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## Money Demand in China: A Meta Study

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## IMPRESSUM

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# Money Demand in China: A Meta Study

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## Abstract

In this paper we reexamine the literature on money demand in China published both in English and Chinese language. Over the past 30 years - starting with the paper by Chow (1987) there has been a regular stream of papers assessing the Chinese money demand function. The literature is mostly focusing on income elasticity, stability, and - which is special for China - the adequate choice and quality of data. In particular regarding stability of money demand, we find a substantial publication bias towards rejecting stability. When controlling for publication bias, and focusing on longer time periods, our paper strongly suggests stable long run money demand in China.

## 1 Introduction

In this paper we reexamine the literature on money demand in China. The past few decades saw more than 60 papers on this issue, starting with the paper by Chow (1987). To get a grasp of the magnitude of research on money demand in CHina, one should consider that Knell and Stix (2003), the first major meta study of money demand covering papers after the “cointegration revolution”, survey 79 papers, i.e. only slightly more than we do but from 16 different countries. The follow up paper by Knell and Stix (2006) that combines the datasets from several previous studies covers roughly 200 studies, and even the extension by Kumar (2014) almost a decade later includes only about 270 papers from more than 70 countries. Thus, it is save to say that even though our inclusion criteria differ slightly from the afore mentioned studies, the interest in Chinese money demand is immense.<sup>1</sup> The reasons are manifold. Not only is

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<sup>1</sup>The only other meta study on money demand concentrating on a single country is the paper by Riyandi (2012) focusing on Indonesia and using a fairly small sample.

China one of the largest economies in the world, but it features a particularly interesting monetary history. Before the reforms initiated in 1978 by Deng Xiaoping, the People's Bank of China (PBoC) was not only the central bank but also served as China's only bank. In the following decades China stuck with a policy that put much more emphasis on monetary aggregates than the Fed, who basically abandoned monetary aggregates as a relevant policy measure after the so called monetarist experiment (see e.g. Bernanke (2006)). Only recently, the PBoC has started focusing more strongly on interest rates.

With this history it seems unsurprising that money demand studies yield a wide range of different results regarding both the income elasticity of money demand and its stability depending on the precise time frame and measurements used. For this paper, we gather 61 studies on money demand in China, covering all those periods of the modern Chinese economic history, some using data going back to the 1950s, other having samples going to current times past the great recession.

Our paper differs from the previous meta literature in one essential way. While most of the literature focuses exclusively on papers published in English, our survey includes papers published in Chinese journals. In a country with institutions that are as unusual as the Chinese ones, we believe it is necessary to give special attention to domestic authors.

The paper is structured as follows: Section 2 presents an overview of money demand theory and the estimation of money demand functions. In Section 3 the principles of meta-analysis are described. In Section 4, we introduce our data and hypotheses about their possible influence on the money demand estimation. In Section 5 we present the results, in particular concerning the two major research questions in money demand: the income elasticity of money demand, and the stability of money demand.

## 2 Money demand in China

### 2.1 A brief monetary history of China

In the past decades the Chinese monetary system has undergone a probably unprecedented development.

Before 1978 the PBoC was not a central bank in the traditional sense, but rather China's only bank.<sup>2</sup> This changed with Deng Xiaoping's Economic Reform and Opening-up Policy that gradually introduced a basic market-oriented economy and financial system.

After 1978 the PBoC assumed the role of a more traditional central bank, although initially the banking system was still completely under government supervision. Not only were the commercial banks focused on their own industry with no competition within the markets (for instance, the Bank of China was

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<sup>2</sup>Other banks were either run as departments of the Bank of China or were non deposit taking institutions at the time, such as for example the China Construction Bank.

exclusively managing China's foreign exchange operations), but also were all bank completely government owned.

First attempts for further reform towards a market oriented financial system were made in the late 1980s and early 1990s, but the major reforms were introduced in 1994. In 1992, the 14<sup>th</sup> National Congress of the CPC decided to introduce a new banking system, comprised of three policy banks – responsible for distributing government funds –, and four commercial banks – which eventually evolved into the modern era big four. Still, those banks were highly specialized, and are (until today) fully state owned.

Since 2008, the financial sector has undergone more changes, triggered by the impact of the global financial crisis on China. During this period, the main objective was to regulate the financial market, as well as to optimize resource allocation.

The changes towards a market driven banking system, required corresponding changes in monetary policy. While the PBoC initially closely monitored banks activities to pursue monetary policy through the banks, the system gradually shifted (and is still shifting) to a more incentive based system, where the PBoC acts mostly through open market operations.

In its policy the PBoC traditionally heavily emphasized the role of monetary aggregates, and is only slowly moving to a stronger focus on interest rates. As of today (2017) there is no single benchmark policy rate, but a range of instruments, such as the target rates for loans, deposit, mortgages and the Repo rate for the PBoC's own interaction with banks.

## 2.2 Money demand in China - a literature review

The literature on money demand in China was pioneered by Chow (1987) who estimated a money demand function derived from the quantity theory. Although using a sample from 1952 to 1983 that mostly covers the time before the reforms in 1978 that introduced commercial banking and gradually loosened price controls, Chow finds an income elasticity fairly close to 1 (1.16).<sup>3</sup> Feltenstein and Farhadian (1987) and Chan et al. (1991) focus on the choice of the appropriate measure of the price level in their analyses, claiming that officially reported prices in China do not reflect true inflation but are correlated to the true value. Both find evidence for some (small) degree of systematic measurement or reporting error in prices. However, their approach did not gain traction in the literature and the vast majority of papers still uses the standard approach.

The empirical literature on money demand in China pretty much developed in parallel to the econometric literature on cointegration. While first papers use simple Engle-Granger type approaches, or occasionally even ignore stationarity issues, the bulk of the literature relies on Johansen (1988) type vector error correction models. Comparably late, roughly since 2009, Pesaran et al. (2001) cointegration approaches seem to dominate.

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<sup>3</sup>He does, however, find a much lower elasticity when controlling for lagged levels of real money balances.

Hafer and Kutan (1994) were the first to empirically study long-run money demand for China employing the Johansen and Juselius (1990) co-integrating procedure and they estimate the long-run equilibrium relationship among nominal money, real national income and the national income deflator over the period from 1952 to 1988. More than a decade later, Bahmani-Oskooee and Wang (2007) were the first to use the ARDL bounds testing approach proposed by Pesaran et al. (2001) using quarterly data (1983Q1 - 2002Q4).

A lot of researchers pay attention to money demand relationship during episodes of China's economic reforms (1978,1994). Huang (1994) and Qin (1994) are the first to estimate error correction models only using data from the post reform period. However, with samples of annual data ranging from 1979 to 1990 and 1978 to 1991 respectively, they face quite substantial small sample issues.

Zheng (1996) is generally credited for his pioneering work in Chinese money demand in Chinese journals. He estimates a long-run money demand function using two different measures of money aggregates, M0 and M2, for the period from 1979 to 1992, with real national income as only independent variable (i.e. he ignores the opportunity cost of holding money).

The focus on the impact of reforms is inseparably connected to the question on the stability of money demand.<sup>4</sup> The afore mentioned work by Huang (1994) was the first to investigate the stability of the money demand function for China, the result of a Chow test and a forecast  $\chi^2$  test show no indication of instability in the model. Chen (1997) uses a stability test developed by Hansen (1992) to test co-integration stability with the null hypothesis that the co-integration relationship is stable.

Bahmani-Oskooee and Wang (2007) employ CUSUM and CUSUMSQ tests using quarterly data from 1983 to 2001, finding that M1 money demand in China is stable but M2 is not. Geng et al. (2009) find similar results using a much longer (but only annual) sample.

Most recent studies, focus on additional factors that might be important for money demand, in particular stock markets, financial innovation, and globalization. (Baharumshah et al. (2009); Jiang and Chen (2003); Shi (2001); Tan et al. (2011); Wang et al. (2013); Zhang (2011); Du and Huang (2016)) Given the huge changes in the Chinese financial system, such indicators might be particularly relevant for China.

