BOFIT Discussion Papers
27 • 2011

Anne-Laure Delatte, Julien Fouquau and
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Explaining money demand in China during the transition from a centrally planned to a market-based monetary system

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Institute for Economies in Transition

Electronic copy available at: http://ssrn.com/abstract=1949078

BOFIT Discussion Papers
Editor-in-Chief Laura Solanko

BOFIT Discussion Papers 27/2011
19.10.2011

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ISBN 978-952-462-722-1
ISSN 1456-5889
(online)

This paper can be downloaded without charge from
http://www.bof.fi/bofit .

Suomen Pankki
Helsinki 2011

Electronic copy available at: http://ssrn.com/abstract=1949078

Contents

Abstract 5
Tiivistelmä 6
I Introduction 7
II Money Demand in China: Institutional Background 10
A The monetary system in the transition process 11
B The rise and fall of the credit plan system 15
III Dataset and data properties 20
A Dataset 20
B Data properties 22
IV Linear Specifications 24
A Five Hypotheses 25
B The Household Circuit 26
C The enterprise circuit 28
D Aggregate money demand (M1) 30
V Non linear tests and estimation procedures 32
A Non linear specification 32
B Linearity Test and estimation 33
VI Non-linear money demand 35
A The Enterprise circuit 35
B Aggregate money demand (M1) 38
VII Conclusions 39
References 42
Figures 47
Tables 54

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Anne-Laure Delatte*, Julien Fouquau** and Carsten A. Holz***

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Abstract

We examine the transition process from a centrally planned to a market-based monetary system in China, with the objective of giving a functional form to the transition in money demand. Applying the cointegrating Time-Varying Smooth Transition Regression model proposed by Choi and Saikkonen (2004) on a constructed dataset spanning the period from 1984 to 2010, and using a seasonal unit-root test developed by Hylleberg et al. (1990), our findings invalidate much of the earlier literature. Our examination of disaggregate as well as aggregate money balances yields the following findings. (1) Households have an infinite demand for money at prevailing interest rates. (2) Enterprises have gradually gained decision-making authority over their deposits. (3) Money is a complement rather than a substitute to capital and this has become more prominent over the period. (4) The credit plan has ceased to be a significant driver of money holdings after 1997. (5) In the aggregate monetary sphere, the deposit interest rate has gained only a minor role as a monetary instrument, and only since 2000.

Key words: money demand, cointegrating time-varying smooth transition regression model, seasonal unit-root test, Chinese economy
JEL Classification: E41, O11, P52, P24, C51

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Carsten Holz gratefully acknowledges research support from the Bank of Finland Institute for Economies in Transition in form of a visiting researcher's position in summer 2011.

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Tiivistelmä

Tutkimuksessa tarkastellaan Kiinan rahankysynnän siirtymää keskusjohtoisesta markkinapohjaiseen järjestelmään. Tutkimus perustuu vuodet 1984–2010 kattavaan aineistoon, johon sovelletaan Choi-Saikkosen (2004) regressiomallia sekä Hyllebergin et al. (1990) yksikköjuuritestiä. Saadut tulokset vaikuttavat kumoavan merkittävän osan aikaisemman kirjallisuuden tuloksista. Tutkimuksessa huomataan, että 1) kotitalouksien rahankysyntä on vallitsevalla korkotasolla ääretön, 2) yritysten päätösvalta omien talletustensa suhteen on kasvanut, 3) raha on pikemminkin komplementti kuin substituutti pääomalle, 4) viralliset luottosuunnitelmat eivät vuoden 1997 jälkeen ole merkittävästi ohjanneet rahan hallussapitoa ja 5) talletuskorolla on vain vähäinen merkitys rahapoliittisena instrumenttina, minkä lisäksi tämä vaikutus oli olematon ennen vuotta 2000.

Asiasanat: rahan kysyntä, yhteisintegroituvuus, kausivaihtelun huomioon ottava yksikköjuuritesti, Kiinan talous
JEL: E41, O11, P52, P24, C51

I Introduction

In the second half of the 1990s, the central bank of China adopted an annual money supply target. Money supply targeting is an effective way to conduct monetary policy if there is a strong and linear relationship between the goal variable—inflation or nominal income—and the targeted monetary aggregate. However, there are a number of reasons why money demand may be non-linear, particularly in countries undergoing a transition from plan to market.

First, a slowdown in money velocity due to the monetization process during economic take-off may cause a progressive increase in the elasticity of money with respect to income. This elasticity is likely to go back to unity once the process is completed. Second, the complementarity hypothesis between money and capital (McKinnon, 1973) states that, in developing economies with limited access by households and small enterprises to external finance, money is accumulated to self-finance investment. In a transition economy such as China, the (changing) extent to which the complementarity hypothesis holds influences money demand. Third, the emergence of a financial market implies that households can allocate their savings alternatively to cash or interest-bearing assets such as stocks and bonds. The opportunity cost of holding money thus emerges in a money demand function with the development and deepening of financial markets. Fourth, institutions can impose defining constraints on the role of money. Some of the constraints of China's pre-reform institutions continue into the reform period, thus potentially causing money demand to be non-linear.

Earlier literature ignored the possibility of non-linear money demand in China altogether. Chow (1987) published a well-known study in which he provided evidence that supported the existence of a stable relation between money, income and prices, using annual data from 1952 to 1983. The same year, Feltenstein and Farhadian (1987) argued that a proper estimation of the money demand in China must take into account prices rigidities that are due to strict controls enforced by the central planning authority. Their central message was that in order to capture a stable money demand function in China, one has to take into account domestic specificities.

Subsequently, the search for a stable money demand function took two different directions. The first direction focused on a correct definition of money and opportunity cost in China (Huang, 1994, Hafer and Kutan, 1994, Chen, 1997, Chow and Shen, 2004, Gerlach and Kong, 2005, Mehrotra, 2006, Laurens and Maino, 2007, Bahmani, Oskee and Wang, 2007). A common result of these studies is that there exists a stable long run money demand, and de-

posit interest rates work as a significant opportunity cost of holding money. A second direction was taken by those who suspected that the conventional definition of the money supply does not apply in China and that institutional factors representative of the transition process must be taken into consideration include Qin (1994), Girardin (1996), Xu (1998), Hasan (1999), and Yu and Tsui (2000).

