The Dynamics of Hot Money in China

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Abstract

We apply Autoregressive Distributed Lag (ARDL) models to identify drivers of hot money, i.e. capital flows that cannot be explained by the trade surplus or foreign direct investment, from January 2000 to December 2012 to China. Our findings suggest that hot money flows to China are related to the expected appreciation of the Renminbi, the change of house prices and the change of the stock market index. However, after the global financial crisis these factors lose their significance. We find that restrictions on foreign real estate investment and the exchange rate policy reform had no effect on hot money flows.

Key words: Hot money, capital flows, China, Autoregressive Distributed Lag (ARDL) model

JEL code: F31, F37, E42

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1. Introduction

Emerging economies have been confronted with financial instability for decades. China, currently the biggest emerging market, is no exception. The recent increase in the level and volatility of hot money flows is widely considered to have generated financial instability in China (Martin and Morrison, 2008; Ljungwall and Wang, 2008). Hot money is generally defined as capital flows that are not related to the trade surplus or foreign direct investment.[1] Although China has taken several measures to restrict hot money flows, they have not been very effective (Martin and Morrison, 2008; Tsuyuguchi, 2009; Guo and Huang, 2010b). The monthly inflow of hot money in China reached about 96.3 billion US dollars in January 2011 (see Figure 1).

Both the expansion and the volatility of hot money flows have raised concerns about their impact on financial stability. Given the sensitivity of hot money flows, even a small shock to the economy can lead to large fluctuations in hot money flows, which in turn may exacerbate the shock and further destabilize the financial system and the domestic economy (Sarno and Taylor, 2003; Bouvatier, 2010). Furthermore, hot money flows may reduce the effectiveness of monetary and exchange rate policies (Glick and Hutchison, 2009; Guo and Huang, 2010a). It has also been argued that hot money inflows have fueled inflation, driven up stock prices and accelerated a worrisome bubble in the real estate market in China (Guo and Huang, 2010a). Therefore, it is of great importance to study the drivers of hot money flows.

Several previous studies have made progress in analyzing the determinants of hot money flows.[2] Still, a major limitation of these studies is that the techniques employed only allow testing long-run relationships under the restrictive assumption that all the variables in the system are $I(0)$ or all variables are $I(1)$. But, as will be shown in Section 5, this is not the case in China probably due to structural changes, such as exchange rate policy reform, the launch of the qualified foreign institutional investors (QFII) system and regulations which restrict foreign investment in the real estate market, and major shocks, such as the recent financial crisis. The only study which takes structural changes into account is Cheung and Qian (2010b), who use several China-specific institutional factors—including a political risk index, a dummy variable

[1] Including Tung and Baker (2004), Zhang and Fung (2006), Martin and Morrison (2008), and Guo and Huang (2010a).

[2] Relevant references include: Shi and Xiao (2011); Zhao et al. (2011); Cheung and Xian (2010b); Ljungwall and Wang (2008); Sicular (1998); and Gunter (1996, 2004).

allowing the effect of the US–China Strategic Economic Dialogue, a dummy variable for exchange rate policy reform, and a dummy variable tracking the evolution of China's capital control policy. They find that the relevance of the selected institutional factors depends on both data frequency and regression specification.

We intend to test for the time varying impact of factors related to hot money flows in China. Are hot money flows related to developments in the real estate and the stock markets, the interest rate differential vis-à-vis the US, and the expected exchange rate appreciation? And is their effect depending on structural reforms, new regulations and the financial crisis? We use Autoregressive Distributed Lag (ARDL) models introduced by Pesaran et al. (1999), which can be used to examine long-run relationships regardless of whether the underlying variables are $I(0)$, $I(1)$, or fractionally integrated. Furthermore, ARDL models are applicable even when the explanatory variables are endogenous.

Our paper adds to the literature as follows. First, we investigate the (possibly time varying) determinants of hot money flows in China. Our sample includes the period of the recent financial crisis, so that we can analyze its impact. Milesi-Ferretti and Tille (2011) report an unprecedented collapse in international capital flows during the recent crisis suggesting that hot money may have become more volatile during the crisis period. Second, we test for the impact of reforms and new regulations, such as the introduction of the qualified foreign institutional investors (QFII) in July 2003, the exchange rate policy reform in July 2005, and new regulations on foreign investment in real estate in July 2006. The impact of driving factors of hot money flows, for example exchange rate expectations, can be time varying because of these reforms and regulations although their direction is uncertain. For instance, Corbo and Hernandez (1996) argue that a more flexible exchange rate system may lead to excessive volatility in hot money, but Ghosh et al. (2012) argue that a fixed exchange rate may encourage greater cross-border borrowing and lending. Finally, we construct a new measure for hot money flows using adjusted foreign reserves on a monthly basis, employing new BOP statistics issued on April 1, 2011.[3]

Our main findings are as follows. First, over the last decade, hot money flows in China have been large and increasing. In line with the findings of previous studies, our results suggest that the expected appreciation of the RMB, the change of house prices and the stock market index are

[3] The State Administration of Foreign Exchange (SAFE) issued BOP statistics using a new caliber on April 1, 2011. The core of the modification is to take the retained profits of foreign direct investment (FDI) into account.

significantly related to hot money flows in China. The interest rate differential vis-à-vis the US turns out to be insignificant. Second, the determinants of hot money changed during the crisis period as all variables we consider lose their significance. Third, the regulations and reforms we consider do not affect the drivers of hot money.

The remainder of the paper is structured as follows. Section 2 reviews the definitions of hot money and provides an overview of hot money in China since 2000. Section 3 discusses the factors which could be associated with hot money flows. Section 4 explains the estimation techniques employed, while Section 5 reports the empirical results. Section 6 considers the influences from reforms, new regulations and the financial crisis. Finally, Section 7 concludes.