### 2.3 Model specification

The money demand literature in China mostly follows the standard textbook setup, where money demand is explained through the transaction motive (which increases money demand) and the opportunity costs of holding money. In most approaches, the opportunity cost of holding money is summarized through the interest rate  $r$  on a risk free asset. In log form the most simple money demand

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<sup>4</sup>Bahmani-Oskooee and Bohl (2000) emphasize that the existence of a co-integration relationship does not necessarily imply stable parameters, and that unstable parameters will cause an incorrect conclusion.

function, the demand for real money balances  $M/P$  can thus be assessed by estimating:

$$m_t - p_t = \alpha_0 + \alpha_1 y_t + \alpha_2 r_t + \varepsilon_t, \quad (1)$$

where  $m$  denotes nominal money balances,  $p$  the price level,  $y$  the scale variable (most commonly GDP) that proxies expenditure (all given in logs as denote by the lower case letters),  $\varepsilon$  the error term and  $t$  the price index. The probably most common extensions of this simple model include inflation  $\pi$  (or more precisely inflation expectations) as further indicator of the opportunity cost, and wealth  $W$  (often proxied through a stock market indicator). In recent years, it has also become standard practice to include both the exchange rate  $xr$  and a foreign interest rate  $r^*$  when studying small open economies (see e.g. Fidrmuc (2009)), and despite its size China is fairly often modeled this way. While other indicators, such as urban population, policy indicators, etc. are occasionally used, they are usually unique to a small set of papers. This yields the equation

$$m_t - p_t = \alpha_0 + \alpha_1 y_t + \alpha_2 r_t + \alpha_3 E(\pi_{t+h}) + \alpha_4 W_t + \alpha_5 xr_t + \alpha_6 r_t^* + \Phi Z_t + \varepsilon_t, \quad (2)$$

that encompasses the vast majority of papers considered in our meta analysis, where  $Z$  is a matrix of (paper specific) controls and  $\Phi$  the corresponding coefficient vector.

However, there is one common variation that is - although not unique to China - much more common than usual when assessing model demand in China. From the very beginning, the quality of Chinese price data has been a major concern of the literature (Feltenstein and Farhadian, 1987). However, even those authors who share those concerns usually believe that the officially reported price level  $P$  is related to the true price level  $\tilde{P}$  by  $\ln \tilde{P}_t = \gamma \ln P_t$  or  $\tilde{p}_t = \gamma p_t$ . Because  $\gamma$  is unknown, this requires to estimate

$$m_t = \alpha_0 + \gamma^{-1} p_t + \alpha_1 y_t + \alpha_2 r_t + \alpha_3 E(\pi_{t+h}) + \alpha_4 W_t + \alpha_5 xr_t + \alpha_6 r_t^* + \Phi Z_t + \varepsilon_t, \quad (3)$$

## 3 A primer in meta analysis

### 3.1 The concept of meta analysis

In this section we briefly introduce the concept of meta-analysis and we outline our procedure for paper selection, study retrieval, and metaregression.

Stanley and Jarrell (1989), who were the first to apply meta-analysis to economic problems, define meta-analysis as an analysis of (some of the previous) empirical analyses that aims to combine and clarify the literature on some important parameters. In brief, a meta-analysis is a statistical analysis that combines the results of multiple scientific studies. Meta-analysis thus provides

the means to extend the analysis of the previous literature beyond standard literature surveys Fidrmuc and Korhonen (2006).

Typically, meta-analysis focuses on selected specific results from the literature that are comparable between studies, or can be standardized in a way that allows comparison. The chosen outcomes<sup>5</sup> then serve as dependent variable in the meta regressions, that aim to explain the estimates from the literature using information on the underlying papers, and to identify and correct a potential publication bias. A meta-analysis needs to include good and poor studies, and add a coefficient level predictor variable that reflects the methodological quality of the studies serving as observations to examine the effect of study quality on the estimated coefficients.

Due to different sample sizes and estimators with varying degrees of power, the observations in a meta study are almost necessarily subject to some degree of heteroscedasticity. The traditional approach is a weighted least square estimation, where the precision of the underlying studies is used as weight. In our case, where one of the outcome variables is binary, we also use weighted probit estimation.

### 3.2 Publication Biases and ‘True’ Coefficients

In recent years, the idea that the requirements and particularities of the process of academic publishing might themselves influence the characteristics of the published results has gained some attention. For example, Stanley (2005) argues that several types of publication bias might be at least partly responsible for the pattern and the variation of various findings.

In particular, the predilection for significant results might still give rise to a pattern where a disproportionate share of cases report results that are statistically significantly positive or statistically significantly negative. In our case, where theory and/or intuition suggest a clear magnitude of the effect, researchers might be induced to try our different specification coefficients matching expectations are obtained.

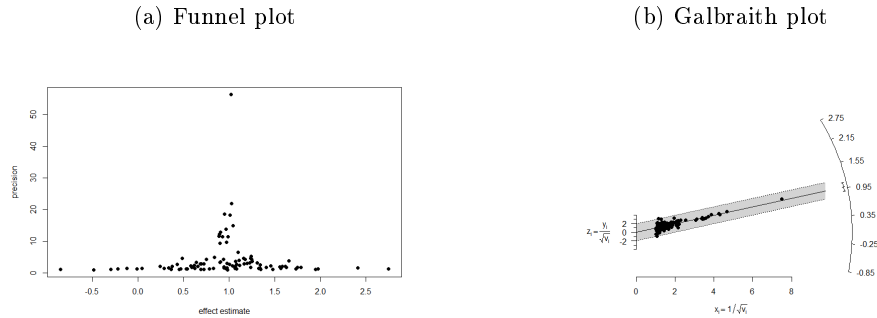
In order to detect publication bias, a variety of graphical and statistical techniques have been developed, e.g. funnel graphs, funnel asymmetry tests or Galbraith plots (Stanley, 2005). Most of those techniques relate coefficient estimates to a measure of their uncertainty (such as precision or standard errors). Almost all of those tests and graphical tools presented below, were originally designed to detect the first type of publication bias, where publication bias draws the results away from the null hypothesis. However, the same logic underlying those tests seems to be applicable in the opposing case (which might be more relevant for us), where the results are drawn towards the null hypothesis, as - for

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<sup>5</sup>Originally coming from medical research, where the outcome most commonly is a treatment effect, the meta literature usually refers to the estimates as effect size Glass (1976); Glass and Smith (1979). We avoid that terminology, since we do not summarize the literature on a treatment effect, and opt for a more general terminology. However, other estimates have been referred to as effect size in economic applications, including elasticities, semi-elasticities, partial correlation coefficients, t-statistics, and regression coefficients Stanley and Jarrell (1989)



Figure 1: Simulated Funnel and Galbraith plots



example - income elasticity matching the theoretically predicted value (usually 1 or 0.5).

### 3.2.1 Funnel and Galbraith plots

Funnel plots, introduced by Light and Pillemer (1984) and discussed in detail by Egger et al. (1997) and Sterne and Egger (2001), are used to graphically assess the publication bias in meta-analyses. A funnel plot is a scatter plot of effect estimates (on the abscissa) against their measure of precision (on the ordinate) to obtain “real” coefficient. There are several possibilities for the choice of measure of precision in a funnel plot, including total sample size, standard error, inverse variance (weight) or inverse standard error. Sterne and Egger (2001) recommend the standard error as the measure of precision. However, like most of the literature, we use the inverse of the standard error. The funnel plot derives its name from the characteristic (inverted) funnel shape that unbiased estimates should have, where high precision estimates (on the top) should be very close to each other and the true effect size, while low precision estimates being scattered more widely – and symmetrically – around the true value. Figure 1a shows a funnel plot with simulated – unbiased – coefficients and a true coefficient of 1 to give an impression of the picture we expect when there is no publication bias.