None of these publications pays much attention to the institutional details of China's pre-reform monetary system. But money in pre-reform China did not constitute a uniform aggregate: the task of the pre-reform financial system was to maintain the flow of two types of monies, with very different functions, through two very different channels. In the household circuit, enterprises made wage and salary payments in cash (only), and this currency in circulation could then be used to purchase consumer goods (only) or to save at state banks. In the enterprise circuit, enterprises purchased materials and capital goods from other enterprises using transfer money, i.e., bank transfers of deposits, only. Each of the two circuits was subject to different types of controls exercised by the planning authorities. It is only in the course of the reform period that the two circuits began to merge and money began to adopt more of the functions it plays in market economies. Consequently, we first consider the demand for money separately for the household and the enterprise circuits, incorporating the limitations to the uses of the different monies, before we move on to aggregate formulations of money demand.

Only three papers have investigated non-linear, i.e., non-stable relationships, and then only with limited regard to institutional details. Lee and Chien (2008) tested the presence of structural changes and identified one major structural breakpoint in 1993. The drawback is that China is likely to have followed a smooth economic transition process while their model includes only two regimes. Austin, Ward and Dalziel (2007) examined non-linearities affecting only the adjustment process to equilibrium. Their approach implies the existence of a single equilibrium relationship towards which money adjusts in each period, in a process that they allow to be non-linear, rather than allowing the equilibrium to evolve. Zuo and Park (2011) used a time-varying cointegration approach based on Park and Hahn (1999). A time-varying cointegration method seems the proper strategy to account for the smooth structural changes in China. However, their estimation is based on 52 quarterly observations from 1996 to 2009, less than the critical sample size to yield robust results. In addition, Choi and Saikkonen (2004) have pointed out a statistical limitation of Park and Phillips' work (1999,

2001): the specific assumption that the instability is only due to a martingale difference errors. They propose a more general procedure (that we adopt in this paper).

We use the non-linear cointegration methodology proposed by Choi and Saikkonen (2004) to test the null hypothesis of a linear cointegrated money demand relationship in China against the cointegrating Time-Varying Smooth Transition Regression (TV-STR) model. This modeling strategy allows us to relax the restrictive and potentially unrealistic assumption of stable coefficients in the relationship. The parameters are allowed to change smoothly as a function of time, which is more consistent with the gradual transition process of China than a structural break is. In other words, we test the hypothesis that the elasticities of the demand for money have changed over time. This model allows us to capture changes in monetary policy and in the behavior of Chinese firms and households towards money. The evolution of the elasticities reveals significant changes in the way money interacts with economic development.

Compared to the earlier literature, we, first, use a transition function that allows for a non-linear transition, rather than assuming (and testing for) the existence of *one* stable money demand function, or allowing for at most two states (Lee and Chien, 2008). Second, we build our work on a rigorous theoretical framework that we develop by examining the institutional details of China's financial transition. (In the literature, only Xu, 1998, gives some thought to financial sector idiosyncrasies.) The papers that have investigated non-linearities have all adopted a conventional definition of the money demand that would not seem to be appropriate given China's recent economic history. Third, we use a meticulously constructed dataset that goes well beyond what the standard databases offer, and we also cover a longer time period, reaching all the way from 1984 to end-2010. To our knowledge, it is the first paper on China money demand based on quarterly data going back to 1984. The length of this time span considerably increases the power of the empirical tests in comparison to previous studies, and also facilitates tracing transition processes. Fourth, to assess the presence of stochastic, possibly non-stationary, seasonal effects, we use a seasonal unit-root test developed by Hylleberg et al. (1990). As it turns out, the consideration of seasonal unit roots invalidates much of the earlier literature, none of which has considered seasonal unit roots. Ghysels and Perron (1993) showed that failing to account for seasonal unit roots leads to biased (underestimated) coefficients, while prefiltering the series using period-to-period differences alter the stochastic structure of series (Franses, 1997).

The following section reviews the salient features of the institutional developments in China's financial system. It serves as the foundation from which we derive the long-term relationships to be estimated. Section II presents our data and the results of the seasonal unit-root tests. Section III reports the results of the linear estimation. Section IV introduces the cointegrating Time-Varying Smooth Transition Regression and explains the linearity and specification tests. We present our non-linear results and implications in Section V. Section VI concludes.

II Money Demand in China: Institutional Background

In the pre-reform, socialist system, the volume of output was determined by the physical plan and prices were fixed. Money fulfilled little more than an accounting function. China's central bank, the People's Bank of China (PBC), controlled the quantity of cash held by households on the one hand, and the amount of deposits held by enterprises on the other hand. Cash flowed from the banking system to households according to plan and was withdrawn from the economy through clearly defined channels such as retail sales. Loans were extended to firms in accordance with the "commodity inventory system:" loans were made available when a firm purchased inputs needed for production, and repaid once the final products were sold.[1] While the volume of loans determined the volume of deposits, enterprises, furthermore, could only use these deposits according to plan. Money—cash for households and deposits for enterprises—thus strictly followed the physical plans.

By 2010, all control over cash disbursements by banks has disappeared, as has any attempt to control the amount and usage of enterprise deposits. Money is no longer simply an accounting unit. Money matters for inflation, for economic growth, and for employment. The transition involved a large number of small, often incremental reforms, all, invariably, affecting the demand for money.

[1]The commodity inventory system specifies that (working capital) credit be extended directly to the user in accordance with specific plans and for specific purposes on the basis of material inventories held by the economic unit. Enterprises are required to promptly pay back their loans to the banks when the commodities that were used to back the loan are transferred outside the enterprise. (See De Wulf 1986.) The commodity inventory system represents the socialist economy's application of the "real bills principle."

A The monetary system in the transition process

The centrally planned economy is characterized by two distinct circuits, the household circuit on the one hand and the enterprise circuit on the other hand. (See Figure 1.) In the household circuit, enterprises make all wage and salary payments to households in cash according to plan; enterprises are state-owned and follow nationwide wage and salary scales. Households use their cash receipts to consume and, with interest rates and inflation at very low levels (prices are government-determined and rarely adjusted), are near-indifferent between holding any excess cash receipts in cash or depositing them in the bank. In the absence of household checking accounts, all household use of money consists of the use of cash.[2]

Figure 1 Enterprise and Household Circuits in the Centrally Planned Economy (page 47)

In the enterprise circuit, enterprises buy producer goods from other enterprises. All payments between enterprises are made through the transfer of deposits between bank accounts, using "transfer," or "book" money. Enterprises' wage and salary payments, in cash, through earmarked accounts, are subject to rigorous cash administration. Enterprises have access to their transfer money in bank accounts to purchase producer goods only if the physical transaction has been approved by the relevant state organ; enterprises are prohibited from purchasing consumer goods.