2. Background

In this section, we first review the definition of hot money, and then we analyze hot money flows to China since 2000.

Corbo and Hernandez (1996) define hot money as short-term, highly volatile capital inflows usually attracted by market imperfections or policy mistakes that create a large gap between domestic and foreign interest rates, adjusted for exchange rate expectations. Kim and Singal (2000) characterize hot money as international capital flows that are not only highly sensitive to differences in interest rates, but also to expectations of future economic growth, and expected returns on holding securities. In the view of Glick and Hutchinson (2000), hot money is particularly footloose, seeking the highest global return, and quite speculative in nature. Hence, funds are likely to flow out of a country just as quickly as they flow in, often without any fundamental cause. Martin and Morrison (2008) use hot money in financial markets to refer to the flow of capital from one country to another in order to earn a short-term profit on interest rate differentials and/or anticipated exchange rate shifts. Glick and Hutchison (2009) interpret non-FDI capital inflows that could potentially switch direction within a short horizon as hot money. Sula (2010) considers portfolio flows and private loans as hot money flows. In sum, the most distinguishing feature of hot money is that it can be reversed quickly.

Scholars use either a direct or an indirect way to measure hot money (see Table 1 for a summary). The direct method use data for specific variables that constitute hot money. The indirect method captures hot money as a residual of other variables.[4]

Table 1. Hot money measurement

Direct way		Indirect way	
Study:	**Method:**	**Study:**	**Method:**
Prasad and Wei (2007) Cheung and Qian (2010a)	Errors and omissions portfolio flows	Zhang and Fung (2006) Martin and Morrison (2008) Tung and Baker (2004) Guo and Huang (2010a & 2010b)	Subtract trade surplus (or deficit) and net flow of foreign direct investment (FDI) from the change in foreign reserves
Loungani and Mauro (2001)	Net errors and omissions (1) Net flows of non-FDI, non-portfolio investment assets and liabilities held by entities other than the monetary authorities, general government, and banks (2)		
Loungani and Mauro (2001)	(1) and (2) plus net flows of non-FDI, non-portfolio investment assets and liabilities held by banks		

A limitation of the direct method is that the errors and omissions in the balance of payments statistics includes not only unrecorded capital flows but also measurement and rounding errors, unreported imports, and registration delays. These items are not hot money. A drawback of the indirect method is that it assumes that there is no hot money in net exports and FDI. This is also not the case. In sum, neither the direct method nor the indirect method can record hot money flows precisely. We approximate net hot money flows to China by subtracting the nation's trade surplus (or deficit) and its net flow of foreign direct investment (FDI) from the change in the nation's foreign reserves. Our motivation for using the indirect method is that it is applicable to monthly data. However, instead of using the raw data of foreign reserves, we use adjusted foreign reserves following Zhang and Xu (2008). The reason is that foreign reserves may change even when there are no capital flows. First, foreign reserves in China mainly consist of US dollars, Euros and Japanese Yen. If the Euro appreciates vis-à-vis the US dollar, the stock

[4] See Kant (1996) for a detailed description of various hot money measures and their limitations.

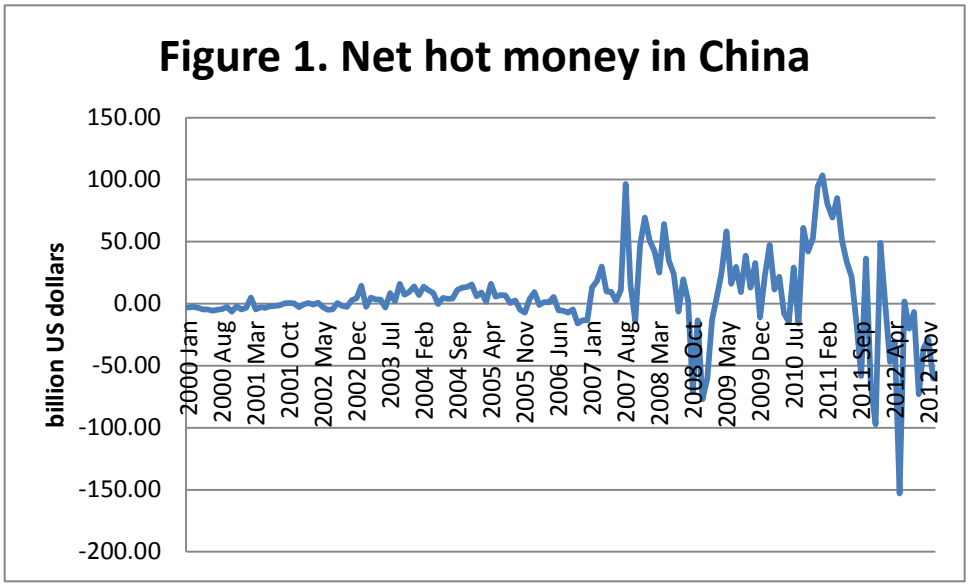
of foreign reserves of China increases even though there is no capital flow. Second, when the China Investment Corporation (CIC) was funded in September 2007, some official foreign reserves were shifted to CIC.[5] These funds should be added to foreign reserves in the corresponding period. Third, state-owned banks received capital injections coming from foreign reserves. These injections should also be added to foreign reserves. Fourth, deposit reserve requirements in foreign currency were imposed on major banks. The amounts of frozen foreign currency should be added to the stock of foreign reserves accordingly. Finally, foreign-exchange swap transactions between the People's Bank of China (PBOC) and major commercial banks in China took place. Unfortunately, these transactions are hard to track since the PBOC does not announce them. We therefore only adjust foreign reserves for the first four factors outlined above.[6] We calculate hot money covering the period from 2000M1 to 2012M12. The quarterly data on FDI comes from BOP. We construct monthly FDI from quarterly FDI following Cheung and Qian (2010b).[7] The monthly exports of goods, imports of goods and foreign reserves come from the IMF's International Financial Statistics (IFS). We subtract net exports of goods and net FDI from the change in adjusted foreign reserves to get hot money.[8]

[5] CIC is a sovereign-wealth fund aiming to make profits using foreign exchange assets held by the Chinese government.

