GLOBALIZATION AND FINANCIAL DEVELOPMENT:
A MODEL OF THE DOT-COM AND THE HOUSING BUBBLES

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Abstract

In the last decade the United States experienced a large sudden drop in both the stock market and house prices. These two episodes have been referred to as the burst of the Dot-Com and the Housing Bubbles. In this paper I develop a model to study the relationship between international trade and the emergence of rational bubbles and analyze how the effect of globalization on house prices depends on the type of bubble. The model is a three-period OLG economy in which young agents borrow to purchase a house and middle-aged agents save to consume when they are old. Agents can only borrow a fraction of the value of the house. The quality of financial institutions determines this fraction. Bubbles cannot arise in a financially developed country in autarky. In contrast, pure asset price and/or housing bubbles can appear when a financially developed country opens up to trade with a financially underdeveloped country. As globalization progresses, the possibility of having a bubble in the financially developed country increases. I also show that an increase in globalization raises house prices when there is a housing bubble but it has no effect on house prices if the bubble is not attached to houses. This prediction is consistent with empirical evidence on house prices for U.S. metropolitan areas. An increase in U.S. current account deficit (over GDP) has a significant effect on real house price appreciation during the Housing Bubble. This effect is larger, the lower the housing supply elasticity is. However, an increase in U.S. current account deficit does not have a significant effect on house price appreciation during the Dot-Com Bubble.

Keywords: Financial development, globalization, rational bubbles, housing supply elasticity.

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1 Introduction

In the last decade the United States experienced a large and sudden drop in both the stock market and house prices. Figure 1 shows these drops using the S&P-500 and Case-Shiller house price indices (in real terms). Some economists relate these trends in house prices and stock market to changes in fundamentals. However, there is a growing consensus that the large drop in the stock market in 2000 was due to the burst of the Dot-Com Bubble and the sharp fall in house prices in 2006 was due to the crash of the Housing Bubble.\(^1\) Consistent with this view, throughout the paper I will assume that there were two different bubbles.

Figures 2 and 3 show the relationship between house prices and current account (over GDP) for the United States and the United Kingdom, respectively. There exists a strong and negative correlation between both series. This relationship holds for a larger set of countries, as shown in, for example, Aizenman and Jinjarak (2008) or Laibson and Mollerstrom (2009). Many economists (e.g. Bernanke 2005) suggest that the \textit{savings glut} was responsible for these \textit{global imbalances}. Therefore, it hints to an effect of global imbalances on house price appreciations.

Some papers argue that the integration of financially underdeveloped countries into world capital markets, to which I refer as globalization, created global imbalances.\(^2\) Nonetheless, its relationship with the emergence of rational bubbles has been largely ignored. This paper provides a framework to understand the effect of globalization on the existence of bubbles. It also distinguishes the effect of globalization on house prices depending on the type of bubble.

This paper yields two main results. The first result is that the possibility of having bubbles in a financially developed country increases with globalization. The intuition is that rational bubbles can only arise if there is a shortage of assets. Under autarky, this can only happen if a country is financially constrained. In the integrated economy, however, bubbles can arise in any country if there is excess demand for assets at the world level. As globalization progresses, more financially underdeveloped countries have access to world capital markets, which makes the world economy more financially constrained and increases the likelihood of having a rational bubble.

My second result highlights the differential effect that globalization has on house prices depending on the type of bubble. House prices are higher with a bubble because the interest rate is lower, which raises housing demand. However, conditional on having a bubble, an increase in globalization raises house prices only if the bubble is attached to houses. The reason is that an increase in globalization affects house prices through two channels. First, it reduces the interest rate, which raises housing demand. Second, it increases the size of the bubble, which raises housing demand if the bubble is attached to houses. When there is a bubble, the interest rate is constant and globalization affects house prices only through the size of the bubble. Therefore, house prices increase with globalization only if the bubble is attached to houses. The empirical section shows that this prediction is consistent with the Dot-Com and the Housing Bubbles using U.S. metropolitan

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\(^1\)See, among others, Case and Shiller (2003) and Shiller (2005) for a discussion on the existence of the Dot-Com and the Housing Bubbles.

\(^2\)See, for example, Caballero et al. (2008a) for a model of global imbalances and financial development without bubbles.
The model is a three-period OLG economy. In the first period, young agents earn a wage and borrow to purchase a house. In the second period, middle-aged agents enjoy housing services, repay the debt, sell the house and save to consume when they are old. In the last period, old agents consume the return on their savings. These assumptions are meant to capture two aspects of the life-cycle. First, the net asset position is negative when agents are young and it increases over time. Second, young agents borrow to purchase a house and enjoy housing services when middle-aged.

An important feature of the model and the source of rational bubbles is that agents may be financially constrained. Young agents can only borrow a fraction of the value of the house. Moreover, the quality of financial institutions determines this fraction. Therefore, in this model, all debt is collateralized by houses.\(^3\)

There are also developers and consumption good producers. They live one period and hire workers in a competitive labor market to produce houses and consumption goods, respectively. The consumption good is perishable. Houses are durable and depreciate at a constant rate.

Section 2 computes the steady-state equilibrium for a financially developed and a financially underdeveloped country when both countries are in autarky. I show that rational bubbles cannot appear in a financially developed country, which is not financially constrained, because the economy is dynamically efficient. However, bubbles can appear in the financially underdeveloped country. The intuition is that middle-aged agents want to increase their savings to consume more in the last period but there are not enough assets in the economy. Asset supply is limited by the amount of debt of young agents, who are financially constrained. Therefore, bubbles can arise in equilibrium because they increase the asset supply and solve the shortage of assets. This result is similar to those in Arce and López-Salido (2008) and Farhi and Tirole (2008).

In section 3 I assume that the world consists of two countries, a financially developed and a financially underdeveloped country. The consumption good and capital are tradable but houses are non-tradable and labor cannot migrate. In the trade equilibrium without bubbles, capital flows from the financially underdeveloped to the financially developed country because agents in the former country invest a fraction of their savings in the latter, which has better financial institutions and can generate more assets. There is a current account deficit in the financially developed country. This is analogous to Caballero et al. (2008a). Assets are used by middle-aged agents as a store of value. Thus, when capital flows towards the financially developed country, the value of its assets increases, they become scarcer, which reduces the interest rate. A novelty of this paper is to emphasize the effect that these capital inflows have on house prices. House prices are higher in the financially developed country because housing demand decreases with the interest rate.

Another contribution of the paper is to study, in subsections 3.2 and 3.3, the effect of globalization on the existence of bubbles. First, I show that bubbles, either attached or detached to houses, can arise in the integrated equilibrium. Then, I assume that the financially underdeveloped economy consists of a continuum of mass one of identical countries and only a certain fraction of these

\(^3\)I interpret this borrowing constraint as financial development but it could also be interpreted as liquidity like in, for example, Farhi and Tirole (2008) and, in an extreme version, Woodford (1990).
countries have access to world capital markets. I define globalization as an increase in this fraction. As globalization progresses, the possibility of having bubbles in the financially developed country increases. Intuitively, as more financially underdeveloped countries gain access to the assets of the financially developed country, it becomes more likely that there exists a shortage of assets in the world economy. If a pure asset price bubble arises in the financially developed country, house prices are higher because the interest rate with the bubble is lower. If the bubble is attached to houses, house prices are even higher because, in addition to the low interest rate, the bubble raises, directly, housing demand. Finally, I show that the trends in house prices, current account and interest rates in the United States in the last twenty years are consistent with the predictions of the model.

Section 5 derives the most salient empirical prediction of the model. House prices are higher with a bubble, either attached or detached to houses. However, the model predicts that, conditional on having a bubble, an increase in globalization raises house prices only if the bubble is attached to houses. The intuition is that as globalization progresses, more capital flows towards the financially developed country, which affects house prices through two channels. First, the interest rate falls which raises housing demand and house prices. Second, the size of the bubble increases. The size of the bubble affects housing demand only if the bubble is attached to houses. When there is a bubble, the interest rate is constant and globalization affects house prices only through the second channel. Thus, only when the bubble is attached to houses, an increase in globalization raises house prices. Moreover, the effect on house prices is larger, the lower the housing supply elasticity is.

Section 6 provides empirical evidence consistent with the main prediction of the model using house prices at the metropolitan statistical area level in the United States from OFHEO, current account deficit (over GDP) from the IMF and housing supply elasticities estimated in Saiz (2009). The sample consists of 138 metropolitan areas from 1983 to 2007. I define the Dot-Com Bubble period from 1996 to 2000 and the Housing Bubble from 2002 to 2006. I find, consistent with the model, that an increase in current account deficit has a significant effect on real house price appreciation during the Housing Bubble and this effect is larger, the lower the housing supply elasticity is. However, the effect is not significant (and it has the opposite sign) during the Dot-Com Bubble.

Finally, I perform welfare analysis in section 4. Welfare of households is higher with a pure asset price bubble. The reason is that the only difference between both types of bubbles is the price distortion of the housing bubble. However, profits of developers are higher with a housing bubble. When I study whether welfare in the financially developed country is higher in the trade equilibrium with bubbles, the same intragenerational problems arise. The interest rate is lower in the steady-state with bubbles which favors middle-aged agents who enjoy higher housing services and developers who earn more profits, but old agents lose because the return on their savings is

lower. Welfare in a financially underdeveloped country participating in the world capital market is higher without a bubble when capital markets are very integrated. The intuition is that when capital markets are very integrated, the gain for having additional assets is offset by the fall in the interest rate.

*Related literature.* This paper relates to different strands of the literature on rational bubbles, financial development, global imbalances and housing. There exists a large literature on the efficiency of the market equilibrium and the role of assets without fundamental value. It includes, among others, the seminal paper of Samuelson (1958), Cass (1972), Diamond (1965) and Shell (1971). As discussed in these papers, under certain conditions, the market equilibrium may be inefficient and assets without fundamental value, bubbles, may improve the market allocation. In my autarky constrained equilibrium, bubbles complete the market by adding assets to the economy.