The organization of the monetary system into two separate, strictly controlled circuits has implications for monetary policy. With household income barely above subsistence level, the supply of consumer goods has to meet little more than the demand for food and everyday household goods. Furthermore, prices are state-determined and fixed. In the household circuit, thus, there is no need for active monetary policy.[3] In the enterprise circuit, imbalances between the demand and supply of producer goods cannot arise as long as all transactions scrupulously follow the physical plan. Furthermore, producer prices are also state-determined and fixed. In the enterprise circuit, thus, there is likewise no need for active monetary policy, and any concept of money demand is irrelevant.[4]

[2] On the concept of two circuits also see Dembinski (1988) and Holz (2000).
[3] The monetary or planning authorities could have used interest rates on household deposits to influence household consumption decisions, but perhaps there was no need—between 1959 and 1979 interest rates in the PRC were adjusted twice, and then only marginally (*Finance Yearbook 1990*, p. 167).
[4] Walter (1985, 290) argues for the case of the PRC that after an unsuccessful credit reform in 1956, "the People's Bank [the only financial intermediary] came to focus primarily on developing its savings operations, which, in contrast to the credit reforms, enjoyed strong local Party support."

Without the need for monetary policy or the fulfillment of any significant allocative function by financial intermediaries, a monobank suffices.[5] In the case of the People's Republic of China, that was the People's Bank of China (PBC). Between 1969 and 1977, the PBC was integrated into the Finance Ministry. Other financial intermediaries and financial markets did not exist. The only other source of financial resources was the state budget which provided all funding for investment in fixed assets as well as a certain amount of "fixed-quota" working capital.[6]

The PRC's pre-reform period financial system was inherently stable. But once economic reforms in the real sphere began, the monetary system had to adapt. The reform period brought about a fundamental change in the functions of money: as enterprises were given the right to make their own production and investment decisions, they also needed the freedom to retain deposits and to decide on the use of these deposits. Money demand of enterprises became a meaningful concept.

In the early 1980s, enterprises began to supplement planned wage and salary payments with bonus payments. (See Figure 2.) The total wage bill increased and became a priori indeterminate.[7] Rising household income meant that the share of easily planned food and everyday household good purchases in total household expenditures declined. The planning bureaucracy subsequently lost partial control over the extent of cash disbursements by the banking system. For example, as can be seen in Table 1, while in 1978 easily planned wages, salary payments and agricultural procurement accounted for 55.1% of all cash disbursements by state banks, this percentage dropped to 17.0% by 1995. In an economy of scarcity, the sales of consumer goods and services are easily determined by their (planned) availability; the share of sales of goods and services in all cash receipts of state banks dropped from 79.2 to 22.1% between 1978 and 1995. The share of the relatively unpredictable depositing and withdrawal

[5] The only other source of financial resources is the state budget which provides all funding for investment in fixed assets as well as a certain amount of "fixed-quota" working capital. The banking system supplements meager fixed-quota working capital allowances by extending short-term working capital loans in accordance with the commodity inventory system.

[6] The banking system, originally the monobank, then supplemented meager fixed-quota working capital allowances by extending short-term working capital loans in accordance with the commodity inventory system.

[7] The central government tried to maintain an upper limit on bonus payments by levying a steep bonus tax. Bonus payments equaling up to four months of wage and salary payments were free of tax, marginal bonus payments equivalent to a fifth month of wage and salary payments carried a 30% tax, those equivalent to a sixth month of wage and salary payments a 100% tax, and those exceeding the equivalent of six months' wage and salary payments a 300% tax. (SC 84/6/28)

of savings as share of total cash disbursements and receipts rose from 9.6% and 10.7% in 1978 to 51.1% and 54.3% in 1995.[8]

Figure 2 Enterprise and Household Circuits after Reform (page 48)
Table 1 Disbursements and Receipts of Cash by State Banks (page 54)

The loss of control over the disbursements and receipts of cash was exacerbated by the illegal use of cash by enterprises for the purchase of producer goods in the enterprise circuit as well as for consumption by enterprises. (Enterprises and various state units would purchase consumer goods for their employees, while formally adhering to the official wage and salary scales). The growth of the individual-owned economy and the rural township and village enterprises, with much of their transactions outside the banking system, further rendered the cash plan difficult to implement. Imbalances in the household circuit became more likely and could, by the late 1980s, with prices successively freed, lead to inflation in the consumer goods market. With rising household incomes and the threat of inflation, households now faced decisions on how much money to hold, and in what form (cash or deposits). Household money demand gradually became a meaningful concept.

On the supply side, the need for active monetary policy arose. In the household circuit, monetary policy focused on withdrawing excess cash by setting appropriate, centrally determined, nationwide uniform interest rates on household deposits, even while monitoring of the cash plan and attempts at enforcing the cash plan continued. Between 1978 and 1999, these interest rates were adjusted eighteen times.[9]

In the enterprise circuit, with the expansion of enterprise-based decision-making and the growth of the non-state economy, the planning and production bureaucracy gradually lost control over physical transactions. The volume and distribution of transfer money began to matter in that excess transfer money could lead to imbalances in the real sphere. Beginning in 1985, prices for producer goods were partially freed in the dual-track price system; by 1993, market-determined prices governed 81.1% of the value of all producer goods sales.[10] Imbalances in the producer goods sector could, furthermore, through the price of materials and the volume of wages and salaries, spill over into the consumer goods sector. Inflation became a

[8] See China Financial Statistics 1952-1987 and Statistical Yearbook 1999, p. 625.
[9] The PBC today still sets all interest rates, subject to State Council approval, at nationwide uniform levels (albeit some, nowadays, with a bandwidth).
[10] See Price Yearbook 1997, p. 482.

threat not only in the enterprise circuit but also in the household circuit, and it became increasingly impossible to conduct monetary policy separately for the two circuits. A first bout of double-digit inflation in 1988-1989 led to panic purchases of consumer goods and the withdrawal of household savings deposits. The PBC responded by inflation-indexing household deposits (but not enterprise deposits) with maturities of three years and longer for the period 10 September 1988 to 1 December 1991.[11]

The need for active monetary policy in the enterprise circuit became urgent. As the use of transfer money by enterprises had to be deregulated, it was the extension of *additional* transfer money (credit) to individual enterprises which became central to monetary policy. The reduction in microeconomic control mechanisms in the real sphere (partial abandonment of the physical plan and of price controls) was compensated for by an elaborate credit plan system with earmarked loans for individual projects and enterprises. While loans were extended by financial institutions, many lending decisions were made outside the financial system by the traditional planning and production hierarchy.