An alternative visual help for meta analysis that is more focused on assessing the true coefficient and heterogeneity is the radial plot or Galbraith plot, introduced by Galbraith (1988). A Galbraith plot is a scatter plot of standardized effect estimates – usually the z-score or t-value - (on the ordinate) against inverse standard error (on the abscissa). A regression line through the origin helps to assess the true coefficient. When precision approaches 0, so does the z-score, and because  $z_i = y_i/v_i$  implies that  $y_i = z_i 1/v_i$ , the regression line approaches the true coefficient (indicated by infinite precision) when  $1/v$  goes to infinity. Whether or not the scatter-plot of individual outcomes is within the confidence bounds of said regression line, can indicate the presence of overly large heterogeneity. Figure 1b shows the Galbraith plot corresponding to the

funnel plot in Figure 1a.

### 3.2.2 FAT, PET and PEESE tests

In the recent decades a number of formal tests have been developed based on the same intuition, to provide a more rigorous assessment in addition to the visual guidance given by funnel and Galbraith plots.

The funnel asymmetry test (FAT) explicitly tests whether the low precision estimates are symmetrically scattered around the high precision estimates, or if they are biased to one direction usually indicating publication bias (see e.g. Egger et al. (1997); Stanley (2008); Stanley and Doucouliagos (2014)). To this end, the estimated effect  $\hat{\alpha}_i$  is regressed on a constant term  $\beta_0$  and the standard errors of the estimated effects  $SE_i$ . If the estimated coefficient on the standard error variable,  $\beta_1$ , is statistically significant, low precision estimates tend to deviate in a specific direction, indicating that the estimates suffer from publication bias. In other words, we test:  $H_0 : \beta_1 = 0$  for the equation

$$\hat{\alpha}_i = \beta_0 + \beta_1(1/SE_i) + u_i, \quad (4)$$

This could be estimate by ordinary least squares, but since meta regressions typically suffer from heteroscedasticity, the equation 3.2.2 is typically estimated using weighted least squares, using  $1/SE_i$  as weight.

Egger et al. (1997) claim that the power of an FAT test is limited when the number of observations is too large, and the individual studies have a few observations. Therefore, Stanley (2008) proposes to focus on another aspect of the same equation in their precision-effect error test (PET). Namely, they test for the presence of a genuine effect beyond publication bias by testing  $H_0 : \beta_1 = 0$ .

However,  $\beta_1$  from equation tends to underestimate the true effect when there is a nonzero treatment effect. To overcome this problem, Stanley and Doucouliagos (2014) propose to use the variance of effect size's standard error,  $1/SE_i^2$ , as the WLS weight to replace  $1/SE_i$  in the equation 3.2.2, yielding the so called PEESE test, using the test equation:

$$\hat{\alpha}_i = \beta_0 + \beta_1(1/SE_i^2) + u_i. \quad (5)$$

## 4 Our meta database

### 4.1 Overview

Our data covers 61 papers published between 1987 and 2016. We select papers where (i) the title contains 'money' or 'monetary', 'demand' and 'China'; or that are (ii) referenced in any of the papers gathered in step (i) indicating the referenced paper includes money demand estimation. (iii) We exclude all papers that do not provide coefficient estimates for long run estimations of money demand function (such as papers only providing narrative or graphical summaries

of their results); and (iv) we remove estimations with negative estimates of income elasticities.<sup>6</sup> All remaining studies were included in our database. Our database was completed in August 2017. Most of the papers in our database include more than one estimation. In total our database comprises 174 individual estimations from 61 papers about money demand in China. What makes our approach somewhat unusual in the realm of meta studies is that we explicitly try to include the non English literature in our endeavor. More precisely, we include both the English and the Chinese literature on the topic at hand. Given the fairly unique institutional setup in China, we feel that it is necessary to explicitly expand our scope in a way that covers papers written by people familiar with those institutions and that write papers that are often targeted at Chinese policy makers. In this respect, our data is fairly balanced with 29 English language and 32 Chinese language papers. The number of individual estimations The number of individual estimations is fairly low for both English and Chinese articles, but even more so for the Chinese papers with only 2.5 regressions on average.

In the following sections, we will provide a brief overview and descriptive analysis of the key variables that are used in this paper. A summary of all indicators and their definition is found in Table 1.

## 4.2 Dependent variables

### 4.2.1 Income elasticity

The estimates of income elasticity vary widely, ranging from 0.11 to 3.41, with a standard deviation of roughly 0.4.<sup>7</sup> However, the estimates cluster around an income elasticity of 1, as suggested by the quantity theory, matching the result from previous (multi-country) meta studies such as Knell and Stix (2005). Table 2 summarizes different weighted and unweighted means of the average income elasticity and their respective standard error. None of those weighted means differs significantly from 1, nor do they differ significantly from each other. Only two thirds of the specifications in our sample come with standard errors, or t-statistics or p-values that would allow their computation. The weighted averages based on standard errors and variance, are thus not performed on our full sample. To allow for easy comparison, we also provide an unweighted average for this subsample. In addition to the fairly standard weighting schemes using standard errors (variance) and the number of observations, we also use a weighting scheme based on the number of years. This is, because small sample bias in dynamic models is not only driven by a low number of observations, but in particular by a short time span covered by those observations.<sup>8</sup>

<sup>6</sup>This happens 3 times across all papers. However, only one paper included negative coefficients only and has thus been removed entirely.

<sup>7</sup>There is one estimate of -1.41 which we remove from our sample, since it seems much more likely to be a typo than an actual estimate of 1.41.

<sup>8</sup>For example El-Shagi (2017) demonstrates that small sample bias in cyclical data is highly related to the number of cycles covered by the sample.

Table 1: Meta-independent variables

| Variable                          | Definition   |
|-----------------------------------|--|
| <i>Dependent Variables</i>        |  |
| Income elasticity                 | the point estimates of long-run income elasticities*               |
| Find stability                    | 1 if a study finds that stability exists                           |
| <i>Monetary aggregates</i>        |  |
| Narrow money                      | 1 if a study uses M0 or M1   |
| Broad money                       | 1 if a study uses M2 or M3   |
| <i>opportunity cost variables</i> |  |
| Interest rate                     | 1 if a study uses a measure of interest rate                       |
| Inflation rate                    | 1 if a study uses a measure of inflation rate                      |
| Exchange rate                     | 1 if a study uses a measure of exchange rate                       |
| Foreign rate                      | 1 if a study uses a measure of foreign rate                        |
| <i>Control variables</i>          |  |
| Price level                       | 1 if a study uses a measure of price level                         |
| Stock price                       | 1 if a study uses a measure of stock price                         |
| Wealth                            | 1 if a study uses a measure of wealth                              |
| <i>Meta variables</i>             |  |
| Mult.eq.                          | 1 if a study uses a multiple equation approach                     |
| C                                 | 1 if a study uses a Chow structural break test (base group)        |
| CU                                | 1 if a study uses a CUSUM type structural break test               |
| H                                 | 1 if a study uses a Hansen structural break test (baseline)        |
| other                             | 1 if a study uses a structural break test not previously mentioned |
| Chinese language                  | 1 if a study is published in Chinese                               |
| Chinese author                    | 1 if at least one author is Chinese                                |
| Published                         | 1 if a study is published in any journal                           |
| Number of observations            | Number of observations   |
| Precision                         | Inverse of the standard error of income elasticity**               |

*Notes:* \*For time varying levels of income elasticity we use the mean. This also applies to papers including their income variable in squared form, thereby implicitly creating a time varying level of income elasticity. \*\* Where t-statistics or p-values are reported the conversion is made accordingly. If only specific significance levels are reported (as frequently done with the asterisks denoting significance at the 1, 5 or 10 percent level), we assume that the p-value matches the border of the class exactly.

