth – there are no intergenerational gifts and bequests – and therefore:

$$f(t, t) + p^k(t)k(t, t) = 0 \quad (26)$$

Also, for simplicity, assume that everyone alive earns the same wage and pays the same taxes, so

$$\begin{aligned} w(t, v) &= w(t) \\ \tau(t, v) &= \tau(t) \end{aligned} \quad (27)$$

It follows that each surviving member of every generation has the same human wealth:

$$h(t, v) = h(t) \quad (28)$$

The aggregate consumption function is given by:

$$C(t) = \xi(t) \left[ F(t) + p^k(t)K(t) + H(t) \right] \quad (29)$$

$$Z(t) = (1 - \eta)C(t) \quad (30)$$

$$R(t) = \frac{\eta}{p(t)} C(t) \quad (31)$$

With

$$\frac{d}{dt}(F(t) + p^k(t)K(t)) = r(t)(F(t) + p^k(t)K(t)) + W(t) - T(t) - C(t) \quad (32)$$

$$\dot{H}(t) = [r(t) + \beta]H(t) - W(t) + T(t) \quad (33)$$

It follows that the aggregate consumption ‘Euler equation’ is given by:

$$\dot{C} = \left( r + \beta - \xi + \frac{\dot{\xi}}{\xi} \right) C - \beta \xi (F + p^k K) \quad (34)$$

With the logarithmic utility function,  $\sigma = 1$ , the aggregate consumption Euler equation (35) simplifies to:

$$\dot{C} = (r + \beta - \mu - \theta)C - \beta(\theta + \mu)(F + p^k K) \quad (36)$$

We also have the aggregate intertemporal budget constraint of the private sector. This can, using (8), be written as:

$$F(t) + p^k(t)K(t) + \int_t^\infty e^{-\int_t^s r(u)du} (W(s) - T(s)) ds = \int_t^\infty e^{-\int_t^s r(u)du} C(s) ds \quad (37)$$

Note that, from (33), the human capital of those currently alive is given by:

$$H(t) = \int_t^\infty e^{-\int_t^s (r(u) + \beta)du} (W(s) - T(s)) ds \quad (38)$$

The presence of the birth rate as an augmentation factor for the discount rate applied to future aggregate after-tax labour income in (38) is due to the assumption, built into the model, that the human wealth of future generations is

not owned by anyone currently alive. This assumption about property rights (effectively the absence of hereditary slavery and hereditary indentured labour), together with the assumption that there are no operative intergenerational gift and bequest motives, makes for the absence of debt neutrality that is a property of all OLG models that make the same two key assumptions.

### 2.3 The Accumulation of Housing Capital

There is a continuum of competitive home construction firms on the unit circle that maximize profits by accumulating housing capital and letting it out. Each firm maximises the following objective function:

$$V(t) = \int_{t^{\infty}}^{\infty} e^{-\int_t^s r(u) du} (p(s)\alpha(s)K(s) - A(s)) ds \quad (39)$$

$$\alpha > 0; K \geq 0$$

subject to the constraint that the resource cost of housing capital formation is quadratic in the investment rate,

$$A(t) = I(t) + \frac{\gamma (I(t) - (\delta + n)K(t))^2}{2K(t)} \quad (40)$$

and the capital stock adjustment identity

$$\dot{K} = I - \delta K \quad (41)$$

Here  $\gamma \geq 0$  measures the severity of the housing capital adjustment costs,  $\delta \geq 0$  is the constant proportional depreciation rate of the stock of housing capital and  $n$  is the natural real growth rate of the economy (the growth rate of the labour force in efficiency units). When  $\gamma \rightarrow \infty$  we have the case of unaugmentable capital. When  $\gamma \rightarrow \infty$  and  $\delta = 0$  we have the case of housing as ‘land’ in the sense of the unaugmentable and indestructible contribution of nature. When  $\gamma$  is positive but finite, the housing stock is fixed in the short run but augmentable in the long run. Note that the decision rule of the construction company would not change if instead of maximising its fundamental value,  $V$ , it maximised its market

value,  $p^k K = V + bK$ , where  $b$  is the bubble component in the market value of a unit of installed capital, as long as the bubble component is independent of the actions of the firm (see below).

Unlike its owners, this enterprise does not die. Its discount rate is therefore the risk-free real interest rate, without the annuity premium added (see Buiter (1989)). The production function for housing services is assumed to be linear in the capital stock and is given by  $\alpha(s)K(s)$ .