The financial link between enterprises and government finance departments was gradually severed. Enterprises making their own production decisions could no longer submit all surplus to the finance departments (or the enterprise's super ordinate government departments); a finance department receiving less funds could no longer provide enterprises with fixed-quota working capital and investment funds. In 1979, enterprises were allowed to retain funds through partial profit retention. A 'tax instead of profit delivery' (*ligaishui*) reform followed in 1983 through 1985 (and then was partly rescinded with the enterprise contract responsibility system in 1988-92). The task of providing *all* working capital and, newly, investment funds, shifted to the banking system in an effort to 'switch from budget appropriations to credit' (*bogaidai*).

The changes in financial intermediation, with an increase in the volume and a diversification in the type of banking business, led to institutional changes in the financial sector. Four "special banks" re-emerged from departments within the PBC and the central Finance Ministry. These "special banks," later relabed "state banks" and then "state commercial banks," joined the small Bank of Communications and the rural credit cooperatives to form China's group of financial intermediaries. Other financial institutions were to follow, in par-

[11] A second period of inflation-indexing began on 11 July 1993, with the inflation subsidy dropping to zero in May 1997. See *Jinrong shibao* 97/10/28 and 99/12/6, *Finance Yearbook* 1997, p. 493, and *Statistical Yearbook 1998*, p. 533.

ticular nationwide other commercial banks and regional commercial banks starting in the late 1980s. The state commercial banks held 85%% of all deposits in China in 1985 (with the remainder held at the rural credit cooperatives), and 41% by the end of 2010.[12]

B The rise and fall of the credit plan system

With the gradual decline of output planning starting in the early 1980s, new macroeconomic control instruments were needed. This led to the creation of an elaborate credit plan system which translated macroeconomic targets into microeconomic lending decisions. Officially, it remained in place until the late 1990s. The system of credit plans consisted of a credit plan for each state commercial bank and a PBC (Refinancing) Credit Plan.[13] An attempt was made to draw up an overall State Comprehensive Credit Plan that covered all financial institutions, but financial institutions other than the four state commercial banks were probably never effectively subjected to anything more than an annual lending limit.

In 1984-86, banks faced both a credit and a deposit plan with refinancing of the difference guaranteed by higher-level branches of the same bank and ultimately by the central bank. Deposits attracted in excess of the deposit plan could be freely turned into working capital loans by the bank branch itself (*duocun duodai*). This created incentives for banks to attract more savings in order to lend more. The policy affected all aspects of the two circuits. In the household circuit, additional loans could pay for bonus payments to households (on top of the planned salary and wage payments). In the enterprise circuit, additional lending was no longer necessarily tied to the commodity inventory system (the linkage between loans and production), and money in the enterprise circuit thus no longer had a direct correspondence to production.

In 1987, refinancing through the central bank became no longer guaranteed—financial institutions were to use the local/ regional interbank money market—and binding credit limits were instituted. Since 1989, the PBC no longer draws up deposit plans; these be-

[12] *People's Bank of China Quarterly Statistical Bulletin* #4/2010, PBC website (www.pbc.gov.cn, accessed 15 July 2011), *Xinhua yuebao* (relevant 1986 issue), *China Financial Statistics 1949-2005*.
[13] For details on the hierarchical organization of the credit plan of each financial institution, and the interlocking effects of the credit plans of the state commercial plans and that of the PBC, see Holz (1992). Almost every single credit regulation available covers aspects of the credit plan. Some of the relevant regulations of the 1980s and early 1990s are PBC 8 Oct. 1984(a), PBC Oct. 1984, ICBC 8 Oct 1984, PBC 24 Dec. 1986, PBC 25 March 1988, PBC 9 March 1989, PBC 12 Feb. 1990, PBC 8 Aug. 1990, PBC 19 Feb. 1992, PBC 11 Feb. 1993(c), PBC 3 March 1993.

came the responsibility of the state commercial banks. In determining credit limits, the PBC was to first determine the increase in money supply based on the quantity equation—considering next year's expected "rational" economic growth, planned price increases and changes in the velocity of money—and then to determine the credit volume accordingly. In the early years, refinancing of the state commercial banks by the PBC occurred predominantly at the provincial if not municipal level (to ensure that lending plans would be met), and the provincial PBC branch appeared to have the authority to determine part of financial institution's credit limits.[14] In 1994, all refinancing authority was centralized.[15]

The credit plan of a state commercial bank (branch) covered loans for investment in fixed assets and working capital loans. Loans for capital construction (one of two types of investment in fixed assets) were imperatively planned in terms of a year-end maximum as well as in terms of planned annual extension of such credit given repayment of old loans; these loans were typically imperatively allocated to individual projects. Loans for technological updating and transformation (the second type of investment in fixed assets) were imperatively planned in terms of their total year-end provincial institution-specific volume only. Working capital loans became subject to an annual limit sometime in the second half of the 1980s. I.e., short-term loans (working capital loans) were much less tightly regulated than loans for investment in fixed assets.

In 1991, guidelines were issued on industries which enjoy priority in lending. Provincial governments were to organize banks and government departments to draw up priorities listing specific enterprises and specific products.[16] In addition to lending guidelines,

[14] With the PBC before 1984 serving as commercial bank, it had branches down to the county level. These branches were maintained after 1984 and seem to have been frequently misused by local governments; the PRC PBC Law of 1995 in Article 12 finally states explicitly that PBC branches on all levels are PBC agencies (*paichu jigou*), which means they are subordinate only to the next higher-level PBC branch.

[15] According to PBC 9 March 1989, provincial PBC branches may not extend any new loans to financial institutions (this seems to exclude recycling of old loans), they may no longer "adjust" various refinancing loans, and no longer enjoy the right to use part of the increases in budgetary deposits and post office savings deposits exceeding the plan to give locally determined refinancing loans. All deposits by central and local state budgets (i.e., the finance ministries on all tiers), local extra-budgetary deposits, deposits by state offices and organizations, capital construction deposits, special deposits, and reserves of financial institutions "belong" to the PBC, with the PBC headquarters deciding on whether to share any of these funds with the provincial PBC branch. (PBC 8 Oct. 1984(b)) At times when it does, the provincial PBC branch may then decide itself how to use these funds (for example, to support some local key project by extending a loan through one of the state commercial banks). For details on the evolution of the credit plan system, see a host of credit regulations issued around that time, such as PBC 24 Dec. 1986, PBC Dec. 1986(a,b), and PBC 24 Feb. 1989.