Table 2: Income elasticity

|                                | Income elasticity | S.E.  | Obs |
|--------------------------------|-------------------|-------|-----|
| Unconditional mean             | 1.033             | 0.033 | 174 |
| Unconditional mean (subsample) | 0.994             | 0.041 | 124 |
| Weighted mean (1/S.E.)         | 0.923             | 0.065 | 124 |
| Weighted mean (1/Variance)     | 1.018             | 0.113 | 124 |
| Weighted mean (observations)   | 1.043             | 0.035 | 174 |
| Weighted mean (years)          | 1.026             | 0.035 | 174 |

Following Knell and Stix (2003) we use kernel density estimation to provide “smoothed” histograms of the distribution of estimates for several sub samples to allow for a simple visual inspection on the impact of various modeling choices on the estimation outcome.

#### 4.2.2 Stability

A substantial share of the studies in our sample assess stability for at least some of their specifications. In total, we have 112 specifications from 41 papers. However, just a small fraction of those studies reports measures of uncertainty regarding stability. For our baseline meta regression we therefore just consider, whether or not the authors find stability. For the weighted versions, that we run as robustness tests, we use years and number of observations as done with the weighted averages in the previous subsection. Table 3 reports the (weighted) share of regressions that confirm stability. Since one might argue, that the concept of money demand can barely be applied to China before the 1978 reform (and that there should be a structural break even if money demand in a market based banking system is stable), we also report the (weighted) shares for all papers where the sample starts after 1978. When finding structural breaks it is common practice to also report results for the break free subsamples, thereby inflating the number of break free results in the dataset slightly. Therefore, the table also reports results restricted to a sample that only considers regressions that use the maximum number of observations used in the respective paper. All three sets of results are extremely similar, and point to some substantial ambiguity with regard to whether or not money demand is stable, with roughly 60 to 70 percent of regressions confirming stability.

The share of regressions that are found to be stable is considerably higher, when weighting using the number of observations. Since stability tests typically use the null hypothesis of stability, this indicates that the tests reject less often in large samples. This sounds implausible at the first glance, since structural breaks should be more likely in longer samples and tests typically gain power in large samples. However, as shown by El-Shagi and Giesen (2013), most structural break tests are substantially oversized (i.e. they overreject) in small samples if the normality assumption does not hold. Given that the samples used for money demand estimation in China - particularly those using data after 1978

Table 3: Income elasticity

|                         | Share confirming stability                     | S.E.  | Obs |
|-------------------------|--|-------|-----|
|                         | Full sample                                    |       |     |
| Unconditional           | 0.616  | 0.046 | 112 |
| Weighted (observations) | 0.669  | 0.048 | 112 |
| Weighted(years)         | 0.608  | 0.053 | 112 |
|                         | Only regressions with data starting after 1978 |       |     |
| Unconditional           | 0.663  | 0.052 | 88  |
| Weighted (observations) | 0.704  | 0.052 | 88  |
| Weighted(years)         | 0.683  | 0.052 | 88  |
|                         | Largest sample in paper                        |       |     |
| Unconditional           | 0.598  | 0.053 | 87  |
| Weighted (observations) | 0.642  | 0.056 | 87  |
| Weighted(years)         | 0.616  | 0.059 | 87  |

- typically use fairly short time periods, this might indicate that the rejections of stability are mostly driven by statistical problems rather than structural breaks.

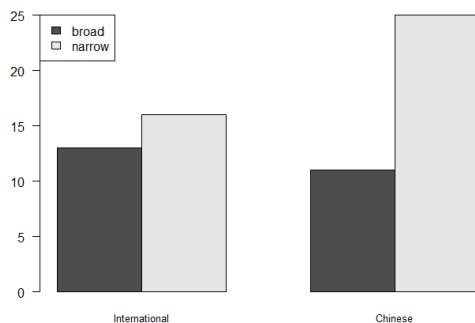
### 4.3 Monetary aggregates

Monetary aggregates played a crucial role in the monetary strategy of the People’s Bank of China much longer than they did for the Federal Reserve. The PBoC used M1 as its monetary target for an extended period starting in 1994 and there is some evidence that it unofficially targeted M1 before (Chen and Werner, 2011). Therefore, looking at demand for (real) M1 seems to be the natural choice. Correspondingly, contrary to studies on money demand for the US and other countries, where M2 (and other broad aggregates) dominate, studies assessing China use narrow aggregates (M1 and less frequently M0) relatively more often. This is particularly true for papers published in Chinese, where more than two thirds of the specifications in our sample use a narrow aggregate.<sup>9</sup> However, the use of broad and narrow aggregates is fairly balanced in studies published in English (see Figure 2). This tendency to look at M2 in English studies might be driven by the expectations of an international audience (who is used to M2 due to its importance in the US), rather than the Chinese institutions.

The choice of the monetary aggregate seems to have substantial impact on the estimation outcome. The kernel density plots in Figure 3 clearly shows how strongly the point estimates of the income elasticities differ across studies. Both estimates using broad and narrow aggregates peak around 1.1. However, for estimates based on narrow monetary aggregates have a second, lower peak

<sup>9</sup>Only two studies consider that neither of those simple sum aggregates matches what economists usually consider as “money” in their theoretical models by using Divisia monetary aggregates pioneered by Barnett (1978) and Barnett (1980). Since those are too few results to allow separate assessment, we subsume the Divisia aggregates with their simple sum counterparts including the same assets.

Figure 2: The choice of monetary aggregates in Chinese and English publications



around 0.4, roughly matching the coefficient implied by the inventory theory of money<sup>10</sup>. This indicates, that there might be some theory based selection in the results reported, i.e. that authors are less reluctant to publish results that are far away from the expected result of 1, if they match another potential theory.<sup>11</sup>

## 4.4 Meta variables

### 4.4.1 Journal publications vs. working papers

We distinguish papers published in a (peer reviewed) journal from papers that merely are available as working paper. The vast majority of the articles in our meta database are published in journals (including Chinese journals), with only 10 working papers estimating 26 specifications. The share of working papers is fairly constant over time. In particular, we do not find a substantial increase of working papers towards the end (which might indicate a lot of current papers that are not yet accepted in journals). While the differences between working papers and published papers are minor, there are some that are worth mentioning. Most importantly, published papers find stability more often than working papers.

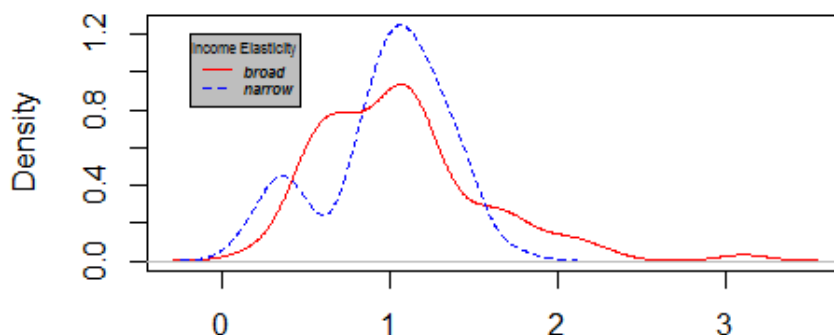
### 4.4.2 Chinese journals and international journals

29 papers in our sample are written in English, compared to 33 papers written in Chinese. Although we have similar numbers of papers written in English and Chinese, the vast majority of papers have at least one Chinese coauthor.

<sup>10</sup>Inventory theory of money explains average money holdings as result of minimizing the cost of obtaining money (e.g. transaction costs) and the opportunity costs of holding money.

<sup>11</sup>Indeed, rather than the distribution of coefficient estimates created by variation in samples, this resembles the distribution of a posterior density function in Bayesian estimation with a bimodal prior.

Figure 3: Kernel density of Income Elasticity estimates by Monetary Aggregates



Papers in Chinese journals (and working paper series) start being published considerably later than in international outlets. While the literature in English journals starts with the seminal paper by Chow (1987), the first Chinese paper follows with Zheng (1996) almost 20 years later. Thus, international papers might have had affect on the research on the Chinese authors. A number of Chinese authors who published in English journal, later published companion and follow-up papers in Chinese outlets, e.g. Wu (2009a,b); Qin (1994, 1997). Both in international and Chinese journals the interest in money demand in China peaks around 2010 (see Figure 4b).