The literature on rational bubbles is rich and diverse. This list includes the seminal paper of Tirole (1985) and, among others, Allen and Gale (2000), Arce and López-Salido (2008), Caballero et al. (2006), Caballero and Krishnamurthy (2006), Farhi and Tirole (2008), Hellwig and Lorenzoni (2008), Santos and Woodford (1997), Tirole (1982), Ventura (2003) and Ventura (2004). The discussion on the existence of bubbles in a closed economy is related to Tirole (1985) and Santos and Woodford (1997). I consider an overlapping generation economy as in Tirole. However, as emphasized in Santos and Woodford, the distinction between an infinitely lived agent and an overlapping generation is not crucial for the existence of rational bubbles. My results only hinge on the different borrowing constraints in both countries. In autarky, bubbles can only appear in the financially underdeveloped country because its agents are financially constrained and the economy does not generate enough assets. The role of the borrowing constraint was also emphasized in, for example, Farhi and Tirole (2008) and Arce and López-Salido (2008). Farhi and Tirole build a closed economy model and also show that rational bubbles can appear when liquidity is scarce. My housing model and discussion on the existence of bubbles in autarky are similar to Arce and López-Salido. However, their model is a closed economy and they only consider partial equilibrium.

Ventura (2004) is the first to study the relationship between bubbles and trade. However, the intuition why bubbles arise in the integrated equilibrium is more related to Ventura (2003). He considers a closed economy with a segmented financial market. In his model, there are inefficient investors who prefer a bubble over their investment opportunity and efficient investors who prefer their investment. This is similar to having a constrained and an unconstrained economy. The difference is that in my model constrained agents can invest in the unconstrained economy and bubbles cannot appear if the unconstrained economy can generate enough additional assets. In his model, the existence of inefficient investors is sufficient for the emergence of bubbles in equilibrium. This paper is also related to Caballero et al. (2006). They consider a closed economy and show that if there is a jump in the savings rate, the economy can transit from a steady state in which bubbles are not possible to one in which bubbles are possible. They construct an example to show

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5I assume that the unconstrained economy is productive enough. In the model, it will translate into assuming that the depreciation rate is small.
that this jump could be given by capital flows. Nonetheless, they do not study why these countries are different nor the effect of globalization for different types of bubbles.

There exist several papers which study the current account deficit in the United States. Laibson and Mollerstrom (2009), Kraay and Ventura (2007) and Ventura (2001) also link the current account deficit with the appearance of bubbles. These papers are mostly silent about the "South" and focus on the current account implications of having asset price bubbles in the United States. Blanchard et al. (2005), Caballero et al. (2008a, 2008b), Dooley and Garber (2007) and Obstfeld and Rogoff (2005), among others, study the current account deficit without relying on bubbles. The closest papers are Caballero et al. (2008a, 2008b). They show that shocks that reduce the aggregate asset supply, generate (permanent) current account deficit in the region with "better" assets. A financially developed country opening up to trade with a financially underdeveloped country is analogous to a reduction in the aggregate supply of assets. However, they do not study the relationship between globalization and bubbles and their model does not include housing.

My empirical analysis is related to different papers on house price appreciations, for example, Aizenman and Jinjarak (2008), Case and Shiller (2003), Glaeser et al. (2008) and Saiz (2009). Aizenman and Jinjarak (2008) study a cross-section of 43 countries for the period 1990-2005 and find that the level of current account deficit is correlated with house price appreciation. Glaeser et al. (2008) find that during house price booms, prices react more in U.S. cities where the housing supply is less elastic. The two main differences is that I am interested in the effect of an increase in the current account deficit and that I divide, consistent with my model, their 1996-2006 housing boom period in two sub-periods, the Dot-Com and the Housing Bubbles.

The main contribution of the paper is to provide a tractable framework to understand the effect of globalization on the emergence of bubbles and analyze the effect of globalization on house prices for different types of bubbles. In the model, the bubble can be attached or detached to houses. Agents derive utility from housing services and real resources are used to build houses. Moreover, houses are used as collateral to borrow.

2 A Model of Housing with Bubbles: Autarky

This section develops a housing model with borrowing constraints and shows that, in autarky, rational bubbles cannot appear in a country with developed financial institutions but bubbles can arise in financially underdeveloped countries.

My framework is a three-period OLG economy which is meant to capture two elements of the life-cycle. First, the net asset position of agents is negative when they are young and it becomes positive as they grow older. Second, one of the reasons why young agents borrow is to purchase a house and enjoy housing services when middle-aged.

An important feature of the model is that households may be financially constrained. Agents can only borrow a fraction of the value of the house. The quality of financial institutions determines this fraction. Thus, agents can borrow more against their house in more financially developed countries.
2.1 Setup

I consider an OLG economy with three generations: young, middle-aged and old. Each generation consists of a continuum of agents of mass one. Young agents are endowed with one unit of labor that they inelastically supply to the labor market. Middle-aged and old agents do not have any endowment. Both the endowment and the population are constant over time.

Households consume housing services when they are middle-aged and consumption good when they are old. The lifetime utility of a household born at time $t$ is

$$U_t = \log(h_{2,t+1}) + \log(c_{3,t+2}),$$

where $h$ and $c$ are housing services and consumption good, respectively, and 2 and 3 stand for middle-aged and old period. The consumption good is perishable. Houses are durable goods, which depreciate at a constant rate $\delta$.

The timing of events for a household born at time $t$ is as follows.

1. At time $t$, the agent is young. She works and receives a wage $w_t$. After receiving the wage, she chooses how much housing $h_{2,t+1}$ she wants to enjoy when middle-aged. Houses must be purchased to enjoy housing services.

2. If the value of the house $p_t h_{2,t+1}$ exceeds her wage, the young agent can borrow an amount $d_t$. I assume that loan repayment is imperfectly enforceable. A young agent with wage $w_t$ needs to borrow $p_t h_{2,t+1} - w_t$. She is supposed to repay $R_t [p_t h_{2,t+1} - w_t]$ when middle-aged. However, if a young agent spends a fraction $\theta$ of the value of the house while being young, she can avoid repayment when middle-aged. I interpret $\theta$ as an index of the quality of financial institutions. It is easier to avoid repayment in less financially developed countries. Thus, the lender will lend to the borrower only up to the point where $R_t [p_t h_{2,t+1} - w_t] \leq \theta R_t p_t h_{2,t+1}$. It follows that $w_t \geq (1 - \theta) p_t h_{2,t+1}$. In other words, young agents need to make a down payment of, at least, a fraction $1 - \theta$ of the value of the house $p_t h_{2,t+1}$ when purchasing it. This implies that the borrowing constraint is $d_t \leq \theta p_t h_{2,t+1}$. The important feature and the source of rational bubbles in this model is that agents may be financially constrained. Other formulations of the borrowing constraint would give qualitatively similar results.

3. At time $t + 1$, the agent is middle-aged. She repays the debt $R_t d_t$ and sells the house at the end of the period. Houses depreciate, therefore, she obtains $(1 - \delta)p_{t+1} h_{2,t+1}$. She chooses an amount of savings $a_{t+1}$ to consume when she is old.

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6 This is a simplifying assumption. If middle-aged and/or old agents had an endowment, the threshold of $\theta$ below which households are constrained should be modified but all the qualitative results would hold.

7 The qualitative results of the paper go through if the borrowing constraint is, for example, an ad-hoc constraint like $d_t \leq \theta$ or it depends on future house prices instead of current prices, like $d_t \leq \theta (1 - \delta)p_{t+1} h_{2,t+1}$. The details of the model with these alternative borrowing constraints are available upon request.

8 Middle-aged agents could keep the house and sell it when they are old. However, in this model it is always better to sell the house when you are middle-aged. This is true because, in equilibrium, the return on savings is higher than the house price appreciation.
4. At time $t + 2$, the agent is old. She consumes the returns on her savings $R_{t+1}a_{t+1}$ and dies.

Therefore, the budget constraint for young, middle-aged and old agents are, respectively,

$$\begin{align*}
p_h h_{2,t+1} & \leq d_t + w_t, \quad (1) \\
R_t d_t + a_{t+1} & \leq (1 - \delta)p_{t+1} h_{2,t+1}, \quad (2) \\
c_{3,t+2} & \leq R_{t+1} a_{t+1}, \quad (3)
\end{align*}$$

the borrowing constraint is

$$d_t \leq \theta p_t h_{2,t+1}, \quad (4)$$

and the non-negativity constraints are $d_t \geq 0, a_{t+1} \geq 0, h_{2,t+1} \geq 0, c_{3,t+2} \geq 0$.

The production side of the economy is described by the consumption good and housing production functions. The production function of the consumption good is $f(l_c^c)$ with $f' > 0$ and $f'' \leq 0$, where $l_c^c$ denotes workers employed in the consumption good sector. Similarly, the production function of houses is $g(l_h^b)$ with $g' > 0$ and $g'' < 0$, where $l_h^b$ denotes workers employed in the housing sector.

I assume that there are developers who run the housing production function and consumption good producers. Both live one period and consist of a mass of one. They choose the number of workers to maximize their profits taking wages and prices as given. They use their profits to consume the consumption good, which is the numéraire.

Labor market clearing requires that the labor demand in the consumption sector $l_c^c$ and the construction sector $l_h^b$ equals the supply. Thus, $l_c^c + l_h^b = 1$ at each date $t$.

Housing market clearing requires that the demand equals the supply of houses. The supply of houses in period $t + 1$ is the new houses $g(l_h^b)$ plus the remaining stock of undepreciated houses of period $t$,

$$H_{t+1}^S = g(l_h^b) + (1 - \delta)H_t^S. \quad (5)$$

I explicitly derive the housing demand in the next subsection. However, it is worth noting that housing demand is a function of both current and future prices. An increase in the current price, reduces housing demand. However, houses are also an asset. Therefore, an increase in future house prices raises the capital gains of middle-aged agents and increases housing demand. This suggests that the equilibrium house prices will be defined in a recursive form.

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\footnote{The assumption that developers only live one period is without loss of generality. Given the technological assumptions, an infinitely-lived developer would solve the same problem. The only relevant assumption is that households do not own the firm. If young agents own the firm, the threshold of $\theta$ which determines when agents are constrained is the same. Otherwise, this is equivalent to middle-aged and/or old agents receiving an endowment and, as discussed in footnote 6, the threshold should be modified but all qualitative results would hold.}
The only financial instrument in this economy are bonds, which are in zero net supply. Thus, the capital market clears when savings of middle-aged agents equal borrowing of young agents.

For simplicity, I assume that the production functions for houses and consumption good are \( g(l^h) = (l^h)^\rho \) and \( f(l^c) = \gamma l^c \), respectively.

2.1.1 Equilibrium

**Definition** A competitive equilibrium is a sequence of house prices \( p_t \), wages \( w_t \), interest rate \( R_t \), choices of consumption \( c_t \), housing services \( h_t \), savings \( a_t \) and debt \( d_t \), an allocation of labor in the construction \( l^h_t \) and consumption good sector \( l^c_t \) for all \( t \geq 0 \) with initial condition \( H_{-1} \) such that households maximize their utility given their income, firms maximize profits and all markets clear.