[16] Establishment of such priorities seems to follow the reforms in the real sphere where a "sectoral policy" is supposed to facilitate approval procedures by planning commissions of investment projects. The State Council passed a "decision on the main points of the present sectoral policy" on 15 March 1989 and an "outline of the

banks also faced explicit external decisions on policy loans.[17] According to Montes-Negret (1995, p. 31), the Industrial and Commercial Bank of China in the early 1990s could autonomously decide on less than 20% of its lending. Xiao (1997, p. 371) reports that approximately 40% of all state bank loans in 1991 were "policy loans" (defined in the source as particular lending categories),[18] while Hui (1994) claims that 20% of all Industrial and Commercial Bank of China loans are policy loans; for the Agricultural Bank of China the share is 30%, for the Bank of China 15%, and for the Construction Bank of China 45%. And yet, by 1993 banks were explicitly encouraged to refuse loans to projects which are not economically viable (PBC 11 Feb. 1993(c)).

In 1993, after numerous scandals in the financial system, many related to trust and investment companies set up by provinces, Zhu Rongji became governor of the PBC (and was concurrently, since 1991, deputy prime minister). A number of financial sector reforms emerged. At the core was a financial sector reform decision passed by the State Council on 25 December 1993. It states that the PBC's intermediate and operational targets are money supply, credit volume, interbank money market rate, and a "safety deposit requirement." Starting 1994, the state commercial banks were to adopt prudential ratios.[19] A number of institutional reforms followed, including the establishment of three policy banks to take over the policy loans of the state commercial banks, the passing of the PBC Law and the Commercial Bank Law in May 1995, the consolidation of provincial-level PBC branches into nine regional branches in October 1998, and the allocation of budgetary funds to take bad loans off the balance sheets of the state commercial banks starting in the second half of the 1990s, culminating in the establishment of asset management companies in 1999 to take over all remaining bad loans of the state commercial banks.

state sectoral policy for the 1990s" on 25 March 1994. For the monetary aspects see, for example, PBC 11 Sept. 1991 and PBC 11 Feb. 1993(a).

[17] What constitutes a "policy loan?" The term appears to have two usages. Policy loans can denote certain categories of loans which are extended at especially low interest rates, such as loans to commercial departments for the purchase of agricultural and sideline products (with not necessarily any reference to individual projects). "Policy loans" can also denote the extent to which a bank's (or bank branch's) loan quota is exhausted by projects determined individually at a higher administrative level within the bank or by the local government (with not necessarily any reference to an interest rate).

[18] These loans range from the loans extended to 240 enterprises under the "double-guarantee system" (the state guarantees all inputs, the enterprise guarantees all outputs) with no decision-making authority for the bank, to agricultural procurement loans for which the government only determines volume and purpose (Xiao, 1997). Not all policy loans are explicitly labeled "policy loans." Local governments and lower-level tier government departments are participating in, if not making, some loan decisions; financial intermediaries may not want to lend to enterprises which do not have borrowing approval from their superordinate ministry.

Even though the 1993 reform decision mentioned money supply targeting and the adoption of prudential ratios, by 1995, the then highly centralized credit plan was still very much relevant. The national economic and social development plan of 1995 (NPC 18 March 1995a) reported only one monetary target for 1995: this was the total increase in bank credit, by no more than 570b yuan (with quarter-by-quarter limits for individual banks). Prudential ratios were not enforced for many years to come.[20]

The switch to money supply targeting officially occurred in the second half of the 1990s. The *South China Morning Post* on 1 February 1996 reported Chinese growth targets for M1 and M2 in 1996 of 18% and 25%. The 1998 national economic and social development plan stated that credit limits on lending by the state commercial banks have now ended. It does not report any monetary targets for 1998, except an increase in currency in circulation of 150b yuan (NPC, 6 March 1998). The 1999 national economic and social development plan for the first time issued M1 and M2 growth targets, for 1999, of "approximately" 14% and 14-15% (NPC 6 March 1999).

The relative late transition from credit limits to money supply targeting suggests that in the early reform years it was difficult to accurately predict movements of the money multiplier between base money and money supply in response to all the ongoing reforms in the real and the financial sphere. That would also hint at difficulties in establishing a stable money demand function. In terms of monetary tools, it appears that only in the second half of the 2000s has the PBC adopted routine open market operations, presumably largely in response to capital inflows, and has begun to frequently change the reserve requirements.

The 2000s also saw a number of institutional changes with WTO accession in 2002 and the gradual opening of China's financial sector to foreign financial institutions, the establishment of the China Banking Regulatory Commission in April 2003 (leaving the PBC primarily with monetary policy tasks), capital injections by the state into the four state commercial banks and their public listing in 2005 (Construction Bank of China, and the Bank of Communications, not one of the four "state commercial banks" but a state-owned bank, nevertheless), 2006 (Bank of China, Industrial and Commercial Bank of China), and 2010 (Agri-

[19] In 1989 the PBC started a deposit safety requirement (*cunkuan beifujin*) of 5-7%, allegedly to guarantee that deposits can be withdrawn any time. This requirement seems to not have been strict and appears to have come to be included with excess reserves. (PBC 9 March 1989)

[20] Money supply data appeared for the first time in 1993, in the back pages of the PBC's monthly magazine *Zhongguo jinrong*, together with all other quarterly financial statistics. The *People's Bank of China Quarterly Statistical Bulletin*, which started publication in 1996, carries retrospectively created data on M1 beginning with March 1990.

cultural Bank of China), exchange rate liberalization starting in 2005, and the transitioning of the three state development banks from banks with policy lending tasks into solely development banks.

While the credit plan system has never been officially dismantled, the underlying loan classification system has been abandoned—loans are now classified by maturity, and not by type (capital construction loans, etc.)—and whatever lending limits and loan allocations are in place are now, presumably, determined bank-internally. Nevertheless, credit limits resurface at unusual times, such as in early 2010, when the head of the China Banking Regulatory Commission, Liu Mingkang, said that overall credit growth in 2010 will be restricted to 7.5 trillion yuan.[21]

There also remains a question as to how effective the credit plan has been in limiting the overall amount of loans. Figure 3, showing the credit plan lending limits of 1983-1995 and the actual amount of loans extended, suggests that the credit plan has had only limited success. This adds an interesting twist: if the credit plan was never a rigorous control instrument, then a standard money demand equation adopted from market economies could well be applicable to China even in the early reform period.

Figure 3 State Banks: Planned vs. Actual Change in Credit (page 49)

A counterargument to the increasing relevance over time of concepts of money demand as applied to market economies could be that what has replaced the two circuits in China is not so much a market-based money demand function, as an infinite demand for money at prevailing interest rates. This argument would be supported by the relatively low (and sometimes negative) real interest rates (Figure 4). The actual volume of money is then determined solely by the supply of money, which in turn is directly related to the volume of loans.[22] In other words, China until today does not have a meaningful demand for money. This is a central question we will address in the empirical section.