[6] See Appendix A for a detailed description of adjusted foreign reserves.

[7] See Chow and Lin (1971) for more methodology details. Net FDI is derived using data on inward FDI. The monthly inward FDI comes from Ministry of Commerce of the People's Republic of China.

[8] In one of our robustness tests, we subtract net current account and net FDI from the change in foreign reserves. We construct monthly current account data from monthly net exports following Cheung and Qian (2010b).



Note: Monthly net hot money flows in China. Net hot money flows: Change in foreign exchange reserves - Net exports of goods - Net foreign direct investments.

Figure 1 shows that hot money generally flew out of China before 2002, while thereafter it flew into China until the start of the global financial crisis in 2008. Between 2002 and 2008, net inflow of hot money in China amounted to 577 billion US dollars. Because of a relatively low US interest rate and a slowly declining dollar, investors had an incentive to borrow in dollars and invest in high-yield RMB assets. On July 21, 2005, China announced the abolition of its fixed nominal exchange rate to the US dollar. Since then, hot money flows became more volatile. McKinnon et al. (2010) argue that between July 2005 and July 2008, "one-way bet on appreciation of RMB" stimulated hot money inflows to China. In July 2008, when the global financial crisis provoked an unwinding of the dollar carry trade with a sharp appreciation of the dollar against most other currencies, the PBOC returned to pegging the RMB to the US dollar (see Zhao et al., 2013 for details). The Chinese authorities motivated their decision as part of the efforts to overcome the temporary interruption to the reform process that was caused by the global financial crisis. On June 19, 2010 the PBOC announced the return to a managed floating exchange rate regime under which the spot exchange rate can move intraday by at most 0.5 percent from the central parity. The RMB started appreciating again (Eichengreen and Rose, 2010) and hot money inflows into China grew dramatically as illustrated in Figure 1. The near-zero interest rate policy in the United States, along with the moderate decline of the dollar in 2010 also contributed to the rise of hot money flows to China (Sen, 2010).

There are two periods with net hot money outflows in China as shown in Figure 1. The first period started in October 2008, when the global financial crisis intensified due to the fall of Lehman Brothers. The hot money flows out of China amounted to about 232 billion US dollars from October 2008 to February 2009. Milesi-Ferretti and Tille (2011) indicate that this period was characterized by a reversal of capital flows, with investors across the globe liquidating holdings abroad. In addition, the State Council in China announced a new regulation on foreign exchange management on August 2008. This regulation requires that all cross-border flows of foreign exchange recorded as entries in the trade account must be truly the results of trade transactions and those recorded as entries of investment income must be truly investment income (Yu, 2009). The use of RMB funds originating from selling foreign exchange to the State Administration of Foreign Exchange (SAFE) must be approved by the authorities.[9] The second period with outflows started in September 2011 and intensified in May 2012. The annual outflow of hot money was about 403 billion US dollars in 2012. This was the largest outflow in one year. Probably this was a result of the end of the "one-way bet".

3. Factors associated with hot money

There is a small but rapidly growing literature on the factors associated with hot money flows. Kim and Singal (2000) argue that hot money flows are highly sensitive to differences in interest rates, expectations of future economic growth, and expected returns from holding securities. According to Bouvatier (2010), the US interest rate and exchange rate revaluation are important factors in explaining hot money inflows. McCauley (2010) poses that prospects for strong performance of Asian economies and currency appreciation (or at least stability of Asian currencies) have led to an acceleration of equity inflows, debt inflows, bond market inflows, bank flows and carry trades in Asia.

Studies on hot money in China emphasize diverse factors. Martin and Morrison (2008) point to two key factors: the interest rate differential vis-à-vis the United States and expectations of an appreciation of the RMB. Zhang and Fung (2006) and Guo and Huang (2010a) argue that hot money mainly flows to the stock and real estate markets in China. Zhang and Shen (2008) show that the appreciation of the RMB and rising stock prices are determinants of hot money

[9] Foreign currency is not allowed to circulate in China. Foreign currency has to be sold to SAFE to get RMB and the purpose of this transaction has to be approved.

flows in China. Likewise, Yu (2010) poses that speculative capital inflows were betting on an increase in the RMB exchange rate and rising property and equity prices. Similarly, Shi and Xiao (2011) find that the main incentives for hot money flows in China are revenues from investment in stock and real estate markets. The expected appreciation of the RMB also has driven hot money in China according to this study, but the interest differential vis-à-vis the US has no effect. Zhao et al. (2011) find that the most significant factor related to hot money flows in China was rising house prices, followed by the exchange rate and interest rate differentials; stock prices had the weakest impact. In sum, although previous studies focus on similar drivers of hot money flows, they do not all come to the same conclusion at to the factors associated with the expansion of hot money flows in China. A possible reason for these diverse findings is that studies use different sample periods. In addition, the methods used, either OLS models or VAR models, require that all variables are *I*(0) or all are *I*(1), and this may not be true in China which is in a process of financial reform.