The first-order conditions for an optimum imply that optimal investment is governed by equations (42) and (43):

$$I = \left( \delta + n + \frac{1}{\gamma} (q(t) - 1) \right) K(t) \quad (42)$$

$$q(t) = \int_t^\infty e^{-\int_t^s ((r(u)+\delta)du} \left[ p(s)\alpha(s) + \gamma(\delta+n) \left( \frac{I(s)}{K(s)} - (\delta+n) \right) + \frac{\gamma}{2} \left( \frac{I(s)}{K(s)} - (\delta+n) \right)^2 \right] ds \quad (43)$$

or

$$\frac{\dot{q}}{q} + \frac{p\alpha + \gamma(\delta+n) \left( \frac{I}{K} - (\delta+n) \right) + \frac{\gamma}{2} \left( \frac{I}{K} - (\delta+n) \right)^2}{q} = r + \delta \quad (44)$$

The shadow price of the capital stock (the current value co-state variable of  $K(t)$  in (41), is Tobin's 'marginal  $q$ '. The market value of the equity held in the construction companies is also given by (39).

Because the investing firm is assumed to be a price taker, and because the production function of housing services is linear in the capital stock and the investment adjustment cost function is linear homogeneous in the investment rate and the capital stock, Tobin's marginal  $q$  also equals Tobin's average  $q$ , which is the fundamental value of a unit of installed housing capital.

This result, first established by Hayashi (1982), implies that

$$V(t) = q(t)K(t) \quad (45)$$



The intuition is, as stated in Hayashi (1982), that average Tobin's  $q$  (and marginal Tobin's  $q$ ) are independent of the initial capital stock if the production and installation functions are linear homogeneous and if the firm is a price-taker.

I write the market value of a unit of installed housing capital as

$$p^k = q + b \quad (46)$$

The first term on the RHS of (46) is the fundamental value of a unit of installed housing, defined by (43) and (42), that is, its shadow price. When  $p^k$  is interpreted not as a shadow price in a dynamic optimisation problem, where the boundary conditions for optimality ensure that the shadow price supports the optimum (that is,  $b(t) = 0$ ), but rather as an asset market price set in a market where there is no invisible hand to impose the transversality condition, there can also be a bubble term  $b(t)$  in (46). If the bubble is (myopically) rational, then

$$\dot{b} = (r + \delta)b \quad (47)$$

The competitive rental rate for housing services,  $x$ , earned by households as dividends from their ownership of housing capital (see equation (2)) is given by

$$x = p\alpha + \gamma(\delta + n)\left(\frac{I}{K} - (\delta + n)\right) + \frac{\gamma}{2}\left(\frac{I}{K} - (\delta + n)\right)^2 - \delta p^k. \quad (48)$$

## 2.4 Equilibrium in the Housing Market or Housing Autarky

We now impose economy-wide equilibrium in the housing market:

$$R(s) = \alpha(s)K(s), \quad s \geq t \quad (49)$$

It follows from (49), (46), (45), (39) and (32), that

$$\int_t^{\infty} Z(s) e^{-\int_t^s (r(u)+\beta) du} ds = F(t) + b(t)K(t) - \Lambda(t) + \int_t^{\infty} (W(s) - T(s)) e^{-\int_t^s r(u) du} ds \quad (50)$$

Here  $\Lambda(t)$ , the present discounted value of all future costs of housing investment, is given by:

$$\begin{aligned} \Lambda(t) &= \int_t^{\infty} e^{-\int_t^s r(u) du} A(s) ds \\ &= \beta e^{-\mu t} \int_{-\infty}^t \int_t^{\infty} e^{-\int_t^s (r(u)+\mu) du} a(s, v) e^{\beta v} ds dv \text{ if } \beta > 0 \\ &= e^{-\mu t} \int_t^{\infty} e^{-\int_t^s (r(u)+\mu) du} a(s, v) ds \text{ if } \beta = 0 \end{aligned} \quad (51)$$