Figure 4 Lending Rate and CPI (page 50)

[21] http://www.bloomberg.com/apps/news?pid=newsarchive&sid=asj.kLMqwSvE, accessed 12 July 2011.
[22] Xu (1998), for example, finds that loans have strong explanatory power in his money demand functions, although he stops short of viewing it as an unlimited demand with limited supply issue.

III Dataset and data properties

A Dataset

Our data are obtained from a wide variety of sources. We work with quarterly and monthly data to obtain quarterly series. When only monthly data are available, these are aggregated into quarterly data. In the case of stock rather than flow values, our quarterly values are mid-quarter values, obtained as the arithmetic average of end-period and beginning-period values. We collected data starting with the year 1978, but then start our analysis with the year 1984 because data on some series are not available for the earlier years. Below is a brief summary of data sources and data manipulations. A lengthy documentation is available upon request. All data used are plotted in Figure 5.

Deposit and loan data are obtained from the monthly magazine *Xinhua yuebao* for the years through 1985, the financial statistics page in the PBC's monthly magazine *Zhong-guo jinrong* for the years 1986-1989, *China Financial Statistics 1949-2005* for the years 1990-2005, and the *PBC Quarterly Statistical Bulletin* and the PBC website (http://www.pbc.gov.cn/) for the years since 2006. The transitions between the different sources are not always smooth: minor adjustment to loan data were required for 1988 and 1989.

The sources of money supply data for M0 are the same as for deposits and loans. Quarterly M1 data for the years through 1990 are obtained from the International Monetary Fund's *International Financial Statistics* (IFS); since then, they are obtained from the *PBC Quarterly Statistical Bulletin* and the PBC website.

Interest rates are obtained from the *Finance Yearbook* and, for 2009 and 2010, from individual announcements on the PBC website. In contrast to the IFS, which seems to use end-month values, we calculate average monthly interest rates (and then average quarterly interest rates).[23] We take into consideration that interest rates on household time deposits (but not on enterprise time deposits) of 3-year or longer duration were inflation-indexed from 10 September 1988 through 1 December 1991, and then again starting 11 July 1993. The spread between U.S. and China's lending rates is the percentage point difference between the U.S. Bank Prime Loan Rate and the China lending rate, both series as published in the IFS.

[23] The average monthly interest rate is the arithmetic mean of the daily interest rates, and the average quarterly interest rate is the arithmetic mean of the monthly interest rates.

Exchange rate data are obtained from the ISF through 1986, and then from the *Finance Yearbook* and the PBC website. The nominal effective exchange rate and the real effective exchange rate are obtained from the IFS.

For data on the real economy, our default source is a series of three statistical magazines published by the National Bureau of Statistics: *Zhongguo tongji yuebao* (July 1985 – 1989), *China Statistics Monthly* (1988 – early 1990s), and *China Monthly Statistics* (starting early 1990s). We also resort to the statistics page in the NBS monthly magazine *Zhongguo tongji* and to the NBS website (www.stats.gov.cn). For the numerous manipulations involved in the creation of quarterly GDP, industrial output, and investment series, we conducted extensive reliability checks before proceeding as we did.

The CPI and the retail price index are published as a monthly year-on-year (yoy) growth rate. We create a price index by setting all monthly CPI (and retail price index) values of the year 2002 equal to 100, and then applying the published CPI (and retail price index) growth rates to this base in order to obtain a continuous index that covers the complete time period. From this continuous index we obtain quarterly yoy growth rates.[24]

The retail sales data had a number of missing data points which then required some (minor) approximations. The raw GDP data are from the *China Quarterly GDP Time Series 1992-2005* and the NBS website. Quarterly values for the years prior to 1992 are obtained by relying on the quarterly proportions of the industrial output data. All final quarterly GDP data are based on the most recently revised annual GDP series (from the *Statistical Yearbook* 2010 and the *Statistical Abstract 2011*) to which the quarterly GDP shares of the raw GDP data (prior to 1992 industrial output values) are applied. We create a real series by taking all four quarterly nominal values of 2002 to also be real values.

Industrial output values are based on the available real and nominal data on gross output value, sales output value, and value-added, for whichever aggregate of industry these data are available (total; directly reporting industrial enterprises, with its changing definition). In addition to the default sources, we consulted the *PBC Quarterly Statistical Bulletin*. From these raw data, we create a monthly yoy real growth index. We also use these series to determine the share of each month or quarter in annual output. Data in levels are based on the an-

[24] We can equally well obtain quarterly yoy growth rates from the published monthly yoy growth rates. The difference between these two series is exceedingly small. Because we obtain real series of other variables by using 2002 as the base year, we take the same approach for the price indices. The choice of 2002 followed careful examination of the price indices in all years. 2002 was a year with average monthly CPI inflation of -0.8% (and a standard deviation of 0.3 percentage points) and it followed two years of near-stable prices.

nual industrial valued added published in the national income accounts (*Statistical Yearbook* 2010 and the *Statistical Abstract 2011*) to which these monthly or quarterly shares are applied. A series of real value added is obtained by taking all 2002 nominal values to also be real values, and then applying the earlier derived real growth rates to the 2002 base (which can then also be readily used to back out a quarterly yoy growth rate series).[25]

The investment data are based on the economy-wide annual investment values published in the *Statistical Yearbook*, to which monthly or quarterly shares are applied. The monthly or quarterly shares are based on a large variety of different investment data available at different points in time (capital construction and technological updating and transformation, investment by state-owned units, urban investment).

Household income is limited to urban household income in 35 or 36 cities (with the exact number of cities depending on year). Our default variable is disposable income, our second choice is living expenditures. A real series is obtained by deflating with the CPI (using 2002 as the base year).

Figure 5 Selection of data (in billion Yuan, current prices if not mentioned otherwise) (page 51)

B Data properties

We need to check the integration order of our series. Although this step is standard, we need to be very cautious given their statistical properties. In particular, some series obviously exhibit seasonal characteristics, an issue that has been overlooked in previous studies (see Figure 5). In fact, prefiltering seasonal series by seasonal dummies assumes that seasonality is only a deterministic phenomenon, which has important drawbacks in the presence of stochastic seasonality. The alternative filtering with an ARIMA X-12 procedure, accounts for stochastic seasonality but assumes stationarity. In sum, filters alter the stochastic structure of series because they impose a particular stochastic structure (Franses, 1997). Unit root tests on linear seasonal filtered data tend to over-reject the null hypothesis of a unit root.