In the next subsections, I compute the autarky steady-state equilibrium for two countries which only differ in terms of the borrowing constraint. In particular, I consider a financially developed economy \( U \) with a level of institutions \( \theta^U \) and a financially underdeveloped economy \( C \) with \( \theta^C \).

**Assumption** \( \theta^U > \theta^* > \theta^C \) where \( \theta^* = \frac{2(1-\delta)}{2-\delta+\sqrt{\delta^2+8(1-\delta)}} \).

This assumption implies that agents in country \( C \) are financially constrained and agents in country \( U \) are unconstrained.

2.2 Financially Developed Country

In this subsection I compute the steady-state equilibrium for a financially developed country \( U \) and show that rational bubbles cannot arise if this country is in autarky.

I assume that the depreciation rate \( \delta \) is small enough so that the economy is dynamically efficient in autarky. In particular, \( \delta < 1/3 \).

The problem of a household born at time \( t \) in country \( U \) is

\[
\max_{\{h_{2t+1},c_{3t+2},d_{t},a_{t+1}\}} U_t = \log(h_{2,t+1}) + \log(c_{3,t+2})
\]

subject to the budget constraints (1) to (3), the borrowing constraint (4) and non-negativity constraints.

Households living in a financially developed country are unconstrained (i.e., \( \theta^U \geq \theta^* \)). Therefore, the budget constraints (1) to (3) bind in equilibrium, the borrowing constraint (4) holds with inequality and the optimization problem can be rewritten as

\[
\max_{\{h_{2t+1},c_{3t+2}\}} U_t = \log(h_{2,t+1}) + \log(c_{3,t+2})
\]

subject to

\[
\left[ p_t - (1-\delta)\frac{p_{t+1}}{R_t} \right] h_{2,t+1} + \frac{1}{R_{t}R_{t+1}} c_{3,t+2} = w_t.
\]
Each household chooses housing services $h$ and consumption good $c$ to maximize her lifetime utility given the budget constraint (6). Equation (6) says that the present value of consumption equals the present value of income. The user cost of a house is the purchasing minus the (discounted) selling price.

This maximization problem can be graphically seen in figure 4. Utility is maximized when the marginal rate of substitution between housing services and consumption good equals their relative price, point $U$. Given the lifetime utility, each household optimally chooses to spend half of her wealth in housing services and half in consumption good.

$$h_{2,t+1} = \frac{1}{2} \frac{w_t}{p_t - (1 - \delta) \frac{p_{t+1}}{R_t}}$$

$$c_{3,t+2} = \frac{1}{2} w_t R_t R_{t+1}.$$

Housing expenditure $\left[ p_t - (1 - \delta) \frac{p_{t+1}}{R_t} \right] h_{2,t+1}$ represents half of total income $w_t$ and consumption expenditure $\frac{1}{R_t R_{t+1}} c_{3,t+2}$ the other half. Housing demand decreases with the purchasing price and increases with the future selling price.

Finally, after solving for the housing and consumption choices, I use the budget constraints (1) to (3) to find the savings and borrowing choices which will determine the equilibrium interest rate.

$$a_{t+1} = \frac{w_t}{2} R_t,$$

$$d_t = \frac{w_t}{2} \left[ \frac{2(1-\delta) p_{t+1}}{R_t} - p_t \right].$$

Savings (or asset demand) $a$ are increasing with the interest rate and borrowing (or asset supply) $d$ is decreasing with the interest rate. Moreover, since borrowing is directly related to housing demand, it increases with the discounted selling price and decreases with the purchasing price. Finally, the asset supply decreases with the depreciation rate. The reason is that all debt is collateralized by houses.

Before computing the rest of the equilibrium, it is useful to do a comparative statics exercise with the interest rate. A decrease in the interest rate $R_t$ represents a fall in the price of a house (it decreases the user cost) and it increases the "price" of delaying consumption. Graphically, figure 5 represents a decrease in the interest rate and the new optimal choice, point $U'$. Consumption good decreases and housing services increase. Savings are proportional to consumption, therefore, savings and the interest rate are positively related.

To find the housing supply and labor demand in the construction sector, I need to consider the problem of a developer. A developer takes house prices and wages as given and chooses the number of workers she wants to employ, in order to maximize her profits,
\[
\max_{\{l^h_t\}} \pi_t^h = p_t g(l^h_t) - w_t l^h_t.
\]

Then, the labor demand in the housing sector is \( p_t g'(l^h_t) = w_t \).

Similarly, the problem of a producer of consumption good is to choose the number of workers \( l^c_t \) to maximize her profits,

\[
\max_{\{l^c_t\}} f(l^c_t) - w_t l^c_t.
\]

It follows that labor demand in the consumption good sector is \( f'(l^c_t) = w_t \).

By Walras’ Law I can focus on three markets to compute the steady-state equilibrium: the capital, the housing and the labor markets. There is a zero net supply of bonds. Thus, the capital market clears when aggregate savings \( A \) equal aggregate debt \( D \). Using the household choices, the capital market clearing condition is

\[
A = \frac{w}{2} R = \frac{w}{2} \left[ \frac{2(1-\delta)}{R} - 1 \right] = D. \tag{7}
\]

Housing supply is given by (5) and housing demand follows from household maximization problem. Therefore, the housing market clearing condition is

\[
H^s = \frac{g(l^h_t)}{\delta} = \frac{1}{2} \frac{w}{p - (1 - \delta) \frac{p}{R}} = H^D. \tag{8}
\]

Aggregate labor supply is one and labor demand comes from the developer and the consumption good producer problem. Then, the labor market clearing condition is

\[
l^c + l^h = 1, \tag{9}
\]

with \( pg'(l^h) = w \) and \( f'(l^c) = w \).

Finally, using the capital (7), the housing (8) and the labor market clearing conditions (9), I derive all the equilibrium outcomes.

\[
l^h = \left[ \frac{p}{\gamma} \right]^{1+\xi}, \quad l^c = 1 - \left[ \frac{p}{\gamma} \right]^{1+\xi},
\]
\[
A = D = \frac{\gamma}{2} r(\delta),
\]
\[
p = \left[ \frac{1}{2} \frac{r(\delta)}{r(\delta) - (1 - \delta)} \right]^{\frac{1}{1+\xi}}, \quad H = \left[ \frac{\gamma}{2} \frac{r(\delta)}{r(\delta) - (1 - \delta)} \right]^{\frac{\xi}{1+\xi}} \psi^{\frac{1}{1+\xi}},
\]
\[
R = r(\delta) \equiv \frac{-\delta + \sqrt{\delta^2 + 8(1-\delta)}}{2} > 1,
\]

11
where $\psi \equiv \frac{1}{\delta} \left[ \frac{\xi}{\gamma} \right]^{1-\epsilon}$ and $\xi \equiv \frac{\partial H^*}{\partial \beta} \frac{\beta}{H^*} = \frac{\epsilon}{1-\epsilon} > 0$. The equilibrium interest rate $r(\delta)$ is higher than one because I assume that the economy is dynamically efficient (i.e., $\delta < 1/3$). The interest rate decreases with the depreciation rate because an increase in the depreciation rate reduces the housing stock and, thus, the asset supply $D$. The proportion of the labor force working in the construction sector increases with house prices because it raises profits of developers. Moreover, both the equilibrium house price and housing stock decrease with the interest rate. The intuition is that when the interest rate falls, the user cost of housing decreases and it raises housing demand. This comparative statics result will be important in the trade equilibrium. Finally, the effect of a change in the interest rate on house price (stock) is larger (smaller), the less elastic the housing supply, $\xi$, is. The role of the housing supply elasticity will be emphasized in section 6, in which I use U.S. Metropolitan Statistical Area (MSA) data to provide empirical evidence consistent with the model.

### 2.2.1 Existence of Rational Bubbles

As shown in Tirole (1985), rational bubbles can appear in equilibrium if i) they grow at the same rate as the interest rate (i.e., $\frac{B_{t+1}}{B_t} = R_t$), ii) there are enough funds in the economy to sustain them (i.e., $A_t(R_t) - D(R_t) = B_t > 0$).

In this model, without growth, a (deterministic) rational bubble is possible if there exists a steady-state with interest rate equal to one and shortage of assets at this interest rate. Thus, rational bubbles are possible whenever $A(R = 1) - D(R = 1) \equiv B > 0$.

Given that $r(\delta) > 1$, $A(R = 1) < D(R = 1)$ and rational bubbles cannot appear in equilibrium. This result can be seen in the right-hand side of figure 6 that represents the capital market for a financially developed country and shows that asset demand $A$ is smaller than asset supply $D$ when the interest rate is one. There is no shortage of assets.

Therefore, this subsection has shown that rational bubbles cannot appear in financially developed countries if they remain in autarky.

### 2.3 Financially Underdeveloped Country

In this section I compute the steady-state equilibrium for a financially underdeveloped country $C$ and show that rational bubbles can arise in equilibrium.

Households living in a financially underdeveloped country are financially constrained (i.e., $\theta^C \equiv \theta < \theta^*$). Thus, the borrowing constraint (4) binds in equilibrium and the problem of households can be rewritten as follows.

$$\max_{\{h_{2,t+1}, c_{3,t+2}\}} U_t = \log(h_{2,t+1}) + \log(c_{3,t+2})$$

subject to
\[
\left[ p_t - (1 - \delta) \frac{p_{t+1}}{R_t} \right] h_{2,t+1} + \frac{1}{R_t R_{t+1}} c_{3,t+2} = w_t,
\]

\[
h_{2,t+1} = \frac{1}{1 - \theta} \frac{w_t}{p_t}.
\]

In addition to the budget constraint which equates the net present value of consumption with the net present value of income, the housing choice is constrained (10). When financial institutions improve (i.e., \(\theta\) increases), this constraint is relaxed and households can afford more housing. Figure 4 represents this maximization problem. The dotted line represents the amount of housing that can be purchased without borrowing (or when financial institutions are so weak that \(\theta\) goes to 0). The vertical line to the right of the dotted line represents the housing constraint and point \(C\) is the optimal choice (where the housing and the budget constraints intersect). Then, the housing and the consumption choices are

\[
h_{2,t+1} = \frac{1}{1 - \theta} \frac{w_t}{p_t},
\]

\[
c_{3,t+2} = \frac{R_{t+1}}{1 - \theta} \left[ (1 - \delta) \frac{p_{t+1}}{p_t} - \theta R_t \right] w_t.
\]

Housing demand is determined by equation (10) and the consumption choice is determined by the budget constraint.