We use two groups of explanatory factors based on previous studies: global and domestic macroeconomic variables. We use interest rate differentials vis-à-vis the US to capture the global factor. If Chinese interest rates are higher than those in the US there arguably will be more hot money inflows to China. We consider three domestic macroeconomic variables. The change of the stock market index and the change of house prices are included to capture flows aiming at acquiring profits from rising asset prices. Expectations for the future RMB exchange are included to take up exchange rate speculation. There will be hot money inflows when stock and house prices rise, and when the RMB is expected to appreciate. We use the monthly change of the Shanghai Stock Exchange Composite Index and the annual change of Chinese house prices.[10] Data on the Shanghai Stock Exchange Composite Index come from DataStream. House prices are calculated using real estate turnover divided by real estate sales; both series have been taken from the Wind database. The interest rate differential between China and the United States equals the one-month interbank offer rate difference between China and the United States; both interest rates come from Reuters. The expected depreciation of the RMB (EE) can be derived using the following equation: $EE = \frac{E^e - E_0}{E_0}$. Non-deliverable forward (NDF) is a proxy for the expected exchange rate E^e, which originates from Bloomberg. The RMB offshore non-

[10] Annual change is used to correct for seasonal effects in the real estate market.

deliverable forwards are not officially subject to China's jurisdiction and, thus, could be viewed as a market indicator of expected currency movements (Cheung and Qian, 2010b). The spot exchange rate is also from DataStream.

4. Methodology

Pesaran et al. (1999) propose the Autoregressive Distributed Lag (ARDL) model. This method can be used regardless of whether the variables are *I*(0) or *I*(1). The ARDL procedure consists of two steps. First, it tests the existence of a long-run relation between the variables in the system using the so-called bound test, which is an F-test. In our model, as shown in equation (1), the null hypothesis of no cointegration as defined by H_0: $\alpha_7 = \alpha_8 = \alpha_9 = \alpha_{10} = \alpha_{11} = 0$ is tested against its alternative H_1: $\alpha_7 \neq 0$, $\alpha_8 \neq 0$, $\alpha_9 \neq 0$, $\alpha_{10} \neq 0$, $\alpha_{11} \neq 0$ using F-statistics. The critical values of the F-statistics for this test are available in Pesaran et al. (2001). They provide two sets of critical values in which one set is computed under the assumption that all variables in the ARDL model are *I*(1), and the other under the assumption that they are all *I*(0). For each application, the two sets provide the bands covering all the possible classifications of the variables into *I*(0) or *I*(1), or even fractionally integrated ones. If the computed F-statistic is higher than the upper bound of the critical value, the null hypothesis of no cointegration is rejected. If it is below the lower bound, the null hypothesis cannot be rejected. If it lies within the lower and upper bounds, the result is inconclusive.

$$\Delta \mathrm{HM}_t =$$

$$\propto_0 + \propto_1 t + \sum_{i=1}^{p} \propto_2 \Delta HM_{t-1} + \sum_{i=1}^{p} \propto_3 \Delta EE_{t-1} + \sum_{i=1}^{p} \propto_4 \Delta ID_{t-1} + \sum_{i=1}^{p} \propto_5 \Delta SP_{t-1} +$$

$$\sum_{i=1}^{p} \propto_6 \Delta HP_{t-1} + \propto_7 HM_{t-1} + \propto_8 EE_{t-1} + \propto_9 ID_{t-1} + \propto_{10} SP_{t-1} + \propto_{11} HP_{t-1} + \mu_t, \quad (1)$$

where p is lag order, t is time trend, μ_t is error term, *HM* is hot money, *EE* is expected depreciation, *ID* is interest rate differential, *SP* is the change of the stock market index and *HP* is the change in house prices. If the results of the F-statistics in the first step suggest cointegration, we move to the second step of the ARDL approach. In this step, the lag order of the variables is chosen according to the Schwarz Bayesian Criteria (SBC). To check the performance of the estimated model, we also present the diagnostic tests for serial correlation, functional form and heteroscedasticity.

5. Results

First we perform ADF unit root tests for each variable.[11] The tests are conducted against three alternatives: stationary fluctuations around zero, stationary fluctuations around a constant term and stationary fluctuations around a constant term and a time trend. Table 2 reports the results and shows that all variables are either $I(0)$ or $I(1)$.

Table 2. Augmented Dickey-Fuller tests

		Level		First difference	
		Lag length	t-statistic	Lag length	t-statistic
Hot Money	(0,0)	2	-3.1990***		
	(c,0)	2	-3.2089**		
	(c,t)	2	-3.1617*		
Expected depreciation	(0,0)	1	-2.7222***		
	(c,0)	1	-2.7411*		
	(c,t)	1	-2.6909	0	-17.3559***
Interest differential	(0,0)	0	-0.9746	0	-11.5605***
	(c,0)	0	-1.2443	0	-11.6027***
	(c,t)	0	-1.677	0	-11.5644***
Change of stock market index	(0,0)	1	-6.5578***		
	(c,0)	1	-6.5376***		
	(c,t)	1	-6.5100***		
Change of house prices	(0,0)	11	-1.5167		
	(c,0)	13	-4.2227***		
	(c,t)	13	-5.2816***		

Notes: This table shows the outcomes of the ADF test. The lag length is based on SBC criterion. (0, 0) refers to the model without constant and without time trend. (c, 0) refers to the model with constant but without time trend. (0, t) refers to the model without constant but with time trend. (c, t) refers to the model with constant and time trend. *** Rejection of the null hypothesis at the 1% level; ** Rejection of the null hypothesis at the 5% level; * Rejection of the null hypothesis at the 10% level.

In the second step, we perform bound tests using model (1) to see whether there are long-term cointegrating relationships among variables. The results for the F-tests are given in Table 3, showing whether the values of the F-statistics are above the critical values (CV) provided by Pesaran et al. (2001) using different lag orders p. These tests support the existence of a long-run relationship between hot money flows and the four factors we investigated, irrespective of their order of integration.

[11] We also performed alternative unit root tests developed by Elliot et al. (1996) and Phillips and Perron (1998). These tests give the same outcomes as the ADF tests (results available on request).