Once we impose the housing market equilibrium or housing autarky condition, given by the first equality in (49), we can rewrite the three consumption functions in the following manner:

$$\begin{aligned} C &= \left( \frac{1}{1-\eta} \right) \xi (F + bK - \Lambda + \Omega + H) \\ Z &= (1-\eta)C \\ pR &= \eta C = \alpha K \end{aligned} \quad (52)$$

where

$$\dot{F} = rF + W - T - (1-\eta)C - A \quad (53)$$

$$\Omega(t) = \eta \int_t^{\infty} (W(s) - T(s)) e^{-\int_t^s [r(u)+\beta] du} (e^{\beta(s-t)} - 1) ds$$

or (54)

$$\dot{\Omega}(t) = r(t)\Omega(t) - \beta \eta \int_t^{\infty} e^{-\int_t^s r(u) du} (W(s) - T(s)) ds$$

$$\frac{d}{dt}(bK) = rbK \quad (55)$$

Equation (55) constrains the bubble and/or the housing investment process. If the bubble is rational, that is, it satisfies the homogeneous equation of the equation of motion driving the fundamental valuation  $q$ , as given by equation (47), it follows that the following relationship has to hold:

$$b(\delta K + \dot{K}) = 0 \quad (56)$$

This implies that either there is no rational bubble,  $b(t) = 0$  or gross housing investment is zero,  $I(t) = 0$ , and  $\dot{K} = -\delta K$ . Irrational bubbles could, of course, exist even if (56) does not hold.

### 3 The Pure Wealth Effect of House Price Changes on Consumption

The key properties of the model can be inferred from the consumption functions summarised in equations (52) to (56).

First, when the birth rate,  $\beta$ , is zero, the term  $\Omega(t)$  in equation (52) (and defined in equation (54)), housing variables affect aggregate consumption, consumption of housing services and consumption of non-housing goods and services only through the cost of future investment,  $\Lambda$ , and through the bubble term in the house price equation,  $bK$ . This is the pure case of ‘everyone always owns the house they live in’. No-one is long or short housing.

Second, when the birth rate is positive,  $\Omega(t)$  becomes positive (assuming that  $\int_t^\infty (W(s) - T(s)) e^{-\int_t^s [r(u) + \beta] du} > 0$ ). The term  $\Omega(t)$  represents the present discounted value of the housing services demanded by future generations (generations yet to be born). In a rational expectations model, this demand from future generations is reflected in today’s fundamental price.

The OLG structure of the model, which is present when  $\beta > 0$ , even though all generations currently alive have identical life expectancies  $\mu^{-1}$  because of the assumption of an age-independent probability of death, therefore invalidates the absence of wealth effects from a change in fundamental house prices found in the representative agent version of the model. All generations currently alive are ‘long housing’, because of the arrival of future generations. The present discounted value of the housing services current generations will consume is less than the present discounted value of current and future housing services demanded by both current and future generations. It is this total current and future demand for housing services, by those currently alive and by those yet to be born, that is reflected in the fundamental house price,  $q$ .

It is true that the Yaari-Blanchard version of the OLG model does not generate effects on aggregate consumption ( $C$ ,  $Z$  and  $R$ ) from changes in fundamental house prices through a *redistribution* of wealth or income among those currently alive. Age, that is, date of birth, and the distinction between those born and still alive and those not yet born, are the only sources of consumer heterogeneity in the Yaari-Blanchard model. But age in the Yaari-Blanchard model does not affect the expected remaining lifetime or the marginal propensity to consume out of wealth. The Yaari-Blanchard model does not have life-cycle effects. In the Allais-Samuelson OLG model, where households have a fixed finite lifespan, there will in general be age-specific propensities to consume, and possibly also age-specific preferences over housing and non-housing consumption. The only household heterogeneity that matters for aggregate consumption in the Yaari-Blanchard model is that between those born and still alive on the one hand and the unborn – future generations – on the other hand.

The present discounted value of the real resource cost of *future* investment in housing  $\Lambda(t)$ , given in equation (51) may of course be affected by the same factors that cause a change in the value of the existing housing stock, but that is a quite separate matter from a change in the fundamental value of the existing housing stock having a pure wealth effect on consumption. This effect of house prices on investment in housing is recognized through the housing investment function, given in equation (42), which makes gross housing investment an increasing function of Tobin’s  $q$ . So  $\Lambda(t)$  is a function not of the current price of housing capital but of the sequence of future (expected) prices of housing capital.

I summarise this discussion as three Propositions:

**Proposition 1:** In the representative agent model (the Yaari-Blanchard OLG model with a zero birth rate), a change in the fundamental value of a unit of installed housing,  $q$ , has no wealth effect on aggregate consumption demand, the demand for housing services or the consumption demand for non-housing goods and services.

**Proposition 2:** In the representative agent model (the Yaari-Blanchard OLG model with  $\beta = 0$ ), a change in the bubble component of the price of a unit of installed housing,  $b$ , is associated with a wealth effect on aggregate consumption demand, on the demand for housing services and on the consumption demand for non-housing goods and services. This bubble can only be a rational bubble if gross investment in housing equals zero.