Figure 4 shows that households in financially underdeveloped countries, point \(C\), enjoy less housing services and more consumption than households in financially developed countries, point \(U\). This implies that, \(ceteris paribus\), savings are higher in financially underdeveloped countries.

In order to find the expressions for savings and borrowing, I need to plug the consumption and housing services choices into the budget and the borrowing constraints (1) to (4). It follows that

\[
a_{t+1} = \frac{1}{1 - \theta} \left[ (1 - \delta) \frac{p_{t+1}}{p_t} - \theta R_t \right] w_t,
\]

\[
d_t = \frac{\theta}{1 - \theta} w_t.
\]

Housing services are determined by the borrowing constraint, therefore, borrowing \(d\) is independent of the interest rate. Moreover, borrowing is increasing with financial development \(\theta\). Savings \(a\) are decreasing with the interest rate. This result is important to understand the existence of bubbles in this model. I provide an intuition of this result by doing the same comparative statics exercise as before.

Figure 5 represents a decrease in the interest rate \(R_t\). The intersection of the dotted line and the budget constraint represents the allocation when agents choose not to borrow in the first period. This allocation does not depend on the interest rate and it is also in the new budget constraint.
(dotted). The slope of the new budget constraint is flatter because the relative price of housing decreases. The housing constraint is represented by the vertical line to the right of the dotted vertical line and the new optimal allocation, point $C'$, is the intersection between the housing and the budget constraints. Agents are borrowing, therefore, this fall in the interest rate represents a wealth increase. Households would like to increase their housing services but they are unable to do that because they are hitting the borrowing constraint. As a result, they spend this additional wealth by increasing the amount of consumption good. This brings about the negative relationship between interest rate and savings discussed above, unlike the positive relationship when households are unconstrained derived in subsection 2.2.

Following the same steps as in the last subsection, I find the steady-state equilibrium outcomes.

\begin{align*}
  l^h &= \left( \frac{p}{\gamma} \right)^{\frac{1}{1-\gamma}}, \quad l^c = 1 - \left( \frac{p}{\gamma} \right)^{\frac{1}{1-\gamma}}, \\
  A &= D = \frac{\theta}{1-\theta \gamma}, \\
  p &= \left[ \frac{\gamma}{\psi} \frac{1}{1-\theta} \right]^{\frac{1}{1+\xi}}, \quad H = \left[ \frac{\gamma}{1-\theta} \right]^{\frac{\xi}{1+\xi}} \psi^{\frac{1}{1+\xi}}, \\
  R &= r^c(\theta) = \frac{1-\delta-\theta}{\theta},
\end{align*}

where $\psi \equiv \frac{1}{\theta} \left[ \frac{\xi}{\gamma} \right]^{\frac{1}{1+\xi}}$ and $\xi \equiv \frac{\partial H S}{\partial p} \frac{p}{H S} > 0$. The interest rate $r^c(\theta)$ is decreasing with financial development $\theta$. The reason is that asset demand $A$ decreases with financial development and asset supply $D$ increases. Financial development has two effects on asset demand. On the one hand, savings increase with financial development because middle-aged agents have a larger house. On the other hand, savings decrease because the debt is larger. The second effect dominates and asset demand decreases with financial development. Asset supply $D$ increases with financial development because young agents can borrow more. Finally, since the borrowing constraint does not depend on the interest rate, neither house prices nor housing stock change with the interest rate.

### 2.3.1 Existence of Rational Bubbles

As discussed in subsection 2.2, in this model (deterministic) rational bubbles are possible if there is a shortage of assets when the interest rate equals one (i.e., $B = A(R = 1) - D(R = 1) > 0$).

The left-hand side of figure 6 represents the steady-state capital market in a financially under-developed country. Given that the asset supply $D$ does not depend on the interest rate and the asset demand $A$ is decreasing with the interest rate, rational bubbles are possible as long as $\theta < \theta^b$, where $\theta^b$ is defined as $r^c(\theta^b) = 1$. If a bubble arises, its size is $B = A(R = 1) - D(R = 1) = \frac{1-\delta-\theta^b}{1-\theta^b}$.

The intuition why bubbles can appear in the constrained economy is that middle-aged agents want to save for consuming when they are old but young agents do not have enough assets to pledge against these desired savings. The bubble adds assets to the economy and solves this shortage of
assets. In this model, rational bubbles can always appear in a financially constrained economy.\textsuperscript{11}

If a financially underdeveloped country improves its financial institutions (increases $\theta$), it generates more assets and it reduces the size of the bubble. If the improvement is large enough (i.e., $\theta > \theta^*$), the country becomes immune to rational bubbles as shown in subsection 2.2.

3 Bubbles and Trade

In this section I study the relationship between globalization and rational bubbles. First, I consider a world that consists of two countries, a financially developed $U$ and a financially underdeveloped country $C$. I show that bubbles can arise in the integrated economy and, in particular, they can appear in the financially developed country which was immune to bubbles in autarky. Then, I assume that the financially underdeveloped economy $C$ consists of a continuum of mass one of identical countries and only a certain fraction of these countries is financially integrated with country $U$. I define globalization as an increase in this fraction. I show that as globalization progresses, the possibility of having bubbles in country $U$ increases. The intuition is that bubbles can only appear when there is excess demand for assets. Under autarky, this can only happen in country $C$, which is financially constrained. As globalization progresses, by definition, the financially constrained economies represent an increasing share of world capital markets, which raises the likelihood of having a rational bubble in, for instance, country $U$.

3.1 Trade Equilibrium

The world consists of two countries, $U$ and $C$. Financial institutions in country $U$ are $\theta^U \geq \theta^*$ and they are $\theta^C \equiv \theta < \theta^*$ in country $C$. Then, households in country $U$ are financially unconstrained and households in country $C$ are constrained. Moreover, country $U$ has a proportion $\alpha$ of the world endowments. Thus, countries differ in terms of scale and financial institutions.

I assume that the consumption good is traded and capital markets are also integrated. However, both the housing and the labor markets are not integrated. Houses are non-tradable and labor cannot migrate.\textsuperscript{12}

**Definition** A competitive trade equilibrium is a sequence of house prices $p^i_t$, wages $w^i_t$, choices of consumption $c^i_t$, housing services $h^i_t$, savings $a^i_t$ and debt $d^i_t$, an allocation of labor in the construction $l^{i,h}_t$ and consumption good sector $l^{i,c}_t$ for all $t \geq 0$ with initial condition $H^i_{-1}$ for each country $i \in \{U, C\}$ and an interest rate $R_t$ for all $t \geq 0$ such that households maximize their utility given their

\textsuperscript{10}Arce and López-Salido (2008) also find a negative savings slope for a range of parameter values and notice that bubbles are possible in this case. This result is also related to Farhi and Tirole (2008) who show that rational bubbles are possible when liquidity is scarce. Caballero (2006) also argues that rational bubbles can be the natural market response in economies with a shortage of assets.

\textsuperscript{11}The reason is that a country is financially constrained if $\theta < \theta^*$, where $\theta^*$ is defined as $r^*(\theta^*) = r(\delta) > 1$. Moreover, rational bubbles can arise in a financially constrained economy if $\theta < \theta^*$, where $\theta^*$ is defined as $r^*(\theta^*) = 1$. Given that $\frac{\partial r^*(\theta)}{\partial \theta} < 0$, it follows that $\theta^* < \theta^*$.

\textsuperscript{12}Physical houses are non-tradable but they are indirectly traded because all debt is collateralized by houses.
income, firms maximize profits and all markets clear. Housing and labor market clearing conditions are for each country \( i \in \{U, C\} \) and capital and consumption good markets are integrated.

There are six market clearing conditions. By Walras’ Law I can ignore the consumption good market clearing condition and focus on the other five. Given that the housing and the labor markets clear for each country, the only additional clearing condition is the capital market. Letting \( A^i \) and \( D^i \) denote aggregate savings and borrowing in country \( i \in \{U, C\} \), respectively, and noting that country \( U \) represents a proportion \( \alpha \) of the world, the capital market clearing condition, which equates world aggregate savings and borrowing, is

\[
\alpha A^U(R^T) + (1 - \alpha)A^C(R^T) = \alpha D^U(R^T) + (1 - \alpha)D^C(R^T),
\]

where \( R^T \) is the interest rate in the trade equilibrium.

Plugging the optimal savings and borrowing choices derived in section 2 by constrained (country \( C \)) and unconstrained (country \( U \)) households into equation (11), it is straightforward to show that \( R^C > R^U > R^T (\alpha, \theta^C = \theta) \) with \( R^T (\alpha, \theta) \) increasing with \( \alpha \) and \( \theta \). The intuition is that both a reduction in \( \alpha \) and \( \theta \) increase the flow of assets from the financially constrained to the financially unconstrained economy. It makes assets in country \( U \) scarcer, which increases their value and reduces the equilibrium interest rate.\(^{13}\)

Given the interest rate, the rest of equilibrium allocations can be easily derived. I focus on the housing market in country \( U \). The expression for house prices derived in section 2 only needs to be modified by plugging the new interest rate. Thus, house prices in the trade equilibrium \( p^{U,T} \) are

\[
p^{U,T} = \left[ \frac{1}{2} \gamma \frac{R^T}{\psi - (1 - \delta)} \right]^{\frac{1}{1+\gamma}} > \left[ \frac{1}{2} \gamma \frac{R^U}{\psi - (1 - \delta)} \right]^{\frac{1}{1+\gamma}} = p^{U,A}.
\]

These results can be graphically seen in figure 7 that represents the capital market in both countries and the housing market in country \( U \) with point \( a \) and \( t \) denoting the autarky and trade equilibrium, respectively. In autarky, as described in section 2, households in country \( C \) are financially constrained and cannot borrow as much as they want because of the lack of collateralized debt. There is a shortage of assets in country \( C \). When both countries integrate, savings of middle-aged agents in country \( C \) are not constrained by the amount of debt that young agents can obtain at home but they can be invested in country \( U \) which has better financial institutions. These capital flows create a current account deficit in country \( U \).\(^{14}\)

Figure 7 also shows that house prices are higher in country \( U \) in the trade equilibrium with respect to autarky. The reason is that a fall in the interest rate raises housing demand. Thus, both house prices and stock are larger in the trade equilibrium. The housing market does not change

\(^{13}\)More explicitly, \( R^T (\alpha, \theta) \) is the solution to \( \alpha \frac{1}{2} \left[ \frac{(R^T)^2 + (1 - \Lambda) R^T - 2\Lambda}{R^T - \Lambda} \right] + (1 - \alpha) \left[ \frac{\Lambda - \theta (R^T - 2\Lambda)}{1 - \theta} \right] = 0 \) where \( \Lambda \equiv 1 - \delta \). Note that the equilibrium interest rate only depends on the level of financial institutions in the financially underdeveloped country \( \theta^C \equiv \theta \).