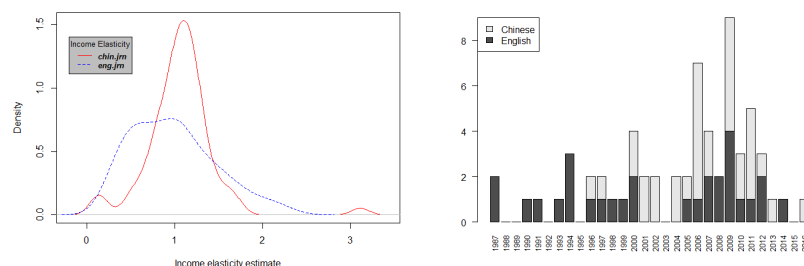
Regarding income elasticity, the average result found by Chinese authors is typically similar to the results published internationally. However, the dispersion of results is much wider (see Figure 4a). Also, papers published in Chinese find stability a little more frequent than papers published in English. The difference in results is particularly interesting because the chosen specifications are highly similar between international and Chinese publications, with the afore mentioned exception of Chinese contributions focusing more strongly on narrow measures of money.<sup>12</sup>

<sup>12</sup>Due to the over-representation of narrow monetary aggregates in Chinese studies, Chinese studies show a moderate second peak around an in come elasticity of 0.4 but much less pronounced.



Figure 4: Results by publication language

(a) Income elasticity by publication language (b) Chinese and English publications over time



#### 4.4.3 Estimation methods

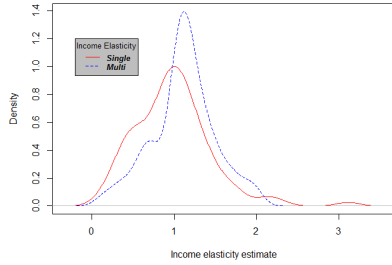
About 80 percent of all papers use some kind of cointegration approach, as is appropriate since neither (real) money balances nor income are stationary. The most frequently used approach is based on Johansen (1988), followed by an Engle and Granger (1987) two step method, and the Pesaran et al. (2001) autoregressive distributed lag model (P). Because cointegration between money and GDP is well established, we do not discard more simple approaches, although they are technically inappropriate. If the variables are cointegrated, even a simple OLS estimator yields unbiased results (which is exploited by the first step of the Engle and Granger (1987) approach). Whether or not the authors test cointegration themselves is thus of little consequence. Figure 5a illustrates the distribution of (point) income elasticity estimates for studies using cointegration and other techniques. Interestingly, the distribution of results obtained from papers not using the appropriate cointegration technique is much wider. Since this should not make a difference as outlined above, it indicates some unobserved variable that might be related to the lack of technical scrutiny. Since simple techniques are predominantly used jointly with narrow monetary aggregates, the second peak in the kernel density of estimates using narrow money is also found here (see Figure 5b).

For our estimation we primarily distinguish between multiple equation approaches (such as the Johansen method), and single equation approaches (such as Engle-Granger and Pesaran) following Kumar (2014).

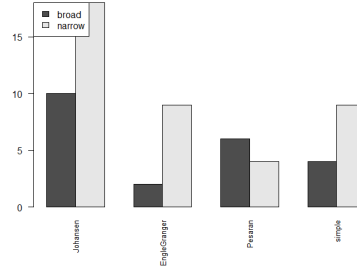
The structural break tests used in the literature most frequently are a simple CUSUM test and the Hansen test, that has been specifically developed to test for structural breaks in cointegrated data. Both allow for breaks at an unknown time. Relatively few papers apply the Chow test that tests for a structural break at a known date, usually testing for breaks that coincide with major reforms.

Figure 5: Estimation methods

(a) Plot of Income Elasticity by Estimation Methods



(b) Estimation methods and monetary aggregates



*Note:* **Multi** refers to multi-equation approaches **Single** refers to single-equation approaches

## 4.5 Other variables

Apart from technique and sample selection, different estimates might result from different empirical models, and indeed - like for most countries - there is no consensus on the most appropriate model of money demand for China. The models in our sample, don't only differ with regard to the chosen measure(s) of the opportunity costs of holding money but also with regard to other controls. For many of them, a correlation with income - which would affect the estimate of income elasticity - is quite evident.

### 4.5.1 Opportunity cost variables

The core measure of opportunity costs of holding money is the domestic interest rate, which - in some form or another - is used in almost every paper considered. A considerable number of papers also accounts for inflation, which - like the nominal interest rate - is driving costs of money holding, and might do so even more since high inflation is typically related to high uncertainty. Relatively few studies also include a foreign (usually) US interest rate and / or the exchange rate. The inclusion of those is standard now in small open economy models, where the opportunity costs of holding money are often compared to the potential income generated by foreign assets. While China is a major player on international financial markets, China's size and degree of capital market restrictions make it unclear whether or not their inclusion is necessary.

### 4.5.2 Control variables

While not included in the majority of specifications, three control variables are used by at least a few papers, warranting to test whether or not they matter

for estimation. Those three are the price level, wealth and the stock price. The inclusion of the price level is relatively specific to China and usually founded on the assumption of misreported inflation (see section 2.3 for details). Contrarily, wealth and stock prices are relatively common in the modern money demand literature (see e.g. Friedman (1988), Dreger and Wolters (2014)). Wealth can exert an influence on money demand through two channels. First, there is a substitution (negative) effect, because a rise in asset prices makes non monetary assets more attractive compared to money. Second, there is a positive income effect, because, as wealth increases, part of the additional money may be stored in liquid instruments.

Finally, the stock price is an important asset price. Because financial transactions increase with a high level of asset prices, money demand for transaction purposes will increase as well. However, stock prices are also highly related to wealth. Therefore, the net impact of stock prices - like the impact of wealth - is ambiguous and the sign of a stock price variable is an empirical matter.

## 5 Empirical Result

### 5.1 Income elasticity

#### 5.1.1 Assessing publication bias and estimating “true” income elasticity

Our results regarding income elasticity are slightly ambiguous. On the one hand, the previously presented bimodal kernel density plots clearly indicate some tendency to confirm one of the major theories on money demand. On the other hand, the results of the standard unbiasedness tests (see Table 4) do not confirm that. Neither a standard FAT test nor its variations indicate an asymmetric response to uncertainty that is usually considered as a sign of selection bias. The funnel plot, however, suggests substantial heterogeneity in the results drawn from different studies, causing the power of FAT to be fairly low (see 6a).<sup>13</sup> The Galbraith plot 6b does not suggest strong outliers. However, the normalization used in the plot is based on a random effects model, i.e. a model that allows for heterogeneous results (i.e. we allow that the true coefficient differs between studies because of different periods considered, different measure of money, etc.).

All of our metaregressions suggest an income elasticity that is statistically indistinguishable from one (see Table 4). The controls in the “full model” are recoded in a way that the constant term  $\beta_0$  reflects the point estimate for the average sample, using all control variables except the price level and real narrow

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<sup>13</sup>There is one more caveat. The FAT has been designed to test a bias towards rejecting the Null hypothesis. In the case of money demand, the results suggest that a potential bias (if present) would drive results towards the theoretically expected results which are often used as Null. So far, there is little evidence how the standard tests behave in this case. One of the few counterexamples is Jae Kim and Stanley (2014). They run a simulation study tailored to their empirical example showing that the tests still have sufficient power. Yet, it is not certain that their result holds for the general case.