Table 3. Results of bound tests (F-statistics)

Lag order (*p*)	**1**	**2**	**3**	**4**	**5**	**6**
HM (0,0)	6.1283***	2.7069**	3.9054***	2.7710***	2.1904*	2.4366**
HM (c,0)	6.1431***	2.7384**	4.1728***	2.8088**	2.2326*	2.5243**
HM (0,t)	6.1691***	2.7416**	4.3629***	2.8744**	2.3538**	2.7393**
HM (c,t)	6.0906***	2.7069**	4.3300***	2.8491**	2.3462**	2.7293**

Notes: This table shows F tests using model (1) using different lag orders shown in the first row. The asterisk denotes test statistics above upper bound critical value. *, **, and *** means significant at the 10%, 5%, and 1% level, respectively. HM (0, 0) gives F statistic for models without constant and without time trend t. HM (c, 0) gives F statistic for models with constant without time trend t. HM (0, t) gives F statistic for models without constant with time trend t. HM (c, t) gives F statistic for models with constant and time trend t.

In the third step, we estimate the ARDL model using the SBC criterion to determine the optimal lag order of each variable in the system. The maximum lag is set at 4 so that the sample period for analysis becomes 2000M5 to 2012M12. Using Microfit 4.1, the optimal model is: ARDL (3,0,0,0,0). The results of this model are summarized in Table 4.

Table 4. Autoregressive Distributed Lag Model: estimation results

	coefficient	t-statistic
Hot money (-1)	0.2064	2.6643***
Hot money (-2)	0.1773	2.2646**
Hot money (-3)	0.2175	2.7643***
Expected depreciation	-0.2451	-3.5084***
Interest differential	0.1467	1.2129
Change of stock market index	0.2131	2.3094**
Change of house prices	0.0901	1.9016*
Constant	0.1711	0.3409
Trend	-0.0072	-1.1434
R-Squared	0.4143	
R-Bar-Squared	0.3815	
F-stat. F(6, 42)	12.6435***	
Serial Correlation	2.1730**	
Q(12)	16.276	
Q(24)	20.281	
Functional Form	0.1835	
Heteroscedasticity	0.7097	

Notes: The dependent variable is hot money flows. Hot money (-1), Hot money (-2) and Hot money (-3) are the first, second and third lag of hot money, respectively. The ARDL (3,0,0,0,0) model is selected based on Schwarz Bayesian Criterion. *** Rejection of the null hypothesis at the 1% level; ** Rejection of the null hypothesis at the 5% level; * Rejection of the null hypothesis at the 10% level.

Table 4 indicates that the overall goodness of fit of the estimated equation is reasonably good (R^2=0.41). The model passes two of the three diagnostic tests: functional form and heteroscedasticity tests. The results indicate that there exists serial correlation, but this does not affect the estimates (Laurenceson and Chai, 2003; Shrestha, and Chowdhury, 2007). Estimates of the long-run coefficients based on the ARDL model are reported in Table 5, while the Error Correction Model is shown in Table 6.

Table 5. Estimated long-run parameters of the ARDL model

	coefficient	t-statistic
Expected depreciation	-0.6146	-3.4555***
Interest differential	0.3678	1.2240
Change of stock market index	0.5343	1.9504*
Change of house prices	0.2260	1.7819*
Constant	0.4289	0.3412
Trend	-0.0181	-1.1180

Notes: The dependent variable is hot money flows. This table shows the long-run parameters based on the estimates shown in Table 4. *, **, and *** means significant at the 10%, 5%, and 1% level, respectively.

The coefficients of the expected exchange rate, change of stock market index and change of house prices as shown in Table 5 are significant with the expected sign. An expected appreciation of the RMB exchange rate, rising stock market prices and house price induce hot money inflows. These results are broadly in line with the findings of previous studies (Zhang and Fung, 2006; Guo and Huang, 2010a; Zhang and Shen, 2008; Yu, 2010; Shi and Xiao, 2011). The coefficient of the interest rate differential has the expected sign, but is insignificant. Also this finding is in line with those of several earlier studies. Although theoretically the interest rate differential is a trigger of hot money, few empirical studies find it to be significant in China (Cheung and Qian, 2010b; Shi and Xiao, 2011). This is probably reflecting that interest rates in China are regulated by the central bank and are not determined by market forces (Goldstein and Lardy, 2006). In addition, Chinese money markets are not accessible to everyone (Cheung and Qian, 2010b).

Table 6. Error correction representation of the selected ARDL model

	coefficient	t-statistic
D(Hot money (-1))	-0.39477	-4.2209***
D(Hot money (-2))	-0.21747	-2.7643***
D(Expected depreciation)	-0.2451	-3.5084***
D(Interest differential)	0.14668	1.2129
D(Change stock of market index)	0.21309	2.3094**
D(Change of house prices)	0.090138	1.9016*
D(Constant)	0.17105	0.34088
D(Trend)	-0.007227	-1.1434
ECM (-1)	-0.3988	-4.3533***
R-Squared	0.4456	
R-Bar-Squared	0.41459	
F-stat. F(6, 42)	14.3673***	

Notes: The dependent variable is the first difference of hot money flows. ECM denotes error correction term obtained from the long-run relationship. *, **, and *** means significant at the 10%, 5%, and 1% level, respectively.