**Proposition 3:** In the OLG version of the Yaari Blanchard model ( $\beta > 0$ ) higher fundamental house prices have a positive aggregate wealth effect and a positive effect on aggregate consumption demand, on the demand for housing services and on the consumption demand for non-housing goods and services if the higher fundamental house prices reflect (expected) demand for housing services by future generations.

### 3.1 Why the Common Error?

How did so many of students of consumption behaviour and wealth effects miss the obvious point of Proposition 1, despite the frequent use of the representative agent framework?

The most likely reason is that the standard consumption function is the decision rule of an individual, or an aggregation of such individual decision rules. When studying consumption behaviour, equilibrium conditions are not normally imposed on these decision rules. On the whole this is good practice – the fact that prices and economy-wide aggregate quantities taken as parametric by individuals are in fact endogenously determined by the interaction of these price-taking economic agents, does not mean that it is not helpful to treat individual decision rules and equilibrium conditions conceptually distinct. But when we deal with general equilibrium responses to policies or shocks, the equilibrium conditions do

of course have to be imposed. This was obviously not done in such papers as Mishkin (2008) or Mulligan and Threinen (2008).

Without imposing the ‘housing autarky’ assumption (49) and using equations (39), (45) and (46), total consumption, non-housing consumption and housing consumption can, respectively, be written as in equations (29), (30) and (31) respectively, that is, as functions of total non-human wealth,  $F + p^k K$  and human wealth,  $H$ , with the equations of motion for non-human wealth and human wealth given by (32) and (33) respectively. In this representation of the consumption function, non-housing financial wealth,  $F$  and housing wealth  $p^k K$  enter with the same marginal propensities to spend,  $\xi$ .

The equation  $C = \xi(F + p^k K + H)$  is the standard ‘permanent income’ consumption function where aggregate consumption is proportional to the sum of aggregate non-human and human wealth, and where aggregate non-human wealth includes the value of the housing stock on the same terms as other non-human wealth. However, when we impose the housing autarky assumption, the same aggregate consumption function can be written as

$$C = \left( \frac{1}{1-\eta} \right) \xi(F + bK - \Lambda + H + \Omega)$$

and the absence of a pure wealth effect of fundamental housing wealth on aggregate consumption demand is confirmed when  $\beta = 0$  because this implies  $\Omega = 0$ . When housing is pure ‘land’, that is non-augmentable and indestructible, then  $\Lambda = 0$  and the consumption function simplifies to

$$C = \left( \frac{1}{1-\eta} \right) \xi(F + bK + H + \Omega).$$

This makes it even clearer that in the model under consideration, in the representative agent special case, when  $\beta = \Omega = 0$ , a change in housing wealth affects consumption if and only if it is due to a change in the speculative bubble component of house prices.

## 3.2 Qualifications of the Housing Wealth Irrelevance Result

### 3.2.1 Wealth isn't Well Being

At the risk of belabouring the obvious, Proposition 1 says that, in the representative agent version of the model, a change in the fundamental value of a unit of housing does not lead to any change in consumption demand. However, since  $R(t) = \alpha(t)K(t)$ , a larger physical stock of housing capital increases equilibrium consumption of housing services and raises utility - makes you better off. Wealth (the value of your endowments) bears no obvious relation to utility in any case, as wealth values the infra-marginal units of assets at the marginal contribution to lifetime utility of the last unit: in a world without scarcity, all endowments would be valued at zero and wealth would be zero, but utility would be maximal.

### 3.2.2 Changes in Housing Wealth due to a Housing Bubble

Proposition 2 points out that when the change in the house price is due to a bubble rather than to a change in fundamental value, that is,  $b(t) \neq 0$  in equation (52), the change in house prices does represent a pure wealth effect. Even if the economy is autarkic in housing, the bubble-inclusive price of the house exceeds the value of the endowment of current and future housing services by the amount of the bubble. Whether the housing market in the US or elsewhere has been characterised by a speculative bubble between, say, 2000 and 2007 is a hotly debated issue (see e.g. Case and Shiller (2003) and Himmelberg, Mayer, and Sinai (2005)). In the simple model of the paper, the marginal propensity to spend out of a change in house prices due to a change in the bubble component of the house price is the same as the marginal propensity to consume out of any other component of non-human or human wealth. Note again that if there can be non-zero gross investment in housing, then there cannot be (myopically) rational speculative bubbles (speculative bubbles that satisfy  $\dot{b} = (r + \delta)b$ , the homogenous equation of the equation of motion for the fundamental value of housing given in equation (44)).