Table 4: Funnel asymmetry test

| Uncertainty      | Weights        | Basic Model      |                   | Full Model       |                   | Obs. |
|------------------|----------------|------------------|-------------------|------------------|-------------------|------|
|                  |                | $\beta_0$        | $\beta_1$         | $\beta_0$        | $\beta_1$         |      |
| $SE$             | $1/SE$         | 0.894<br>(0.044) | 0.828<br>(0.690)  | 0.858<br>(0.211) | 0.471<br>(0.495)  | 125  |
| $SE^2$           | $1/SE$         | 0.917<br>(0.037) | 1.509<br>(1.338)  | 0.903<br>(0.201) | 0.996<br>(0.858)  | 125  |
| $1/y\text{ears}$ | $y\text{ears}$ | 1.006<br>(0.068) | 0.340<br>(1.187)  | 1.259<br>(0.251) | -0.907<br>(2.920) | 176  |
| $1/obs$          | $obs$          | 1.063<br>(0.061) | -1.058<br>(2.186) | 1.122<br>(0.177) | 1.707<br>(3.377)  | 176  |

*Note:*

Standard errors in parentheses. All models have the form  $\eta_i = \beta_0 + \beta_1 \text{uncertainty}_i + BZ_i + u_i$ , where  $\eta$  is the estimate of income elasticity. The standard funnel asymmetry test (FAT) for unbiasedness is the test of  $H_0 : \beta_1 = 0$  using the standard error (SE) of estimates as measure of uncertainty without (basic model) and with (full model) additional controls. The other rows consider alternative measures of uncertainty.  $\beta_0$  is the estimator of the true effect given the entire meta information. Continuous control variables are demeaned (with the exception of the measure of uncertainty). All indicator dummies capturing the inclusion of controls - with the exception of the price level - are recoded to equal 0 in the case of inclusion. That is, the constant term of the full model reflects the true coefficient for the average sample, using all available control variables, narrow money, using a cointegration approach, published in English in a journal, with uncertainty approaching zero.

money supply. We choose to exclude the price level because the most common reasoning for its inclusion are measurement problems regarding inflation that are corrected by explaining nominal money demand and including the price level as right hand side variable. Since only few specifications use nominal money, and including the price level otherwise is questionable, we consider the more common specification as appropriate baseline.

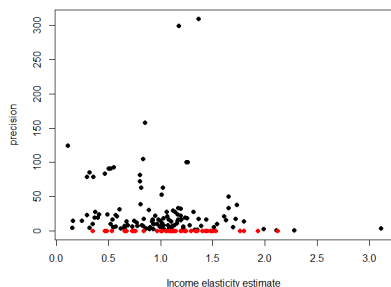
### 5.1.2 Determinants of variation in income elasticity estimates

Table 5 summarizes the results for our meta regressions. Since standard errors are not available for a large share of our sample, we report results that are based on a simple OLS approach and weighted least squares using the number of observations as weights. In addition to the full model, we also apply Bayesian Model Selection (BMS) to identify indicators that robustly affect the estimated income elasticity. BMS applies priors that are mostly flat, with the exception of a strong peak at 0.

Surprisingly, the choice of the model seems to have very little impact on the

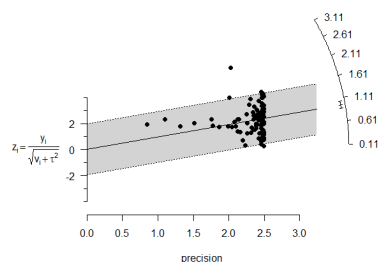
Figure 6: Graphical analysis of publication bias

(a) Funnel plot



*Note:* Black dots represent estimates where a measure of uncertainty (standard error, t-statistic, or p-values) was reported. Red dots (where we assume a precision of zero) are from those estimations where a measure of uncertainty is not available.

(b) Galbraith plot



*Note:* The Galbraith plot relates normalized coefficients to precision. The normalization we choose is based on a random-effects model. That is, we assume that there might not be one true income elasticity but that different samples, monetary aggregates, etc. might partly yield different results because the true coefficient is indeed different.

estimated income elasticity. Foreign interest rates, the exchange rate and inflation all come out insignificant in our full meta regression (both using OLS and WLS) and have extremely low inclusion probabilities when applying Bayesian model selection. Only the results for the domestic interest rate are marginally stronger, being significant in the full specification and showing a 20% inclusion probability. However, – and in contrast to the other indicators of opportunity costs – the inclusion of the domestic interest rate is uncontroversial and there are extremely few studies omitting it. Similarly, neither the inclusion of the price level<sup>14</sup> nor of stock prices seem to matter.

What does matter, however, is the choice of the monetary aggregate. Whether the authors use broad or narrow monetary aggregates is driving results quite strongly with broad money exhibiting substantially higher income elasticity. This might be related to the fact that (simple sum) broad monetary aggregates measure savings rather than liquidity holdings, a criticism frequently voiced in the money measurement literature.

There is some evidence that the frequency of the data matters. However, none of the methods used to identify the long run relationship should be too sensitive to that aspect of the data. It is thus most likely that the impact of frequency is mostly driven by the sample period, as exclusively papers covering (at least partly) the pre reform period use annual data. Yet there still is an additional (and fairly robust) impact of the first year of the sample indicating

<sup>14</sup>Using nominal money as left hand side variable – which usually goes hand in hand with including the price level – also has no impact.

some gradual movement in income elasticity.<sup>15</sup>

## 5.2 Stability

### 5.2.1 Assessing publication bias and estimating the true probability of stable money demand

Stable money demand is essential for the conduct of monetary policy because it enables money supply to have a predictable impact on prices and the real economy. Contrarily, unstable money demand would imply that the PBoC would fail to meet the fundamental precondition for an effective anti-inflationary policy.

We assess whether or not authors find stability based on a subsample, that only covers those observations where stability is actually tested. This reduces our sample size from 173 to 95 regressions covered. We run a meta-probit-regression on the binary outcome of finding stability (1) or not (0).

In Table 6, we report the results of a probit counterpart of a standard FAT/PES/PEESE setup, i.e. we try to explain the (binary) finding of the studies in our sample using a measure of precision and further controls. Since most studies do not report measures of uncertainty for their stability tests, we use the inverse of the number of observations and the number of years covered by the respective sample as simple proxies for precision.

We find evidence for a bias in favor of rejecting stability. In particular when including other controls, this finding is highly robust.

Since the constant term in the probit equation lacks the intuitive interpretation of the constant term in a standard FAT equation, we translate it into the probability that the paper finds stability.<sup>16</sup> The evaluation of the probability to find stability is done at the mean for all continuous variables, including the variables that describe the period covered by the sample used in the underlying studies.

Estimating the unbiased probability that money demand is stable depends quite strongly on what we consider to be the correct model. For the model with all (considered) indicators of the opportunity cost of holding money, stock prices and real narrow money as dependent variable, the probability to find stability is merely 43%. However, when we chose to believe the argument that the price level is distorted in China and thus the correct specification includes the price level as exogenous variable in a model explaining nominal money supply, this probability increases to almost 100%.

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<sup>15</sup>As a robustness check, we also apply an estimator with study fixed effects. Given the low number of observations per study, the large number of studies with one result only, and the low variance of many indicators within one study, this estimator is not very informative. Of the three indicators that significantly affect the estimated income elasticity only the “broad money” dummy remains significant. Given that both the frequency and sample barely vary within a study, this outcome matches expectations.

<sup>16</sup>We normalize our variables to set them all equal to zero for the preferred model specification. The probability to find (i.e. to not reject) stability, thus is equal to the standard normal cdf at the estimated intercept.