The results in Table 6 provide further evidence of cointegration among the variables in the model. The error correction term (i.e. ECM (−1)) has the right sign (negative) and is statistically significant. The estimated value of ECM (-1), which indicates the speed of adjustment to equilibrium following short-run shocks, is -0.3988. So about 40% of the disequilibrium, caused by shocks, is corrected in each period in the converge process to the long-run equilibrium. The ECM model is as follows:

ECM = HM + 0.6146*EE -0.3678*ID -0.5343*SI -0.2260*RE -0.4289*C + 0.0181*T

The overall results show that the selected variables are appropriate. We conclude that the evidence so far corroborates evidence of previous studies concerning the factors driving hot money flows, despite our different definition of hot money flows. The sensitivity tests as shown in Appendix B suggest that our results are fairly robust when we use another concept of hot money.

6. Are the determinants of hot money time varying?

The introduction of several regulations and reforms as described in Section 2, may have affected the determinants of hot money flows. We consider the influence of the QFII system (July, 2003), the exchange rate policy reform (July, 2005), the regulation on foreign investment in the real estate market (July, 2006), as well as the global financial crisis (September, 2008). Columns (1)-

(3) in Table 7 provide the estimated long-run coefficients based on selected ARDL models in which we add interaction terms of dummies for the launch of QFII system, the reform of the exchange rate policy and the regulation on foreign investment in the real estate market and the determinants possibly affected by these reforms. The dummies are one after the reform, and zero before. Column (4) gives the results for the sample after the start of the global financial crisis.

Column (1) in Table 7 introduces an interaction term of the dummy for the introduction of the QFII system and the change of the stock market index (Dummy1=0 before June 2003, Dummy1=1 after July 2003). It tests the influence of the launch of the QFII system which relaxed foreign exchange controls for China's stock market on the relationship between hot money flows and the change of the stock market index. Under the QFII scheme, foreign investors are allowed to invest in 'A' shares[12], bonds and warrants listed on China's domestic stock exchanges, securities investment funds and other instruments permitted by the China Securities Regulation Commission. The scheme allows a single QFII to hold up to 10 per cent of the 'A' shares in one listed company while the total foreign shareholding held by a QFII in any one listed company cannot exceed 20 per cent. The accumulated investment quota for a single QFII is currently capped at US$1 billion. The results show that the coefficient of the interaction term of Dummy1*Change of stock market index is not significant (t = 0.5597), suggesting that the launch of QFII did not affect the relationship between hot money flows and the change of the stock market index.

Column (2) provides the results for testing the effect of the exchange rate policy reform in July 2005 on the relationship between hot money flows and expected depreciation. An interaction term of the dummy and the change of the expected depreciation is introduced (Dummy2=0 before June 2005, Dummy2=1 after July 2005). Again the coefficient of the interaction term is not significant (t = -1.0938). Our results therefore do not confirm that the impact of speculating on an exchange rate appreciation on hot money flows changed after the exchange rate became more flexible, thereby not providing support for the views of Ghosh et al. (2012). Our results also do not support the view of Corbo and Hernandez (1996), who argue that a more flexible exchange rate system may lead to excessive volatility in hot money.

Column (3) gives results for testing the influence of the regulation on foreign investment in the real estate market in 2006M7 on the relationship between the change of house prices and

[12] 'A' shares are specialized shares that are traded on the Shanghai and Shenzhen stock exchanges.

hot money flows. We incorporate an interaction term of the dummy and the change of house prices (Dummy3=0 before June 2006, Dummy3=1 after July 2006). It is clear from the results that the coefficient of the interaction term is insignificant (t =1.3296). So our results suggest that the regulation which aimed at restricting hot money inflows to the real estate market was not effective.

The results for the sample after the start of the global financial crisis (2008M9) are presented in Column (4). It is remarkable that factors which turn out to be significant for the full sample period, i.e. expectations about a depreciation of the exchange rate, real estate and stock market prices, are not driving hot money flows movements after the global financial crisis. As the financial crisis unfolded, the house and stock markets fell in China. As pointed out before, during the crisis the Chinese authorities re-introduced the peg of the RMB to the US dollar, thereby making exchange rate speculation no longer lucrative.

Table 7. Estimated long-run coefficients
(with interaction terms with reform dummies and subsample for crisis period)

	(1)	(2)	(3)	(4)
	Dummy1 2003M7	Dummy2 2005M7	Dummy3 2006M7	2008M9 to 2012M12
Expected depreciation	-0.6605***	-0.3572	-0.5976***	-0.4830
	(-3.2774)	(-0.8797)	(-3.6464)	(-1.1322)
Interest differential	0.3301	0.5946	0.4783	0.7136
	(1.0508)	(1.2405)	(1.5743)	(0.5294)
Change of stock market index	-0.0515	0.5139**	0.4781*	0.6723
	(-0.0460)	(1.9816)	(1.9201)	(1.0505)
Change of house prices	0.2236*	0.2104*	0.0512	0.3350
	(1.7274)	(1.7485)	(0.1974)	(1.5392)
Dummy1*Change of stock market index	0.624			
	(0.5383)			
Dummy2*Expected depreciation		-0.2984		
		(-0.6134)		
Dummy3*Change of house prices			0.2086	
			(0.7228)	
Constant	0.4458	1.2005	1.7497	0.0616
	(0.3417)	(0.6332)	(1.2307)	(0.0205)
Trend	-0.0075	-0.0401	-0.0513*	-0.1104
	(-0.3073)	(-0.7428)	(-1.7131)	(-0.7099)
Dummy1	-1.1991			
	(-0.5438)			
Dummy2		1.59		
		(0.3865)		
Dummy3			2.7315	
			(1.1630)	

Note: The dependent variable is hot money flows. T-statistics are shown in parentheses. *, **, and *** means significant at the 10%, 5%, and 1% level, respectively.

The error correction term[13] obtained from the long-term coefficient estimation has the right sign (negative) and is statistically significant, which confirms the evidence of cointegration among the variables in the model.