The empirical relevance of asset bubbles is a contested issue. Clearly, if the fundamentals driving house prices are stationary but house prices are non-stationary, a non-stationary bubble must be present. With finite length time series, however, it is very difficult to distinguish between the hypothesis that the

fundamentals are stationary and there is a non-stationary bubble, and the alternative interpretation that the fundamentals themselves are non-stationary, in which case no bubble is required to rationalise the non-stationarity of house prices. Recent studies by Laibson (2009) and Khandani et al. (2009) have stressed the contribution of rising house prices to consumer demand in the US, prior to the financial crisis that started in August 2007. Both these studies come down on the side of a possible role for speculative bubbles in driving US house prices. The issue remains, however, open.

My definition of an asset price bubble is the standard one: an asset price bubble is any deviation between the market price of the asset and its fundamental price - the present discounted value of the future earnings stream to which the asset represents a claim. In practice, when the future earnings stream is uncertain and the appropriate (stochastic) discount factors cannot be readily and objectively observed, the distinction between the bubble component and the fundamental component of an asset price may not be as easily established as in my theoretical paper. With imperfect information and observation, the distinction between bubbles and misperceptions about the drivers of the fundamental valuation can become fuzzy. Indeed, as shown in an early (unpublished) paper by myself and Paolo Pesenti (Buiter and Pesenti (1990)) we should that rational speculative bubbles could even be functions of the same variables that drive the fundamental valuation.

Finally, in a dynamic model in which the future behaviour of predetermined state variables, like the capital stock, can be influenced by today's asset bubbles, the distinction between bubbles and fundamentals becomes further blurred, because today's bubbles shape tomorrow's fundamentals. This blurring of the distinction between bubbles and fundamentals is closely related to the notion of reflexivity developed by George Soros (2009), in which imperfect cognition and human action interact to produce the possibility of self-fulfilling prophecies. If faulty past and present expectations affect prices, if these prices influence present and future fundamentals and if these fundamentals in turn shape future expectations etc., then the economy can generate self-reinforcing patterns that do not in any meaningful sense tend towards equilibrium. A serious consideration of this important class of issues is clearly beyond the scope of this paper.



### 3.2.3 Distributional Effects, including Intergenerational Distribution

In more general OLG models, especially those with systematic variations in household size over the life cycle and with age-dependent propensities to consume (among other reasons because remaining (conditional) life expectancy is negatively related to age after some point), a decline in house prices redistributes wealth from those for whom the value of the housing stock they own is greater than the present discounted value of their future consumption of housing services to those for whom the value of the housing stock they own is less than the present discounted value of their future planned consumption of housing services. That is, a house price decline redistributes wealth from homeowners to tenants.

In Proposition 3, I showed that even in the Yaari Blanchard model, redistribution through higher fundamental house prices from the unborn to those current alive will make those currently alive better off if the price increase reflects a higher future demand for housing services by those not yet born. It therefore raises aggregate consumption today.

More generally, in a life-cycle model, the young, and all others planning to trade up in the housing market in the future will benefit from a current decline in house prices. The old and all others planning to trade down in the housing market in the future will lose when house prices fall. If the old have higher marginal propensities to consume out of wealth, as life-cycle principles would suggest, this means that a redistribution from the young to the old through higher house prices will boost aggregate consumption. If younger households, and especially younger households with rising age-earnings profiles (e.g. yuppies) are liquidity-constrained, the marginal propensity to consume of these yuppie households (who are short housing) could be larger than the marginal propensity to consume of the old. Higher house prices would then depress aggregate consumption through the redistribution channel. An Allais-Samuelson overlapping generations model is the natural vehicle for analyzing these intergenerational distributional effects. Other distributional effects can occur in open economies where the residents are tenants of non-resident landlords.

### 3.2.4 Credit or Collateral Effects

Finally, unlike human capital, housing wealth is collateralisable. This means that households can borrow using the value of the homes they own as security.