Table 5: Explaining estimates of income elasticity

|                      | OLS            |         |                                   | WLS     |                |         |         |         |
|----------------------|----------------|---------|-----------------------------------|---------|----------------|---------|---------|---------|
|                      | Full Model     | Model 1 | Model 2                           | Model 3 | Full Model     | Model 1 | Model 2 | Model 3 |
| Constant             | 1.214 (0.156)  | 100.0%  | 1.183                             | Model 3 | 1.392 (0.177)  | 100.0%  | 1.183   | 1.028   |
| Broad Money          | 0.195 (0.064)  | 80.4%   | 0.17                              | 0.156   | 0.164 (0.064)  | 80.6%   | 0.170   | 0.156   |
|                      |                |         | <i>Monetary aggregates</i>        |         |                |         |         |         |
|                      |                |         | <i>opportunity cost variables</i> |         |                |         |         |         |
| Domestic ir          | 0.147 (0.070)  | 20.8%   |                                   |         | 0.164 (0.069)  | 20.1%   |         |         |
| Foreign ir           | -0.131 (0.114) | 5.6%    |                                   |         | -0.313 (0.095) | 5.4%    |         |         |
| Exchange rate        | 0.095 (0.099)  | 1.2%    |                                   |         | 0.003 (0.093)  | 1.1%    |         |         |
| Inflation rate       | -0.040 (0.068) | 0.6%    |                                   |         | -0.058 (0.066) | 0.6%    |         |         |
| Price level          | -0.054 (0.106) | 1.2%    |                                   |         | -0.198 (0.101) | 1.2%    |         |         |
| Stock price          | 0.198 (0.119)  | 5.2%    |                                   |         | 0.126 (0.105)  | 5.4%    |         |         |
|                      |                |         | <i>Control variables</i>          |         |                |         |         |         |
|                      |                |         | <i>Meta variables</i>             |         |                |         |         |         |
| 1/obs                |                |         |                                   |         | 0.802(3.379)   | 3.7%    |         |         |
| Mult.eq.             | 0.123 (0.072)  | 8.60%   |                                   |         | 0.103 (0.070)  | 8.5%    |         |         |
| Low Frequency        | -0.379 (0.104) | 100.0%  |                                   |         | -0.426 (0.129) | 100.0%  | 0.373   | -0.402  |
| Chinese author       | -0.033 (0.099) | 2.3%    |                                   |         | -0.041 (0.096) | 2.3%    |         |         |
| Chinese language     | -0.217 (0.087) | 93.1%   |                                   |         | 0.164 (0.090)  | 93.1%   | 0.247   | 0.240   |
| First year           | -0.057 (0.018) | 98.0%   |                                   |         | -0.076 (0.017) | 98.0%   | -0.028  | -0.032  |
| Last year            | -0.030 (0.018) | 23%     |                                   |         | -0.049 (0.016) | 22.2%   |         |         |
| Real Money           | -0.001 (0.000) | 6.9%    |                                   |         | -0.141 (0.106) | 6.4%    |         |         |
| Year (publication)   | 0.014 (0.012)  | 2%      |                                   |         | 0.024 (0.011)  | 1.9%    |         |         |
| Cited                | -0.001 (0.000) | 34.8%   |                                   |         | -0.001 (0.001) | 34.2    |         | -0.001  |
| Published            | -0.240 (0.098) | 46.8%   |                                   |         | -0.328 (0.098) | 46.7%   | 0.198   |         |
| First reform (1978)  | -3.128 (1.825) | 45.8%   |                                   |         | -4.498 (1.863) | 45.1%   |         |         |
| - (squared)          | 1.070 (1.908)  | 52.8%   |                                   |         | 2.070 (1.944)  | 53.5%   | -1.321  | 1.576   |
| Second reform (1994) | -0.552 (0.638) | 12.5%   |                                   |         | -0.050 (0.627) | 12.0%   |         |         |
| - (squared)          | 1.166 (0.541)  | 29.2%   |                                   |         | 1.240 (0.580)  | 28.1%   |         |         |

Note: Standard errors in parentheses.  $p$  is the probability for an indicator to be included in the “true” model as identified by Bayesian model selection. Models 1, 2, and 3 are the 3 models with the highest individual probabilities.

Unsurprisingly, the exact timing of the sample is quintessential for the question whether the sample includes a structural break. Figure 7 shows the probability that at study finds stable results on a heatmap for the studies using data after the economic reforms of 1978.

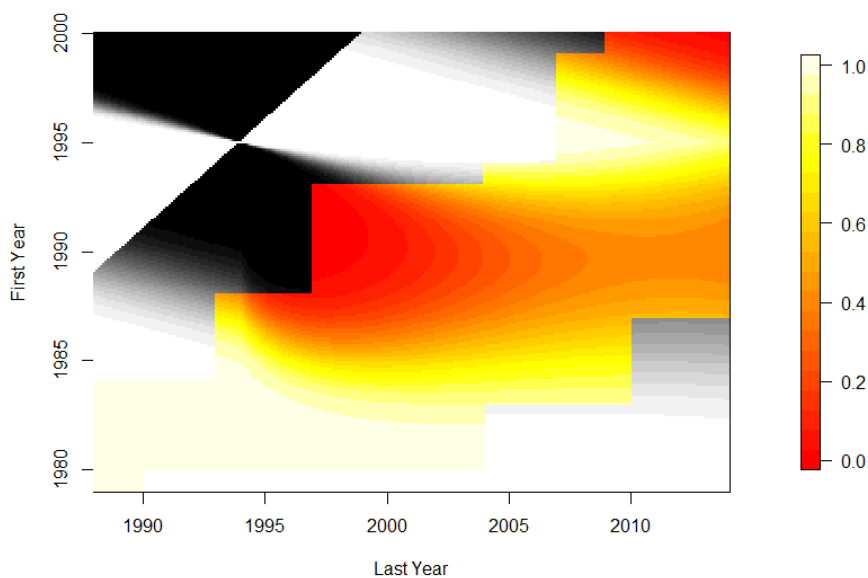
Table 6: FAT tests and the true probability of stable money demand

| Uncertainty  | Weights      | Basic Model                |                    | Full Model                 |                    | Obs. |
|--|--------------|----------------------------|--------------------|----------------------------|--------------------|------|
|  |              | $p(\varepsilon < \beta_0)$ | $\beta_1$          | $p(\varepsilon < \beta_0)$ | $\beta_1$          |      |
| Full Data; Baseline specification                            |              |                            |                    |                            |                    |      |
| 1/ <i>years</i>  | <i>years</i> | 0.538                      | 0.722<br>(0.983)   | 0.033                      | -4.116<br>(4.768)  | 95   |
| 1/ <i>obs</i>  | <i>obs</i>   | 0.723                      | -15.431<br>(1.673) | 0.438                      | -13.875<br>(5.789) | 95   |
| Only regressions starting after 1978; Baseline specification |              |                            |                    |                            |                    |      |
| 1/ <i>years</i>  | <i>years</i> | 0.725                      | -4.927<br>(1.292)  | 0.994                      | -21.218<br>(6.527) | 71   |
| 1/ <i>obs</i>  | <i>obs</i>   | 0.744                      | -16.778<br>(1.896) | 0.901                      | -20.017<br>(7.004) | 71   |
| Full Data; nominal money controlling for price level         |              |                            |                    |                            |                    |      |
| 1/ <i>years</i>  | <i>years</i> | 0.538                      | 0.722<br>(0.983)   | 0.998                      | -4.116<br>(4.768)  | 95   |
| 1/ <i>obs</i>  | <i>obs</i>   | 0.723                      | -15.431<br>(1.673) | 1.000                      | -13.875<br>(5.789) | 95   |

*Note:* Standard errors in parentheses. All models have the form  $s_i^* = \beta_0 + \beta_1 \text{uncertainty}_i + BZ_i + \varepsilon_i$ ,  $s = 1$  if  $s^* > 0$  and  $s = 0$  if  $s^* \leq 0$  where  $s$  is the outcome of the stability test,  $s^*$  the underlying latent variable and  $\varepsilon \sim \mathcal{N}(0, 1)$  the residual. Because standard errors are not available for most estimates, we use alternative measures of precision for the FAT test, namely the inverse of the number of observations and the number of years covered by the data in the underlying studies. All indicator dummies capturing the inclusion of controls - with the exception of the price level - are recoded to equal 0 in the case of inclusion. That is, the constant term of the full model reflects the true level of  $s^*$  for the average sample, using all available control variables, narrow money, using a cointegration approach, published in English in a journal, with uncertainty approaching zero. To simplify interpretation, we translate this into a probability to find stability.