7. Conclusions

In this paper we apply Autoregressive Distributed Lag (ARDL) models to establish which factors are related to hot money flows from January 2000 to December 2012 to China. Our findings

[13] The detailed results are available on request.

suggest that hot money flows are related to the expected appreciation of the Renminbi, the change of house prices and the change of the stock market index. These results are in line with the findings of most previous studies.

The expected appreciation of the RMB was a crucial factor driving hot money flows in China. Its coefficient is always significant except in the period since the start of the global financial crisis period when China returned to a peg of the RMB to the dollar. The exchange rate policy reform in 2005 had no significant impact on this relationship. The relationship between the change of the stock market index and hot money flows, as well as changes in house prices and hot money flows, are positive, and have not significantly been affected by the QFII system or a new regulation of foreign investment in the real estate market.

Our results suggest that the factors relate to China's hot money flows are sensitive to the financial crisis. All investigated determinants lose their significance after the global financial crisis. This result is in accordance with the findings of Fratzscher (2012) who reports that external factors were overall the main drivers of capital flows during the crisis. This was also the case during the Asian financial crisis as shown by Prasad et al. (2005).

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Appendix A

Calculating adjusted foreign reserves

1. China's foreign exchange reserves mainly consist of assets denominated in U.S. dollar, euro and yen. Foreign reserves are published in U.S. dollars. In case the US dollar depreciates, the dollar value of assets denominated in other currencies will appreciate, so the stock of foreign reserves in dollars will increase. We assume that since 2000, China's foreign exchange reserve currency structure remains the same, i.e. the U.S. dollar, euro and yen assets account for 70%, 20% and 10%, respectively (Zhang and Xu, 2008) and we adjust the stock of foreign reserves for currency fluctuations accordingly.
2. China Investment Corporation (CIC) is a sovereign-wealth fund which was established in September 2007. CIC received 200 billion USD, funded by special government bonds. These were recorded as capital account outflow transactions in the BOP statistics. From August 2007 to December 2007, the Ministry of Finance issued eight special treasury bonds with a total amount of 15 trillion RMB. We assume that the Ministry of Finance buys foreign currency on the day when they issue special treasury bonds. From August 2007 to December 2007, the central bank set aside totally 207.9 billion US dollars from foreign exchange reserves. Taking into account that the CIC has paid 67 billion US dollars to central bank in the acquisition of Central Huijin, the net amount CIC obtained from the central bank's foreign exchange reserves is 140.9 billion US dollars. We add these special bonds to the foreign reserves, and subtract the amount the CIC paid to the central bank.

Table A1. Special bonds issued from Ministry of Finance

Number	Time	Amount in RMB	Exchange rate	Amount in US dollar (billion)
1	Aug 2007	6000.0	7.5505	79.47
2	Sep 2007	1033.8	7.5050 ~ 7.5230	13.76
3	Nov 2007	705.3	7.4336 ~ 7.4624	9.47
4	Dec 2007	7763.5	7.3790 ~ 7.3797	105.20

Source: Zhang and Xu (2008).

3. The central bank injected funds through Central Huijin to state-owned commercial banks and securities companies in order to assist reforms of these banks and companies. Most

of these funds are in foreign currency. Central Huijin was established on December 2003. The injected funds are shown in table A2. We add these injections to the foreign reserves.

Table A2. Injected funds by Central Huijin

Institution	Date	Amount	Note
Bank of China	Dec, 2003	22.5 billion US dollars	
China Construction Bank	Dec, 2003	20 billion US dollars	
China Jianyin Investment	Dec, 2003	2.5 billion US dollars	
Bank of Communications	Jun, 2004	3 billion Chinese Yuan	0.36 billion US dollars
			On loan
Industrial and Commercial Bank of China	Apr, 2005	15 billion US dollars	
China Galaxy Securities	Jun, 2005	10 billion Chinese Yuan	1.21 billion US dollars
The Export-Import Bank of China	Jul, 2005	5 billion US dollars	
Shenyin & Wanguo Securities	Aug, 2005	2.5 billion Chinese Yuan	0.31 billion US dollars
			+1.5 billion loan in Chinese Yuan
Guotai Junan Securities	Aug, 2005	1 billion Chinese Yuan	0.12 billion US dollars
			+1.5 billion loan in Chinese Yuan
China Galaxy Financial Holdings	Aug, 2005	5.5 billion Chinese Yuan	0.68 billion US dollars
China Everbright Bank	Sep, 2005	10 billion Chinese Yuan	1.24 billion US dollars
China Investment Securities	Sep, 2005	0.35 billion Chinese Yuan	0.04 billion US dollars
			Restructure Nanfang Securities, rename as
			CIS
			+8.7 billion loan in Chinese Yuan
China Everbright Bank	Nov, 2007	20 billion US dollars	
Industrial and Commercial Bank of China	Sep, 2008	4.15*2=8.3 million Chinese Yuan	Buy 2 million share in each bank
China Construction Bank		4.55*2=9.1 million Chinese Yuan	25.8 million Chinese Yuan=3.77 million US dollars
Bank of China		3.7*2=7.4 million Chinese Yuan	
Agriculture Bank of China	Nov, 2008	130 billion Chinese Yuan	19.04 billion US dollars
China Construction Bank	From 23, Sep, 2008 to 28, Nov, 2008	4.55*5.08=23.1 million Chinese Yuan	Totally 7.08 million share minus 2 million on 23, Sep,

			2008
China Development Bank	Dec, 2008	20 billion US Dollars	3.37 million US dollars Restructure
China Export & Credit Insurance Corporation	Dec, 2012	20 billion Chinese Yuan	3.2 billion US dollars

Source: Wikipedia, http://zh.wikipedia.org/wiki/%E4%B8%AD%E5%A4%AE%E6%B1%87%E9%87%91%E6%8A%95%E8%B5%84%E6%9C%89%E9%99%90%E8%B4%A3%E4%BB%BB%E5%85%AC%E5%8F%B8.