Unsecured borrowing is more expensive than secured borrowing and may often not be possible on any terms. With free labour (no slavery or indentured labour), future labour earnings cannot be collateralised in a legally enforceable way and, unless reputational concerns are a powerful motivator, commitments to use future after-tax labour income to service unsecured debt may not be credible. Housing wealth therefore permits credit constraints to be relaxed (see e.g. Hurst and Stafford (2004), Iacoviello (2004) and Klyuev and Mills (2006)). A decline in house prices reduces the amount households can borrow (through ‘mortgage equity withdrawal’ or MEW). Assuming that human wealth is not collateralisable at all, a simple way to bring the housing collateral role into the model of this paper is to introduce the further constraint on individual household optimisation that net financial wealth cannot be negative, or that it is bounded from below:

$$\begin{aligned} -f(t, v) &\leq p^k(t)k(t, v) + \chi(t, v) \\ \chi &\geq 0 \end{aligned} \tag{57}$$

or, in the aggregate version:

$$\begin{aligned} -F(t) &\leq p^k(t)K(t) + X \\ X &\geq 0 \end{aligned} \tag{58}$$

This constrains net debt not to exceed the value of the housing stock plus some (exogenous) maximum amount of unsecured borrowing,  $\chi$  for the individual and  $X$  for the aggregate population. If this constraint is binding, a fall in house prices will clearly lower aggregate consumption in the short run, regardless of whether housing price changes have a pure wealth effect, that is, even in the representative agent version of the model. In the long run it will, for given sequences of wages and real interest rates, lower consumption, because of the greater household net indebtedness permitted by the relaxation of the borrowing constraint.

In his simulation of the effect of a house price decline on consumption and investment demand in the US, Mishkin (2008) captured this credit effect of a change in house prices by assigning to housing wealth double the long-run marginal propensity to consume (0.076) he assigned to other financial wealth (0.038). There are two problems with this approach.

First, because of the housing autarky argument, the model of this paper suggests that, without the collateral/credit effect, the marginal propensity to consume out of housing wealth would be zero, not 0.038 in the representative agent version of the model. The redistributive effects of an increase in house prices in OLG models do favour a net expansionary effect from higher house prices if the higher prices reflect future demand by generations as yet unborn. Redistribution from the young to the old caused by higher house prices will tend to boost aggregate consumption for life-cycle reasons but may depress it if the young are more likely to be liquidity-constrained than the old. It is therefore doubtful that the benchmark wealth effect of house price changes in the absence of collateral constraints should be assigned the value 0.038 used for all consumption in the FRB/US model.

Second, Mishkin's specification assumes that adding a binding collateral constraint always raises the marginal propensity to consume. However, the debt incurred through MEW has to be serviced. Although current consumption will be higher as a result of a household's ability to relax a borrowing constraint by increasing the size of its mortgage, the present discounted value of future consumption will have to be lower. At market interest rates, the present discounted value of current and future consumption does not change as a result of a decline in house prices and the associated tightening of the credit constraint. There will of course be behavioural consequences because the shadow price of credit exceeds the market price of credit in the credit-constrained equilibrium.

Modelling the credit effect of a house price decline properly would introduce it as a tightening of a borrowing constraint, but with the household's intertemporal budget constraint satisfied both in the benchmark (with borrowing collateralised against property) and in the counterfactual simulation (with lower MEW). It may not be easy to determine reliably when the consumption-reducing effect of increased debt service will kick in and dominate the consumption-increasing effect of higher borrowing potential for a credit-constrained household, but to assume, as Mishkin does, that it never kicks in surely makes no sense.

## 4 Conclusion

The value of a house is its fundamental value – the present discounted value of its future actual or imputed rentals – plus a speculative bubble component, if any. A fall in house prices due to a change in its fundamental value redistributes wealth from those long housing (for whom the fundamental value of the house they own exceeds the present discounted value of their planned future consumption of housing services) to those short housing (from whom the fundamental value of the house they own is less than the present discounted value of their planned future consumption of housing services). In a closed economy representative agent model there is no pure wealth effect on consumption from a change in house prices if this represents a change in their fundamental value. In the Yaari-Blanchard model with a positive birth rate, higher fundamental house prices will boost aggregate consumption if the higher prices reflect higher expected future housing demand by generations yet to be born.

There is a pure wealth effect on consumption from a change in house prices if this reflects a change in the bubble component of house prices, even in the representative agent special case.

Two other channels, not considered in the formal model, through which a fall in house prices can affect aggregate consumption are (1) redistribution effects if the marginal propensity to spend out of wealth is different between those long housing (the old, say) and those short housing (the young, say) and (2) collateral or credit effects due to the collateralisability of housing wealth and the non-collateralisability of human wealth. A decline in house prices reduces the scope for mortgage equity withdrawal. For given sequences of future after-tax labour income and interest rates, this may depress consumption in the short run while boosting it in the long run.

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