\(^{14}\)Caballero (2006) and Caballero et al (2008a, 2008b) also link the shortage of assets in emerging economies to the current account deficit in financially developed countries.
in country $C$ because the borrowing constraint does not depend on the interest rate. Finally, the increase in house prices in country $U$ depends on the housing supply elasticity $\xi$. The more inelastic the housing supply is, the larger the rise in house prices is.

### 3.2 Existence of Rational Bubbles

In this subsection I show that asset price and/or housing bubbles can appear in the integrated equilibrium and, in particular, they can arise in the financially developed country.

As discussed in section 2, bubbles are possible if there is a shortage of assets when the interest rate is one. Capital markets are integrated, therefore, the shortage of assets needs to be at the world level. Then, bubbles are possible if the world supply of assets falls short of the asset demand,

$$A(\alpha, R = 1) - D(\alpha, R = 1) = B(\alpha) > 0,$$

where $A(\alpha, R = 1) = \alpha A^U(R = 1) + (1 - \alpha) A^C(R = 1)$ and an analogous expression for $D(\alpha, R = 1)$.

Subsection 2.2 shows that if the world is financially unconstrained (i.e., $\alpha = 1$), bubbles are not possible. Similarly, subsection 2.3 shows that if the world is financially constrained (i.e., $\alpha = 0$), bubbles can appear in equilibrium. The next proposition shows that if the world is "financially constrained enough", bubbles are possible in equilibrium.

**Proposition 1** (Existence of Rational Bubbles in Trade Equilibrium) Bubbles attached to houses and/or pure asset price bubbles are possible if $\alpha < \alpha^*(\theta, \delta)$ where $\alpha^*(\theta, \delta)$ is decreasing in $\theta$ and increasing in $\delta$.

**Proof.** Define $\alpha^*(\theta, \delta)$ as $A(\alpha^*(\theta, \delta), R = 1) - D(\alpha^*(\theta, \delta), R = 1) = B(\alpha^*(\theta, \delta)) = 0$ and note that $B(\alpha)$ is decreasing in $\alpha$. Moreover, $\alpha^*(\theta, \delta) = \frac{1}{1 + \Phi}$ with $\Phi = \frac{\frac{3(1-\delta)-2}{1+\delta} - \delta}{1-\theta}$. ■

Proposition 1 says that for a given allocation of the world endowment $\alpha$, bubbles are less likely to arise when financial institutions in country $C$ improve (i.e., $\theta$ increases). The reason is that when financial institutions improve, the amount of assets that country $C$ generates increases. Moreover, a higher depreciation rate of houses increases the possibility of having bubbles. The intuition is that even though country $U$ is not financially constrained, the amount of assets (i.e., houses) it can generate depends on the depreciation rate. A larger depreciation rate implies a lower supply of assets and makes bubbles more likely to arise in the integrated economy.

The condition for existence of bubbles does not depend on whether the bubble is attached or detached to houses.\(^{15}\) However, as I show below, the distinction between housing and pure asset price bubbles is important to understand the effect of globalization on house prices. Section 6

\(^{15}\)There exists an indeterminacy of different types of bubbles. I assume that the bubble is either attached or detached to houses but any combination of both types of bubbles is possible. The model only determines the aggregate size of the bubble. For a further discussion, see, for example, the equilibrium with "bubble substitution" in Tirole (1985) or Example 4.1 in Santos and Woodford (1997).
provides empirical evidence consistent with this differential effect. It would be interesting to further investigate the conditions which make one type of bubble more likely to arise than another.

The location of the bubble is not determined by Proposition 1, it only shows when bubbles can appear in the integrated equilibrium. In the rest of the paper and consistent with the empirical section I assume that when bubbles are possible, they arise in the financially developed country. It would be nice to also have a theory of the location of the bubble, but I leave it for future research.

Figure 8 represents the capital market in both countries and the housing market in country U when a pure asset price bubble appears in country U. The effects are exacerbated with the bubble (see figures 7 and 8). Capital flows from country C to country U are larger, which increase the current account deficit. Moreover, the interest rate is lower, which makes the housing demand and, consequently, house prices higher. Graphically, the size of the bubble is the horizontal distance between the new (dotted) and old D lines in figure 8.

The solution represented in figure 8 corresponds to the case in which there is a pure asset price bubble. In this case, the only effect that the bubble has on house prices in country U is through the fall in the interest rate. Therefore, house prices are higher when there is an asset price bubble \( p_{U,DB} \) than without a bubble \( p_{U,T} \) because the interest rate is lower,

\[
p_{U,DB} = \left[ \frac{1}{2} \psi \frac{1}{1 - (1 - \delta)} \right]^{\frac{1}{1 + \xi}} > \left[ \frac{1}{2} \psi \frac{R^T}{R^T - (1 - \delta)} \right]^{\frac{1}{1 + \xi}} = p_{U,T}.
\]

However, the bubble can be attached to houses. If this is the case, all these extra savings instead of being allocated to a "useless" asset are directed to purchase houses. Therefore, when the bubble is attached to houses, the housing market clearing condition in country U is

\[
H^S = \alpha \frac{g(\ln h)}{\delta} = \alpha \frac{1}{2} \frac{1}{\psi} \frac{1}{1 - (1 - \delta)} + \frac{B}{p} = H^D,
\]

where the difference with a pure asset price bubble is the term \( B/p \). It represents the additional number of houses that are purchased only as an investment.\(^{16}\) It follows that house prices with a housing bubble \( p_{U,HB} \) are higher than with a pure asset price bubble \( p_{U,DB} \),\(^{17}\)

\[
p_{U,HB} = \left[ \frac{1}{2} \psi \frac{1}{1 - (1 - \delta)} + \frac{B}{\alpha} \frac{1}{\psi} \right]^{\frac{1}{1 + \xi}} > \left[ \frac{1}{2} \psi \frac{1}{1 - (1 - \delta)} \right]^{\frac{1}{1 + \xi}} = p_{U,DB}.
\]

This section underscores the importance of two strong assumptions made in Glaeser et al. (2008) to show that rational housing bubbles cannot appear in equilibrium in a frictionless economy. First, they assume that houses do not depreciate and therefore the stock of houses (and value of assets) goes to infinity. More importantly, they consider a closed economy. In section 2 I also showed

\(^{16}\)In this model a pure asset price bubble only reduces the interest rate and it does not have any extra effect in the economy. However, there exist papers in which a pure asset price bubble has additional effects. For example, in Ventura (2003) a pure asset price bubble increases the capital stock because inefficient investors stop investing and it reduces the cost of capital for entrepreneurs. Similarly, Olivier (2000) assumes that an asset price bubble encourages R&D investment and it increases growth.

\(^{17}\)The notion of bubble is similar to the one used in Allen and Gale (2000). There is a housing bubble when the equilibrium house prices are higher than their fundamental value (i.e., \( B > 0 \)).
that bubbles cannot appear in financially developed countries if they remain in autarky. However, this section has shown that when international capital flows are allowed (and houses depreciate), rational housing bubbles can appear in a financially developed country when it integrates with a financially underdeveloped economy.

The recent years were characterized by an increase in globalization and financial development. I briefly discuss the predictions of the model for an increase in financial development and I will focus on globalization in the rest of the paper. The model predicts that an increase in financial development of financially constrained countries decreases the probability of having bubbles and the size of the bubble when it appears. Although this model abstracts from several aspects which exacerbated the recent subprime crisis, it is worth mentioning that financial development has also positive effects. Indeed, if the reason for the appearance of bubbles is the shortage of assets in the economy, financial development is a good policy to reduce the emergence and size of bubbles.

3.3 Effect of Globalization

In this subsection I study the effect of globalization on the existence of bubbles in the integrated economy. I also interpret the current account, house prices and interest rate trends in the United States in the last twenty years through the lens of the model.

I assume that the financially underdeveloped economy $C$ consists of a continuum of mass one of identical countries. However, only a certain fraction $\tau$ of these countries have access to the capital market of country $U$. I define globalization as an increase in $\tau$. This definition is meant to capture the increasing role of emerging economies in world capital markets witnessed in recent years. Therefore, in this exercise, capital markets are not fully integrated. There is one capital market for each of the financially underdeveloped countries which cannot participate in the world capital market and the "integrated" capital market. This integrated capital market consists of country $U$ and the fraction $\tau$ of financially underdeveloped countries with access to the world capital market. I discuss the possibility of having a bubble in the countries which are not part of the "globalized world" at the end of this subsection. However, I first derive which is level of financial integration that makes bubbles possible in the financially developed country.

The capital market clearing condition derived in the trade equilibrium (11) needs to be modified to take into account the stage of globalization $\tau$,

$$\alpha A^U(R^T) + (1 - \alpha)\tau A^C(R^T) = \alpha D^U(R^T) + (1 - \alpha)\tau D^C(R^T).$$

Note that the integrated equilibrium characterized in subsection 3.2 is a particular case when $\tau = 1$ and the solution to the autarky equilibrium in subsection 2.2 is a particular case when $\tau = 0$.

The next proposition shows that the possibility of having bubbles in the financially developed country is increasing with globalization.

**Proposition 2 (Existence of Rational Bubbles and Globalization)** Bubbles attached to houses and/or pure asset price bubbles are possible if $\tau > \tau^*(\alpha, \theta, \delta)$ where $\tau^*(\alpha, \theta, \delta)$ is increasing in $\alpha$ and $\theta$ and
decreasing in $\delta$.

**Proof.** Define $\tau^*(\alpha, \theta, \delta)$ as $A(\tau^*(\alpha, \theta, \delta), R = 1) - D(\tau^*(\alpha, \theta, \delta), R = 1) = B(\tau^*(\alpha, \theta, \delta)) = 0$ and note that $B(\tau)$ is increasing in $\tau$. Moreover, $\tau^*(\alpha, \theta, \delta) = \frac{\alpha}{1-\alpha} \Phi$. ■

When $\alpha = \alpha^*(\theta, \delta)$, $\tau^*(\alpha^*, \theta, \delta) = 1$ where $\alpha^*(\theta, \delta)$ is defined in Proposition 1 as the minimum share that the financially developed country needs to represent of the world economy for not having rational bubbles in the integrated equilibrium. Therefore, given that $\tau^*(\alpha, \theta, \delta)$ is increasing with $\alpha$, if $\alpha > \alpha^*(\theta, \delta)$, bubbles are never possible. However, when $\alpha < \alpha^*(\theta, \delta)$, there exists $\tau^*(\alpha, \theta, \delta) < 1$ such that bubbles are possible if globalization has sufficiently advanced (i.e., $\tau > \tau^*(\alpha, \theta, \delta)$).