To address this issue, we apply a seasonal unit-root test developed by Hylleberg et al (1990) (HEGY) that has the advantage of testing for unit roots at zero frequency (long run

[25] The issue of two series of quarterly yoy real growth rates is the same as in the case of the price indices. See the previous footnote.

behavior) and for seasonal unit roots. To do so, the tests decompose a quarterly series y into the seasonal and the zero-frequency components:

$$(1-L^4)y_t = \gamma_1(1+L+L^2+L^3)y_{t-1} + \gamma_2(1-L+L^2-L^3)y_{t-1} + \gamma_3(1-L^2)y_{t-1} - \gamma_4(1-L^2)y_{t-2} + \varepsilon_t$$

,

where L is the lag operator. The value of γ_i(i=1 to 4) determines the existence of a unit root in the different frequencies. To check the significance of γ_i, the test proceeds as a standard ADF test with critical values simulated by Hylleberg et al (1990). If $\gamma_1 = 0$, the variable has one non-seasonal (long run) unit root. If, in addition, γ_i(i=2 to 4) = 0 then the variable has also a seasonal unit root. It corresponds to a unit root in the semi-annual frequency if $\gamma_2 = 0$ and in the quarterly frequency if $\gamma_3 = \gamma_4 = 0$ which implies a joint F-test. In sum, this test allows us to identify the frequency at which the data have a unit root.

Table 2 reports HEGY test and standard unit root tests. For all tests we have to specify the number of lagged difference terms of the dependent variable to be added to the test regression. The usual advice is to include a number of lags sufficient to remove serial correlation in the residuals.

Table 2 Standard and Seasonal Unit Root Tests (page 55)

First, the HEGY test identifies which variable has a unit root in the zero-frequency, which is a pre-requirement to study a cointegration relationship. The test reveals that the following variables are stationary: cash (m_0) household deposits, real growth of disposable income, inflation, real 5-year-fixed-term deposit interest rate, real growth rate of industrial output, investment, US vs. China Interest rate spread. The rest of the variables are nonstationary: GDP, industrial output, total loans, short-term loans, M1, retail sales, CPI index, household disposable income, living expenditures.

The standard tests ADF, PP or KPSS yield similar conclusions as HEGY tests in the zero frequency, with the exception of cash (M_0). In fact, we find that m_0 is stationary in the zero-frequency but has a unit root in the semi-annual frequency. It means that every year the variable has different characteristics (such as volume) in the first half of the year from the second half. It is possibly due to Chinese New Year, when households conduct more purchases than at other times of the year, with the excess currency in circulation later withdrawn

by the PBC, and when household give newly printed money as present. This result suggests that the standard tests wrongly reject the variable's stationarity because of the presence of a seasonal unit root.

Second, the HEGY test shows the stochastic seasonal characteristics. The variables GDP, retail sales and CPI index are found to have a unit root in the zero-frequency and semi-annual frequency ($\gamma_2 = 0$). The variable industrial output has a unit-root both in the zero-frequency and quarterly frequency ($\gamma_3 = \gamma_4 = 0$) with a Fisher test.

Now that we have identified the frequency in which the data have unit root (s), we use this information to filter the data. If the series has only a unit root in the zero-frequency and no seasonal unit root, we use this variable in levels. If the series has a zero-frequency unit root and a seasonal unit root, we cannot use the standard procedure of Engle and Granger (1987). To focus only on the long run relationship, we eliminate the seasonal unit root and keep only the unit root in the zero-frequency. More precisely, we work with seasonal component S1= $(1 + L + L^2 + L^3)y_{t-1}$ as in Engle, Granger, Hylleberg and Lee (1993). With this component, we can use the traditional cointegration test.

Given the proper treatment of seasonality and integration order of the series, we continue with stationary and non- stationary series to examine the linear empirical specification.

IV Linear Specifications

In a market economy, economic agents choose the level of money to balance between their transaction motives and the opportunity cost of holding money. In the case of China, other arguments specific to its institutional background may have shaped money demand. In the following, we present a total of five hypothetical motives that may plausibly to determine money demand. To do justice to the origins of China's current monetary system, we analyze money demand in China using the concept of the two circuits before moving on to M1, the monetary aggregate of the market economy.

A Five Hypotheses

The first and obvious explanation of money demand is the transactions motive. Second, in a transition economy, the transaction motive goes with a monetization trend. As Xu (1998) explains, monetization has two aspects: monetary transactions replace nonmarket activities, and more market transactions are conducted with cash rather than settled through bank transfers. The first aspect implies an increasing volume of monetary transactions affecting all monetary aggregates, while the second aspect implies a higher degree of cash use relative to some production or sales value. Monetization implies a drastic increase in money demand in the early stages of reform that levels off progressively over time.

A third potential explanation is complementarity. Mc Kinnon's (1973) complementarity argument runs that in developing economies with limited access by households and small enterprises to external finance, money is accumulated to self-finance investment. Investment and bank deposits are not substitutes, but complements. The complementarity hypothesis holds if the demand for money is positively correlated with the real return on capital.

In the case of China, the argument has two facets. (i) If investment happens according to plan and the state makes the funding available (either through the budget or the state banking system), as was the case probably through at least the mid-1990s, there is no complementarity. (ii) For private and collective-owned enterprises with limited access to bank loans, complementarity may be relevant. The share of own funds in total funding of investment in fixed assets in China has been invariably high at around 50%, with a slight upward trend, which could suggest that despite the availability of bank loans for at least some enterprises, complementarity may have a role to play.[26]

Fourth, once the straightjacket of the plan was relaxed and investment opportunities arose and the possibility of inflation appeared, the opportunity cost of holding of money became relevant. All household deposits in China bear interest. Current account deposits come with the lowest interest rates. Only savings deposits of three years maturity or longer enjoyed inflation-indexed interest rates at times of high inflation. The effect of inflation on money holdings is complex. A high rate of inflation can imply a high opportunity cost to holding cash or maintaining high balances in checking accounts, i.e., lead to reduced cash holdings. But a high rate of inflation can also induce households to desire a higher degree of liquidity,

[26] In 1993, the first year for which the data are available, own funds accounted for 47% of all funding for capital construction and technological updating and transformation (with no data available on total investment in fixed assets); in 2009, own funds accounted for 61% of all funding of investment in fixed assets (*Statistical Yearbook*).

because they need more money to purchase a given amount of goods or services at the now higher prices. It can also signal to households that the government is losing control and that it is a safer bet to reduce savings deposits and purchase available consumer goods and services before inflation rises even further (a view that is supposed to have prevailed in the late 1980s, a period marked by "panic purchases").