For most of the time the probability to confirm stability is clearly above 50%. The exceptions are fairly short samples centered around the financial market reforms of 1994 and 2008. However, the fact that longer samples including the same periods do no longer find any sign of instability (although the power of the tests is increasing in the sample size), cast some doubt on the idea of a structural break in money demand. Especially in small samples, structural break tests are





*Note:* The full (black and white) figure shows the fitted probability for all combinations of first and last years including those which are literally impossible (e.g. because the last year is before the first). The part of the figure illuminated as a heatmap shows only sample sizes covered in our metadata.

Figure 7: Probability to find stability by sample period

very sensitive to individual outliers or strong heteroscedasticity as it might easily occur during times of financial reform. It seems, that this type of situation was mistaken as sign of an instable long run relationship in some studies around that time.

### 5.2.2 Determinants of the outcome of stability tests

To assess whether studies find stability or not, we apply a (weighted) probit model, predicting the probability to find stability. As with our study on income elasticity, we also apply a BMS approach to identify the most robust predictors.

Only two indicators are found to impact the finding of stability relatively robustly. First, as briefly mentioned in the previous paragraph, it seems that models including the price level typically find stable money demand. However, there are only 10 estimations from 6 different studies using the price level as right hand side variable. That is, very few studies are driving this result.

Second, studies that include the inflation rate as a proxy of opportunity costs of holding money, reject stability more often. This might indicate, that the seeming instability is indeed more driven by the instability of inflation.

Interestingly, the type of test used to assess stability plays a very minor role.

The indicator dummies for the testing methods are all insignificant in the full model, and not selected by a Bayesian model selection approach.

## 6 Conclusion

In this paper, we reexamine the abundant literature on money demand in China that has been published in international and Chinese outlets over the past 30 years. While there is huge heterogeneity in terms of the estimated income elasticity, the results seem to be randomly scattered around a coefficient of one, without noteworthy publication bias and in line with theoretical expectations.

However, the frequently found instability of money demand seems to be due to the desire to reject the null hypothesis (i.e. stability for most tests). After accounting for uncertainty, we find a substantially higher probability that money demand is indeed stable than a mere (weighted) average suggests. This result becomes even stronger when focusing on long samples. It seems as if most findings of instability are driven by short periods of turmoil (for example around the 1994) reforms, and studies that use a short time period giving those difficult episodes an overly large weight.

In short, we find that money demand in China is indeed surprisingly stable since the market oriented reforms initiated by Deng Xiaoping in 1978, in particular when considering the major reforms of the financial sector that happened since.

Table 7: Determinants of estimates of stability

|                                   | Probit               |         |         | Weighted Probit |                     |         |         |
|-----------------------------------|----------------------|---------|---------|-----------------|---------------------|---------|---------|
|                                   | Full Model           | Model 1 | Model 2 | Model 3         | Model 1             | Model 2 | Model 3 |
| Constant                          | 4.407<br>(2.270)     | -0.088  | 0.431   | 0.085           | 4.472<br>(0.387)    | -0.088  | 0.085   |
| Broad Money                       | -0.651<br>(0.441)    |         |         |                 | -0.638<br>(0.067)   |         |         |
| Real Money                        | -1.192<br>(1.416)    |         |         |                 | -1.215<br>(0.262)   |         |         |
| <i>Monetary aggregates</i>        |                      |         |         |                 |                     |         |         |
| Domestic ir                       | 0.164<br>(0.470)     |         |         |                 | 0.042<br>(0.076)    |         |         |
| Foreign ir                        | -0.040<br>(0.760)    | 0.810   |         |                 | 0.519<br>(0.122)    | 0.810   |         |
| Inflation rate                    | -1.038<br>(0.479)    |         | -0.625  |                 | -0.637<br>(0.072)   |         |         |
| Exchange rate                     | -0.426<br>(0.744)    |         |         |                 | -0.639<br>(0.116)   |         |         |
| <i>Opportunity cost variables</i> |                      |         |         |                 |                     |         |         |
| Price level                       | 3.488<br>(279.396)   | 5.485   | 4.966   | 5.193           | 3.445<br>(53.764)   | 5.485   | 5.193   |
| Stock prices                      | -0.691<br>(0.904)    |         |         |                 | -1.155<br>(0.129)   |         |         |
| <i>Control variables</i>          |                      |         |         |                 |                     |         |         |
| <i>Metavariables</i>              |                      |         |         |                 |                     |         |         |
| 1/obs                             |                      |         |         |                 | -13.875<br>(5.789)  |         |         |
| Mult.eq.                          | -0.016<br>(0.686)    |         |         |                 | 0.085<br>(0.106)    |         |         |
| Low frequency                     | -0.556<br>(1.107)    |         |         |                 | 0.346<br>(0.194)    |         |         |
| Chinese author                    | -2.464<br>(1.293)    |         |         |                 | -3.046<br>(0.204)   |         |         |
| Chinese language                  | 0.925<br>(0.870)     |         |         |                 | 1.042<br>(0.139)    |         |         |
| First year                        | -0.646<br>(0.222)    |         |         |                 | -0.724<br>(0.045)   |         |         |
| Last year                         | -0.009<br>(0.131)    |         |         |                 | -0.120<br>(0.028)   |         |         |
| Year (publication)                | 0.216<br>(0.106)     |         |         |                 | 0.288<br>(0.018)    |         |         |
| Citation                          | 0.025<br>(0.012)     |         |         | 0.010           | 0.019<br>(0.002)    |         |         |
| Published                         | 0.688<br>(0.960)     |         |         |                 | 1.502<br>(0.210)    |         |         |
| First reform (1978)               | -117.904<br>(42.590) |         |         |                 | -147.735<br>(8.784) |         |         |
| - squared                         | 140.969<br>(54.379)  |         |         |                 | 179.592<br>(10.763) |         |         |
| Second reform (1994)              | -11.945<br>(6.081)   |         |         |                 | -11.461<br>(1.020)  |         |         |
| - squared                         | 19.785<br>(7.511)    |         |         |                 | 21.324<br>(1.349)   |         |         |
| CUSUM test                        | -1.067<br>(0.984)    |         |         |                 | -1.730<br>(0.162)   |         |         |
| Hansen test                       | -2.070<br>(1.181)    |         |         |                 | -2.740<br>(0.192)   |         |         |
| other stab-test                   | -0.227<br>(2.136)    |         |         |                 | 1.586<br>(0.355)    |         |         |
|                                   |                      |         |         |                 |                     | 100.00% | 0.085   |
|                                   |                      |         |         |                 |                     | 0.70%   |         |
|                                   |                      |         |         |                 |                     | 3.70%   |         |
|                                   |                      |         |         |                 |                     | 2.00%   |         |
|                                   |                      |         |         |                 |                     | 13.10%  |         |
|                                   |                      |         |         |                 |                     | 48.10%  |         |
|                                   |                      |         |         |                 |                     | 0.80%   |         |
|                                   |                      |         |         |                 |                     | 0.70%   |         |
|                                   |                      |         |         |                 |                     | 0.70%   |         |
|                                   |                      |         |         |                 |                     | 0.80%   |         |
|                                   |                      |         |         |                 |                     | 34.20%  |         |
|                                   |                      |         |         |                 |                     | 10.40%  |         |
|                                   |                      |         |         |                 |                     | 6.50%   |         |
|                                   |                      |         |         |                 |                     | 6.50%   |         |
|                                   |                      |         |         |                 |                     | 0.70%   |         |
|                                   |                      |         |         |                 |                     | 0.80%   |         |
|                                   |                      |         |         |                 |                     | 0.80%   |         |
|                                   |                      |         |         |                 |                     | 9.20%   |         |
|                                   |                      |         |         |                 |                     | 0.90%   |         |

Note: Standard errors in parentheses.  $p$  is the probability for an indicator to be included in the “true” model as identified by Bayesian model selection. Models 1, 2, and 3 are the 3 models with the highest individual probabilities.

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