In other words, if the world economy is financially constrained enough (i.e., $\alpha < \alpha^*(\theta, \delta)$), the possibility of having bubbles is increasing with globalization. Bubbles are not possible if the fraction of financially constrained countries with access to world capital markets is low (i.e., $\tau < \tau^*(\alpha, \theta, \delta)$) but bubbles are possible when this fraction increases (i.e., $\tau > \tau^*(\alpha, \theta, \delta)$).

The level of globalization above which bubbles can appear in equilibrium $\tau^*(\alpha, \theta, \delta)$ is increasing with the financial development of the constrained economy $\theta$. Assume that the United States is an unconstrained economy and China and Europe are constrained economies with equal size but Europe has better financial institutions. Proposition 2 implies that the United States can integrate more with Europe than with China while remaining immune to rational bubbles.

In subsection 2.3 I showed that bubbles are possible in a financially developed country if it remains in autarky. Then, bubbles can appear in each of the fraction $1 - \tau$ of financially underdeveloped countries which cannot participate in the world capital market. The reason is that the capital market clearing condition in these countries is the same as the one derived in subsection 2.3 where I showed that $B = A_C(R = 1) - D_C(R = 1) > 0$.

### 3.3.1 A Tale of Two Bubbles

In this subsection I interpret the trends of house prices and current account in the United States, shown in figure 2, through the lens of the model.

Assume that the world consists of the United States which is financially unconstrained (country $U$ in the model) and the Rest of the World which is a mass one of identical financially constrained countries. The United States represents a constant share $\alpha < \alpha^*(\theta, \delta)$ of the world and the initial level of globalization is $0 < \tau(t_0) < \tau^*(\alpha, \theta, \delta)$.

If globalization increases over time (i.e., $\tau(t)$ is exogenously increasing with $t$), Proposition 2 says that bubbles cannot happen in the "globalized world" when $t < t^* \equiv \tau^{-1}[\tau^*(\alpha, \theta, \delta)]$ and can appear afterwards. If $t^* \leq 1995$, the model could explain why emerging markets experienced several bubbles during the 1980s and early 1990s and the Dot-Com and the Housing Bubbles arose in the United States.

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18 See, for example, Caballero and Krishnamurthy (2006) for a discussion on bubbles in emerging economies.
The comparative statics on current account is consistent with figure 2. The current account deficit in country $U$ is, by definition, $\text{CAD}(\tau) = B(\tau) + D^U(R(\tau)) - A^U(R(\tau))$. When there is no bubble, $B(\tau) = 0$ but since $R(\tau)$ is decreasing in $\tau$, the current account deficit increases with globalization. Moreover, when there is a bubble, $B(\tau) > 0$ and the size of the bubble is increasing with globalization. Therefore, a deeper globalization increases the possibility of having a bubble and its effect on current account deficit is exacerbated when a bubble arises.

House prices in country $U$ increase with globalization when there is no bubble. The interest rate decreases with globalization, which raises housing demand. House prices are higher if there is a bubble, either attached or detached to houses, because the interest rate is lower with a bubble. House prices are higher if there is a housing bubble because the bubble directly raises housing demand. Section 5 derives the main empirical prediction of the model and section 6 tests it using house prices for U.S. metropolitan areas.

4 Welfare Analysis

This section performs welfare analysis. First, I study whether a housing bubble is better than a pure asset price bubble. Then, I study whether welfare in country $U$ and in a financially underdeveloped country $C$ with access to world capital markets is higher with a bubble located in country $U$.

4.1 Welfare with a Housing and a Dot-Com Bubble

The difference between a housing and a pure asset price bubble is that in the first case the extra assets that the bubble generates are used to buy houses whereas they are not used, for production purposes, in the latter. The housing market of a financially constrained country is not affected by whether the bubble in country $U$ is attached or detached to houses. Therefore, I can focus on the welfare effects in country $U$.

**Proposition 3** Utility of households is higher with a Dot-Com Bubble and profits of developers are higher with a Housing Bubble.

From the point of view of a household, the only difference between both types of bubbles is house prices. If there is a housing bubble, house prices are $p^{U,HB}$ and when the bubble is detached, house prices are $p^{U,DB}(< p^{U,HB})$. From the equilibrium allocations derived in Section 3, it is straightforward to show that the difference in the lifetime utility of households in country $U$ between having a pure asset price and a housing bubble is

$$U^{DB} - U^{HB} = \frac{1}{1 + \xi} \ln \left( \frac{1}{2 - \psi} \frac{1}{1 - (1-\delta)} + \frac{B}{\alpha \psi} \frac{1}{1 - (1-\delta)} \right) \geq 0.$$ 

The lifetime utility of households is (weakly) higher with a Dot-Com Bubble. The more inelastic the housing supply is, the larger the welfare loss of having a Housing instead of a Dot-Com Bubble is (i.e., $\frac{\partial U^{DB} - U^{HB}}{\partial \xi} < 0$). The intuition is that the only difference between both bubbles is the price
appreciation (and distortion) of the Housing Bubble. Thus, the welfare loss of having a Housing Bubble is larger in countries with a low housing supply elasticity. Both bubbles deliver the same lifetime utility when the housing supply elasticity goes to infinity (i.e., \( \lim_{\xi \to \infty} U^{DB} - U^{HB} = 0 \)).

Profits of consumption good producers are zero with both bubbles. However, profits of developers are higher with a Housing Bubble. From the problem of the developer it follows that, in equilibrium, the profits with a housing bubble \( \pi^{h,HB} \) relative to a pure asset price bubble \( \pi^{h,DB} \) are

\[
\frac{\pi^{h,HB}}{\pi^{h,DB}} = \left[ \frac{p^{U,HB}}{p^{U,DB}} \right]^{1+\xi} > 1.
\]

Therefore, a Housing Bubble can be better than a Dot-Com Bubble depending on the weight that a Social Planner gives to developers. The reason is that the increase in profits of developers can offset the reduction on the utility of households. For example, if developers have the same utility function as households and receive the same weight, housing bubbles are better.\(^{19}\)

### 4.2 Welfare in Country U

In this section I study whether welfare in country \( U \) increases if a bubble arises in country \( U \).

I assume that the economy starts in a steady state with trade without bubbles, characterized by a level of globalization \( \tau \), and it coordinates to a steady-state with a pure asset price bubble located in country \( U \). Graphically, I assume that the economy starts in point \( t \) in figure 7 and it coordinates to point \( b \) in figure 8.\(^{20}\)

**Proposition 4** Welfare in country \( U \) is higher with a Dot-Com Bubble when the housing supply elasticity \( \xi \) is higher than a threshold \( \xi^* \). Otherwise, it depends on how different agents and generations are weighted. The utility of households (excluding the first generation) is lower but profits of developers and the utility of the first generation of households (they receive the bubble) are higher with a Dot-Com Bubble.

From the utility function and equilibrium allocations, the lifetime utility of households in country \( U \) when the level of globalization is \( \tau \) can be written as

\[
U^U = \frac{\xi}{1+\xi} \ln \left[ \frac{R^T(\tau)}{R^T(\tau) - (1-\delta)} \right] + 2 \ln R^T(\tau) + \text{constant} \tag{12}
\]

If we forget about the initial generation (they receive the bubble), the lifetime utility of next generations in the steady-state with bubbles is given by setting \( R^T(\tau) = 1 \) in equation (12). Thus, each next generation gains from being in a steady-state with a bubble if the lifetime utility (12) is decreasing with the interest rate.

\(^{19}\)From the equilibrium allocations derived in section 3.2, it follows that \( U^{HB} + \ln \pi^{h,HB} - (U^{DB} + \ln \pi^{h,DB}) = \frac{\xi}{1+\xi} \ln \left[ \frac{\tau^2 + (1-\tau)(1-\delta)}{2 \tau (1-\delta)} \right] > 0 \).

\(^{20}\)The same qualitative results hold when comparing welfare with and without a Housing Bubble. The only difference is that the threshold of the housing supply elasticity above which welfare is higher with a bubble is larger. This follows from Proposition 3.
A fall in the interest rate has two effects in the utility of households. First, the amount of consumption good decreases because the returns on the savings of old agents decrease. Second, the fall in the interest rate raises housing demand and housing services. The second effect dominates when the housing supply is very elastic. If the housing supply is infinitely inelastic (i.e., $\xi = 0$), utility of households in country $U$ decreases with a bubble. On the contrary, if the housing supply is infinitely elastic (i.e., $\xi \rightarrow \infty$), utility increases with a bubble. It can be shown that the utility of households (after the first generation) is higher with a bubble if $\xi > \xi_{21}$.

The first generation receives the bubble. Therefore, if the size of the bubble is large enough, the aggregate welfare of households is higher with a bubble. This is more likely to happen when the quality of financial institutions in the constrained countries, $\theta$, is very low and the level of globalization, $\tau$, is high.

Consumption good producers make zero profits and are indifferent. However, profits of developers are higher if there is a bubble because housing demand and, thus, house prices increase when the interest rate falls,

$$\frac{\pi^{h, DB}}{\pi^{h, T}} = \left[ \frac{p^{U, DB}}{p^{U, T}} \right]^{1+\xi} > 1.$$ 

Thus, profits increase because house prices are higher with a bubble. The first generation of households gains because they receive the bubble. Utility of next generations depends on the housing supply elasticity. Then, when utility of next generations is higher with a bubble (i.e., $\xi > \xi$), welfare in country $U$ is higher. Otherwise, it depends on how different generations and agents are weighted.

4.3 Welfare in Country C

In this subsection I do the same welfare analysis exercise as in subsection 4.2 for a financially constrained economy participating in world capital markets, country $C$. I study how welfare in country $C$ changes when the world economy is in a steady state with trade without bubbles and it coordinates to a steady-state with an asset price bubble in country $U$.

**Proposition 5** Welfare in country $C$ is higher with a bubble located in country $U$ when the interest rate $R^T(\tau)$ is larger than $\frac{1-\delta}{2\theta}$.

Profits of both developers and consumption good producers in country $C$ are not affected by a bubble located in country $U$. Moreover, since the bubble is created in country $U$ there is no additional gain for the first generation. Thus, it suffices to study how the steady-state lifetime utility of households changes when a bubble arises in country $U$.