4. The People's Bank of China started requesting major banks to submit deposit reserves in US dollars since August 2007. On the balance sheet of the PBOC, foreign currency deposits from banks were recorded under "other foreign assets", rather than "foreign exchange reserves". We first calculate the amount of the funds which have been frozen/released when the reserve ratio changes. Since not every commercial bank was subject to the requirements of deposit reserve in US dollars, we use the ratio of 70% as suggested by Zhang and Xu (2008). We convert these frozen/released amounts into US dollars and add/abstract the amounts to the foreign reserves.

Table A3. Estimate of deposit reserves of commercial banks

Date	Deposits (hundred million Yuan)	Deposit rate	Frozen or released (hundred million Yuan)	70% of frozen or released	Exchange rate (RBM to US dollars)	Amount in US dollars (billion)
2007 Aug	377415.9	0.12	1887.080	1320.956	7.576	17.436
2007 Sep	382981.2	0.125	1914.906	1340.434	7.516	17.834
2007 Oct	378483.7	0.13	1892.419	1324.693	7.513	17.633
2007 Nov	385507.2	0.135	1927.536	1349.275	7.425	18.171
2007 Dec	389371.1	0.145	3893.711	2725.598	7.372	36.975
2008 Jan	391551.5	0.15	1957.757	1370.430	7.252	18.898
2008 Mar	415693.1	0.155	2078.466	1454.926	7.089	20.523
2008 Apr	422275	0.16	2111.375	1477.963	6.999	21.117
2008 May	431274	0.165	2156.370	1509.459	7.003	21.554
2008 Jun	438989.3	0.175	4389.893	3072.925	6.902	44.524
2008 Oct	458331.5	0.17	-2291.657	-1604.160	6.839	-23.456
2008	466203.3	0.155	-6993.050	-4895.135	6.843	-71.538

Dec 2010	612877.3	0.16	3064.386	2145.070	6.827	31.419
Jan 2010	622436.8	0.165	3112.184	2178.529	6.833	31.882
Feb 2010	660756.8	0.17	3303.784	2312.649	6.827	33.876
May 2010	708784.3	0.18	7087.843	4961.490	6.637	74.755
Nov 2010	718237.9	0.185	3591.190	2513.833	6.655	37.773
Dec 2011	712828.1	0.19	3564.140	2494.898	6.590	37.859
Jan 2011	726017.6	0.195	3630.088	2541.062	6.597	38.521
Feb 2011	752838.4	0.2	3764.192	2634.934	6.570	40.107
Mar 2011	756262.4	0.205	3781.312	2646.918	6.532	40.525
Apr 2011	767339	0.21	3836.695	2685.687	6.498	41.333
May 2011	786432.6	0.215	3932.163	2752.514	6.480	42.475
Jun 2011	809368.3	0.21	-4046.842	-2832.789	6.371	-44.467
Dec 2012	817398.1	0.205	-4086.990	-2860.893	6.300	-45.414
Feb 2012	854499.7	0.2	-4272.498	-2990.749	6.322	-47.311
May						

Source: The People's Bank of China.

Appendix B

Robustness test

In this appendix, we construct an alternative hot money indicator by subtracting net current account and net FDI from the change in foreign reserves instead of subtracting net export of goods and net FDI from the change in foreign reserves. We construct monthly current account data from monthly net exports following Cheung and Qian (2010b).

Table B1 reports the estimated long-run coefficients of the selected ARDL model. It shows that the expected deprecation, change of stock market index and change of house prices are significant factors driving hot money flows in China. Table B2 shows the estimated long-run coefficients of the ARDL model with interaction terms included. All interaction terms are insignificant, similar to the results we obtained in Section 6.

Table B1. Robustness test on estimated long run coefficients using ARDL

	coefficient	**t-statistic**
Expected depreciation	-0.5191	-3.3047***
Interest differential	0.4274	1.5763
Change of stock market index	0.4970	2.0279**
Change of house prices	0.2256	1.9744*
Constant	0.3532	0.3115
Trend	-0.0192	-1.3242

Notes: The dependent variable is hot money flows. This table shows the long-run parameters of the selected ARDL(3,0,0,0,0) model. *, **, and *** means significant at the 10%, 5%, and 1% level, respectively.

Table B2. Robustness test on Estimated long-run coefficients using ARDL (add both interaction terms and dummies)

	(1)	**(2)**	**(3)**
	2003M7	2005M7	2006M7
Expected depreciation	-0.5685***	-0.2447	-0.5094***
	(-3.2270)	(-0.6646)	(-3.4301)
Interest differential	0.3806	0.5556	0.4976*
	(1.3593)	(1.2725)	(1.7727)
Change of stock market index	0.0217	0.4854**	0.4585**
	(0.0217)	(2.0631)	(1.9964)
Change of house prices	0.2222*	0.2110*	0.0368
	(1.9226)	(1.9232)	(0.1533)
Dummy1*Change of stock market index	0.5062 (0.4922)		
Dummy2*Expected depreciation		-0.3307	
		(-0.7466)	
Dummy3*Change of house prices			0.2289
			(0.8560)
Constant	0.4077	0.7644	1.3937
	(0.3523)	(0.4398)	(1.0702)
Trend	-0.007	-0.0288	-0.0432
	(-0.3171)	(-0.5822)	(-1.5711)
Dummy1	-1.4111		
	(-0.7157)		
Dummy2		0.6013	
		(0.1596)	
Dummy3			1.8578
			(0.8567)

Note: The dependent variable is hot money flows. This table shows the long-run parameters based on the selected ARDL(3,0,0,0,0) model. *, **, and *** means significant at the 10%, 5%, and 1% level, respectively.