It is easy to check that utility of households in country $C$, with a level of globalization $\tau$, is proportional to $R^T(\tau) \left[ (1 - \delta) - \theta R^T(\tau) \right]$.

---

21 The housing supply elasticity threshold is $\xi = \frac{2R - 2(1 - \delta)}{3(1 - \delta) - 2R}$. It follows from setting the partial derivative of equation (12) with respect to $R$ equal to zero.

22 House prices in country $C$ are not affected by the type of bubble located in country $U$. Then, welfare in country $C$ does not depend on whether the bubble in country $U$ is attached or detached to houses.
Housing is determined by the borrowing constraint which is not directly affected by the interest rate. The interest rate affects utility only through the consumption good. There are two effects. On the one hand, the returns on savings increase with the interest rate. On the other hand, a higher interest rate lowers the amount of savings because middle-aged agents have to pay more for the money they borrowed. The second effect dominates when $R^T(\tau) > \frac{1-\delta}{2\theta}$.

Therefore, welfare of households in country $C$ is higher without a bubble than with a bubble located in country $U$ when the interest rate is below $\frac{1-\delta}{2\theta}$. Since the interest rate is decreasing with globalization, this is more likely to happen when capital markets are already very integrated. The intuition is that when capital markets are very integrated, the gain for having additional assets is offset by the fall in the interest rate.

5 Empirical Prediction

This section derives the most salient empirical prediction of the model.

The model predicts that, conditional on having a bubble, the effect of globalization on house prices is different depending on whether the bubble is attached or detached to houses.

Section 3 shows that house prices in a financially developed country when there is a housing bubble are

$$p^{U,HB} = \left[ \frac{1}{2} \frac{\gamma}{\psi} - \frac{1}{1 - (1 - \delta)} + \frac{B(\tau)}{\alpha} \right]^{\frac{1}{1+\gamma}},$$

where $B(\tau)$ is the size of the bubble for a given level of globalization $\tau$. If there is a pure asset price bubble, houses prices are

$$p^{U,DB} = \left[ \frac{1}{2} \frac{\gamma}{\psi} - \frac{1}{1 - (1 - \delta)} \right]^{\frac{1}{1+\gamma}}.$$

From these equations, it follows that, conditional on having a bubble, house prices only increase with globalization if the bubble is attached to houses (i.e., $\frac{\partial p^{U,HB}}{\partial \tau} > 0$ and $\frac{\partial p^{U,DB}}{\partial \tau} = 0$). The intuition is that globalization affects house prices through two channels. The first channel is the interest rate. When globalization increases, more capital flows towards country $U$, driving down the interest rate and raising housing demand and house prices. The second channel is the size of the bubble. As globalization progresses, the size of the bubble increases. The size of the bubble only affects house prices if the bubble is attached to houses. When there is a bubble, the interest rate is constant and the only effect of globalization on house prices is the second one. Therefore, an increase in globalization raises house prices only if the bubble is attached to houses. Moreover, the more inelastic the housing supply is, the larger the effect of globalization on house prices is.
5.1 An Extension: n Financially Developed Cities

This extension shows that the empirical prediction discussed above extends to \( n \) financially developed cities.

In this extension, I allow for labor mobility across cities. Therefore, these cities have a common labor market and different housing markets. Only capital and consumption good can be traded between countries. Each city \( i \) has the same level of financial institutions \( \theta^i = \theta^U \geq \theta^* \) and the same size \( \alpha^i = \alpha / n \). The only difference is the elasticity of the housing supply. In particular, I assume that \( g^i(l^h;i) = (l^h;i)^{\epsilon^i} \) with \( \epsilon^i > 0 \) for \( i \in \{1, ..., n\} \).

Using the results in subsection 2.3, savings \( a^i \) and borrowing \( d^i \) in each city \( i \) are

\[
\begin{align*}
a^i_{t+1} & = \frac{w^U_t}{2} R_t, \\
d^i_t & = \frac{w^U_t}{2} \left[ \frac{2(1-\delta)p_{t+1}^i - p^i_t}{p^i_t - (1-\delta)p_{t+1}^i} \right].
\end{align*}
\]

where \( w^U_t \) is the wage in any city \( i \) in country \( U \) and \( p^i_t \) is house prices in city \( i \).

The steady-state capital market clearing condition is the same as when considering one financially developed country, equation (11). This is, \( \sum_{i=1}^{n} \alpha^i a^i = \alpha A^U \) and \( \sum_{i=1}^{n} \alpha^i d^i = \alpha D^U \) where \( A^U \) and \( D^U \) is the aggregate savings and borrowing derived in subsection 2.3, respectively. The reason is that borrowing \( d^i \) does not depend on house prices.

There is a housing market in each city \( i \), thus, using the equations derived in subsection 2.3, it follows that the housing market clearing condition in city \( i \) is

\[
H^{S;i} = \frac{g^i(l^h;i)}{\delta} = \frac{1}{2} \frac{w^U}{p^i - (1-\delta)w^U} = H^{D;i}, \forall i \in \{1, ..., n\}.
\]

Labor market is integrated for all cities, therefore, there is a unique market clearing condition

\[
\sum_{i=1}^{n} l^{c;i} + \sum_{i=1}^{n} l^{h;i} = \alpha,
\]

with \( p^i g'(l^h;i) = w^U \) and \( f'(l^{c;i}) = w^U \), \( \forall i \in \{1, ..., n\} \).

Given the assumption on the production function of the consumption good, only the allocation of labor in the construction sector is uniquely determined for each city \( i \). Nonetheless, it suffices to derive house prices. It follows that house prices in city \( i \) are

\[
p^i = \left[ \frac{1}{2} \frac{\gamma}{\psi^i R - (1-\delta)} R \right]^{\frac{1}{1+\epsilon^i}}
\]
where \( \psi^i \equiv \frac{1}{\gamma} \left[ \frac{\epsilon_i}{\gamma} \right]^{\frac{\epsilon_i}{\gamma-1}} \) and \( \xi^i = \frac{\partial H_S^i}{\partial p} \frac{p}{H_S} = \frac{\epsilon_i}{1-\epsilon_i} > 0 \).

Therefore, house prices in city \( i \) with a housing and a pure asset price bubble are

\[
p^{i, HB} = \left[ \frac{1}{2} \frac{\gamma}{\psi^i} \left( 1 - (1 - \delta) \right) + \frac{B^i(\tau)}{1 \psi^i} \right]^{1+\xi_i^i} \quad \text{and} \quad p^{i, DB} = \left[ \frac{1}{2} \frac{\gamma}{\psi^i} \left( 1 - (1 - \delta) \right) \right]^{1+\xi_i^i}, \tag{13}
\]

respectively, where the housing bubble in each city \( i \) is \( B^i(\tau) > 0 \) with \( \sum_{i=1}^{n} B^i(\tau) = B(\tau) \). The effect of globalization on house prices is qualitatively the same (i.e., \( \frac{\partial p^{i, HB}}{\partial \tau} > 0 \) and \( \frac{\partial p^{i, DB}}{\partial \tau} = 0 \)). Thus, the empirical prediction I take to the data is as follows.

**Prediction**  Conditional on having a bubble, an increase in globalization raises house prices only if the bubble is attached to houses. Moreover, this effect is larger, the lower the housing supply elasticity is.

### 6 Empirical Evidence

This section provides empirical evidence consistent with the main empirical prediction of the model described in section 5.

#### 6.1 Data and Descriptive Statistics

To test the prediction of the model I consider that the \( n \) financially developed cities are Metropolitan Statistical Areas (MSAs) of the United States and that the financially underdeveloped country is the Rest of the World. The reason for choosing metropolitan areas of the United States is for data availability and because the United States experienced a Dot-Com and a Housing Bubble which allows me to test the prediction of the model.

I use the house price index at the Metropolitan Statistical Area (MSA) level from Office of Federal Housing Enterprise Oversight (OFHEO) and the CPI index from Bureau of Labor Statistics to obtain real prices.\(^{23}\) The first row of Table 1 presents the average and standard deviation of house prices growth for the period I consider (1983-2007) and the two sub-periods I am interested in, the Dot-Com Bubble (1996-2000) and the Housing Bubble (2002-2006). During both bubbles the average house prices growth was higher than the whole period but it was much higher during the housing bubble. The choice of the housing bubble period is consistent with Glaeser et al. (2008) who consider that the housing boom was between 1996 and 2006.

My proxy for an increase in globalization is the current account deficit of the United States (over GDP) from International Financial Statistics (IMF). The current account deficit is very similar to the definition of globalization used in the model.

\(^{23}\)I choose the OFHEO price index over the Case-Shiller because this index only covers ten metropolitan areas from 1987 to 2000 and 20 from 2000 onwards.
The housing supply elasticity at MSA level is obtained from Saiz (2009). These elasticities are a function of both physical (e.g. the share of land with a slope above 15 degrees) and regulatory constraints. Data appendix shows some descriptive statistics of these elasticities and a list of the metropolitan areas with the least and most elastic housing supplies. For example, Miami (FL) and Los Angeles (CA) have the least elastic housing supplies and Wichita (KS) and Fort Wayne (IN) have the most elastic housing supplies. See Saiz (2009) for more details.

Figure 9 shows the growth rate of (real) house prices (per year) during the Dot-Com and the Housing Bubbles for different metropolitan areas represented by the housing supply elasticity. The two lines are the fitted values of a linear regression of house prices on the housing supply elasticity for both sub-periods. Two things are worth mentioning. First, the level is higher during the Housing Bubble. Second, the slope is negative and it is significantly larger during the Housing Bubble. Both facts are consistent with the model. The level is higher when the bubble is attached to houses because houses, in addition to the consumption value, have an extra asset value. The slope being negative and larger during the Housing Bubble means that house prices rise more in areas where the housing supply elasticity is lower and they are more sensitive to the housing supply elasticity when the bubble is attached to houses.

Finally, I use population and personal income at the metropolitan area level from Bureau of Economic Analysis as control variables. The second row of Table 1 reports the average and standard deviation of population growth for the whole period and the two sub-periods. Notice that they are very similar in both periods. The last row reports the average and standard deviation of personal income share growth. Personal income share is the personal income of each metropolitan area divided by the personal income of the United States. These number are also similar in the two sub-periods.

6.2 Empirical Strategy

I use the following equation to test the empirical prediction described in section 5,

$$HP_{it} = \sum_{j \in \{HB, DB, O\}} \beta_j \cdot CAD_t \cdot Elast_i \cdot \rho_j + \phi X_{it} + \delta_i + \delta_t + \eta_{it},$$

(14)

where $\rho_{HB}, \rho_{DB}, \rho_{O}$ are dummies for the Housing Bubble, the Dot-Com Bubble, and the rest of the sample, respectively. $HP_{it}$ is (real) house price in metropolitan area $i$ in year $t$, $CAD_t$ is current account deficit (over GDP) in the United States in year $t$, $Elast_i$ is the housing supply elasticity in metropolitan area $i$, $X_{it}$ are control variables and, $\delta_i$ and $\delta_t$ are a set of area and time fixed effects, respectively. All variables are growth rates. The sample consists of 138 metropolitan statistical areas (MSAs) and covers the period between 1983 and 2007.\footnote{The sample is chosen to maximize the number of observations while keeping a balanced panel.}
triple interaction between the current account deficit, the housing supply elasticity and the Housing Bubble dummy $\beta_{HB}$ and the triple interaction with the Dot-Com Bubble dummy $\beta_{DB}$. The model predicts that $\beta_{HB} < 0$ and $\beta_{DB} = 0$. The double interactions and main effects are not included in equation (14) because they are captured by the time and metropolitan area fixed effects.

6.3 Results

Table 2 reports the coefficients of regression (14) with robust standard errors clustered by metropolitan area in parentheses. Column (1) reports the coefficients when population is included as control variable. As expected, the coefficient on population is positive. More importantly, consistent with the model, the coefficient on the interaction term is not significant during the Dot-Com Bubble and the coefficient is negative and statistically significant (-0.171) during the Housing Bubble. It means that an increase in current account deficit only has a significant effect on the growth of house prices if there is a Housing Bubble. Moreover, the less elastic the housing supply is, the larger the rise in house prices is.

The regression reported in column (1) is ignoring the fact that some metropolitan areas may have a larger house price appreciation because they are growing above the mean. In order to take this into account, column (2) adds the income share as control variable. The coefficient on the income share is positive. Indeed, house prices increase more in metropolitan areas whose income grows more than the national income. However, the two coefficients of interest remain almost unchanged. The coefficient on the interaction term during the Housing Bubble is negative and significant (-0.199), whereas it is not significant during the Dot-Com Bubble.

These results are also economically significant. To give an example, Santa Barbara (CA) is in the 10th percentile of the housing supply elasticity (0.91) and Richmond (VA) in the 75th percentile (2.16). If Santa Barbara and Richmond only differ on the housing supply elasticity, the coefficients on column (2) imply that one percent increase in the current account deficit translates into an increase in house prices 0.25 percentual points higher in Santa Barbara than in Richmond during the Housing Bubble. In contrast, during the Dot-Com Bubble, an increase in the current account deficit has no differential effect.

This section has provided empirical evidence consistent with the main prediction of the model. The model predicts that the effect of an increase in current account deficit on house prices is different depending on which asset the bubble is attached to. The prediction is that, when there is a bubble, an increase in capital inflows raises house prices only when the bubble is attached to houses. The coefficients reported on Table 2 are consistent with this prediction. I find that an increase in current account deficit (over GDP) has a significant (and positive) effect on real house price appreciation during the Housing Bubble, 2002-2006, but it has no significant effect during the Dot-Com Bubble, 1996-2000.
7 Concluding Remarks

In this paper I developed a framework to study the relationship between international trade and the emergence of rational bubbles and analyze how the effect of globalization on house prices depends on the type of bubble.

The model is a three-period OLG economy. Young agents earn a wage and borrow to purchase a house. Middle-aged agents consume housing services, repay the debt and sell the house to save and consume when they are old. An important feature of the model is that households may be financially constrained. Young agents can only borrow a fraction of the value of the house. Moreover, the quality of financial institutions determines this fraction.

I showed that, in autarky, rational bubbles can only appear in financially underdeveloped countries. The reason is that middle-aged agents want to save more to consume when they are old, but the economy does not generate enough assets because young agents are financially constrained. Bubbles are possible because there is a shortage of assets, which bubbles solve by adding assets to the economy.

In the trade equilibrium I assumed that the world consisted of two countries, a financially developed and a financially underdeveloped country. I showed that rational bubbles can appear in the integrated equilibrium and be located in the financially developed country. Then, I assumed that the financially underdeveloped economy consisted of a continuum of mass one of identical countries and only a certain fraction of these countries had access to world capital markets. I defined globalization as an increase in this fraction. I showed that as globalization progresses, the possibility of having bubbles in the financially developed country increases. The intuition is that as more financially underdeveloped countries integrate into world capital markets, it becomes more likely that there is a shortage of assets in the world economy.

I also showed that the effect of globalization on house prices depends on which asset the bubble is attached to. House prices are higher when there is a bubble, either attached or detached to houses, because the interest is lower with a bubble. However, conditional on having a bubble, an increase in globalization only affects house prices if the bubble is attached to houses. The reason is that when there is a bubble, the interest rate is constant and globalization affects house prices only through increasing the size of the bubble. The size of the bubble affects housing demand only if the bubble is attached to houses. Therefore, an increase in globalization raises house prices only if there is a housing bubble. The less elastic the housing supply is, the larger the rise in house prices is.

In the empirical section I showed that this prediction is consistent with the Dot-Com (1996-2000) and the Housing Bubbles (2002-2006) using house prices from 1983 to 2007 for U.S. metropolitan statistical areas (MSAs). An increase in U.S. current account deficit (over GDP) has a positive effect on house prices during the Housing Bubble. The effect is larger, the lower the housing supply elasticity is. However, an increase in current account deficit has no significant effect on house prices during the Dot-Com Bubble.

To conclude, one cause of the severity of the recent subprime crisis is that banks were holding the bubble whereas the Dot-Com bubble was held by households. It matters who holds the bubble.
when it bursts. In my model there is no financial sector and bubbles do not burst. Therefore, an interesting extension would be to include these two features into the model to provide a better welfare analysis of having different types of bubbles.
8 References


9 Figures and Tables

Figure 1: The Dot-Com and the Housing Bubbles.

Figure 2: House Prices and Current Account in the United States. Source: Case-Shiller house price index and International Financial Statistics (IMF).
Figure 3: House Prices and Current Account in the United Kingdom. Source: House prices from Nationwide and current account (over GDP) from UK National Statistics.

Figure 4: Household Maximization. Optimal choice in Financially Developed (U) and Financially Underdeveloped Country (C).

Figure 5: Comparative Statics: Decrease in Interest Rate.
Figure 6: Autarky equilibrium: Capital market.

Figure 7: Trade equilibrium without bubbles.

Figure 8: Trade equilibrium with a pure asset price bubble appearing in Country $U$. 
Figure 9: Growth Rate (per year) of House Prices during the Dot-Com (1996-2000) and the Housing Bubbles (2002-2006) in different U.S. metropolitan areas. Source: House price index from OFHEO and elasticity from Saiz (2009).

Table 1: Descriptive Statistics

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<th>Dot-Com Bubble</th>
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<tr>
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<td></td>
<td>(5.63)</td>
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<tr>
<td>Observations</td>
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<td>690</td>
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<td>Population</td>
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<tr>
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<td>(1.34)</td>
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<td>(1.07)</td>
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<tr>
<td>Income Share</td>
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<td>0.02</td>
<td>-0.07</td>
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<tr>
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</table>

Values are averages of the (annual) growth rate during sample period, with standard deviations in parentheses. House price index is from Office of Federal Housing Enterprise Oversight (OFHEO). CPI index, used to compute real prices, is from Bureau of Labor Statistics. Population and Income data at metropolitan area level is from Bureau of Economic Analysis. Dot-Com Bubble period is between 1996 and 2000 and Housing Bubble period is between 2002 and 2006. The sample consists of 138 U.S. metropolitan statistical areas (MSAs) and the period is between 1983 and 2007.
Table 2: Current Account Deficit and House Prices for different Bubbles

<table>
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<td>House Prices</td>
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<td>CAD-Elast-HB</td>
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<td>Observations</td>
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Fixed effect OLS regressions with robust standard errors clustered by metropolitan area in parentheses. House price index is from Office of Federal Housing Enterprise Oversight (OFHEO). CPI index, used to compute real prices, is from Bureau of Labor Statistics. Elasticity data is from Saiz (2009). Current Account and GDP data is from International Financial Statistics (IMF). Population and Income data at metropolitan area level is from Bureau of Economic Analysis. Dot-Com Bubble period is from 1996 to 2000 and Housing Bubble period is from 2002 to 2006. All variables are growth rates. The sample consists of 138 U.S. metropolitan statistical areas (MSAs) and the period is between 1983 and 2007.
10 Data Appendix

The housing supply elasticities for different Metropolitan Statistical Areas (MSAs) are estimated in Saiz (2009). These housing supply elasticities are a function of physical (geography) and regulatory constraints. I just show some descriptive statistics and the list of metropolitan areas with the least and most elastic housing supplies included in the sample. See Saiz (2009) for more details on the estimation of these elasticities.

<table>
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<td>0.66</td>
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Top 10 Least Elastic Housing Supply MSAs

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<td>Los Angeles, CA</td>
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<tr>
<td>Ft. Lauderdale, FL</td>
<td>0.72</td>
</tr>
<tr>
<td>San Francisco, CA</td>
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</tr>
<tr>
<td>San Diego, CA</td>
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</tr>
<tr>
<td>Oakland, CA</td>
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</tr>
<tr>
<td>New York, NY</td>
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</tr>
<tr>
<td>Salt Lake City, UT</td>
<td>0.82</td>
</tr>
<tr>
<td>San Jose, CA</td>
<td>0.83</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Top 10 Most Elastic Housing Supply MSAs

<table>
<thead>
<tr>
<th>City</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubbock, TX</td>
<td>3.14</td>
</tr>
<tr>
<td>Davenport, IA-IL</td>
<td>3.18</td>
</tr>
<tr>
<td>Evansville, IN-KY</td>
<td>3.24</td>
</tr>
<tr>
<td>Casper, WY</td>
<td>3.27</td>
</tr>
<tr>
<td>Topeka, KS</td>
<td>3.35</td>
</tr>
<tr>
<td>Lafayette, LA</td>
<td>3.62</td>
</tr>
<tr>
<td>South Bend-Mishawaka, IN</td>
<td>3.64</td>
</tr>
<tr>
<td>Longview, TX</td>
<td>3.90</td>
</tr>
<tr>
<td>Wichita, KS</td>
<td>4.10</td>
</tr>
<tr>
<td>Fort Wayne, IN</td>
<td>4.11</td>
</tr>
</tbody>
</table>