Fifth, one argument that is always looming in the background, as elaborated above, is to what extent does China have a meaningful demand for money rather than an infinite demand for money at the state-determined prevailing interest rate, constrained only by supply? As argued in the section on institutions, the volume of loans was a major monetary instrument to try and control money holdings in the economy. Therefore, we will test whether the volume of loans is a significant fourth determinant of money holdings. If among all relevant regressors only credit is significant, we would conclude that money holdings are determined by the volume of credit.

In total, we examine the following long term relationship specification:

$$y_t = \beta_0 + \beta_1 Transaction_t + \beta_2 Monetization_t + \beta_3 Complementarity_t + \beta_4 Opportunity_t + \beta_5 Credit_t + u_t, \quad (1)$$

where y_t represent the different monetary aggregates identified in the institutional analysis and u_t is a stationary error term.

B The Household Circuit

We explore the household circuit through the determinants of the demand for cash and household deposits in the banking system. Lacking a concise breakdown of household deposits by maturity for the complete reform period, and since all deposits earned interest, we operate with one aggregate of household deposits.

In the pre-reform period, a rule of thumb used by the planning authorities was that one yuan of currency in circulation is sufficient for eight yuan worth of retail sales transactions per year.[27] In the pre-reform period, household deposits constituted a small residual (of wages and salaries over retail sales) in the household circuit. This residual was periodically

[27] See *China Aktuell*, no. 9 (1984), p 525. With retail sales constituting the main channel trough which currency in circulation returned to the state banks, and wages and salaries being the main channel through which currency entered circulation, the government could use the 1:8 equation to calculate the increase in retail goods supply needed if wage and salary payments were raised by a certain percentage.

absorbed by the banking system, mainly in the course of savings campaigns as the low interest rates provided few incentives to save. If wages and salaries increased, all else constant, household deposits may have increased; similarly, if retails sales dropped, all else constant, household deposits may also have increased.

Economic reforms would suggest increasingly autonomous household decisions on the allocation of their money balances. Yet the seasonal unit-root tests in Table 2revealed that cash (m0) and household deposits are stationary. By definition, stationarity means that they both have a constant mean and variance. In other words, the two aggregates vary steadily along an upward trend. This property suggests that they are planned rather than the result of free rational choice, which would imply a random walk: household deposits did not turn into a function of the opportunity cost to holding non-interest bearing forms of money. In sum, household shave an infinite demand for money at prevailing interest rates.

This finding is possibly due to the fact that the interest rate is lower than the market interest rate. With the PBC (and the SC) setting nationwide interest rates (gradually switching to bands for some lending rates), there is no market interest rate. The only comparison one can make is with the inflation rate. Figure 4 shows that lending rates until 1995 indeed were relatively low, except for a few years around 1990, and often negative in real terms. Only since 1997 has the real lending rate been mostly positive, though it remained relatively low. In the household circuit, the low interest rate has probably allowed the continued enforcement of the cash administration regulations, issued in 1977 and revised in 1988.[28] Reminders to adhere to the regulations were issued in other years. As recently as in mid-1997, the Agricultural Bank of China prided itself on having strictly adhered to the cash disbursement plan in the first half of the year.[29]

This first finding is important because it statistically confirms a persistent control by the state over household decision on money holdings allocation. Our finding may be surprising in that two out of three *standard* stationary tests (mis)conclude that m_0 is non-stationary—this underlines the importance of properly accounting for seasonality to disentangle seasonal peaks from a pure random walk, which the standard stationary tests cannot do.

[28] See SC 28 Oct. 1977, SC 8 Sept. 1988, and PBC 12 Sept. 1988.
[29] See Zhongguo chengxiang jinrongbao, 21 July 1997.

C The enterprise circuit

Contrary to what we find in the household circuit, enterprise deposits are non-stationary (see Table 2). It is a first indication that economic reforms implied increasingly autonomous enterprise decisions. In the pre-reform economy, enterprise deposits were simply a reflection of the commodity inventory system; they depended on production. In the reform period, even the state-owned enterprises have become highly profit-oriented and ceased enjoying a soft budget constraint. As a consequence enterprises gradually gained decision-making authority on their deposits.

Therefore, we can test the inclusion of different hypothetical determinants in a cointegrating vector. The top half of Table 3—based on equation (1) and the explanations in the section on the five hypotheses above —summarizes the explanatory variables we will use to capture our hypotheses in the enterprise circuit.

Table 3 Explanatory Variables (page 56)

In order to check the robustness of our results, we try different alternative variables to capture our hypotheses. For example, as deposits came to fund not only production but also investment, the transaction motive is captured alternatively with the nominal industrial production and with investment[30]. To be consistent with the transaction motive, the monetization trend is the same squared variable (industrial production or investment). The complementarity hypothesis runs that deposits are positively related with the real return on capital, proxied with two alternative variables, the real growth rate of industrial output and the real 5-year deposit interest rate. Two different interest rates are included to test the opportunity cost hypothesis. Lastly, the effect of the credit plan constraint is tested with the introduction of short-term loans, a maturity specific to the production sector.

Proceeding to the cointegration tests, the research question of this paper is the stability of money demand in China. More precisely we focus only on the long term relationship to test whether it is time-varying. Therefore, for the linear specification, cointegration tests rely on Engle and Granger (1987) tests using Phillips and Ouliaris (1990) critical values.

The results are presented in Table 4 (The term "included" denotes variables initially included in a vector in which cointegration was *rejected*; a Schwartz criterion is used to select the optimal cointegration relationship).

Table 4 Linear Demand for Money in the Enterprise Circuit (page 57)

First, regarding the transaction motive, cointegration is rejected when investment is used as a transaction variable (all spec 3), while almost always accepted when the nominal industrial output is used (spec 1a, 2a and 2b). It means that the proper variable to proxy corporate spending is the nominal industrial output. In addition, the monetization trend is significant and positive (spec 1a, 2a and 2b). This result confirms that deposits have been increasingly used for settling transactions. The fact that the estimated monetization coefficient is close to zero implies that monetization does not level off towards the end of the period. It means that the monetization process is not yet completed in this circuit. In fact, the growth of money balances decreases relatively to the volume of transactions when agents use other assets than deposits as a store of value. But as we will see in the next paragraph, we find that money is complementary to capital in China. As a result, agents have less incentive to economize on deposits.

To test the complementarity hypothesis, we proceed with two variables. When we use the real 5-year deposit interest rate as a proxy for the real return of capital, it is cointegrated but negatively correlated with enterprise deposits (spec1a). The negative sign cannot be interpreted as a complementarity effect because the complementarity hypothesis holds only if the correlation is positive. It probably acts more as a measure of opportunity cost, playing out in addition to the interest rate already included in the regression. When we switch to the real growth of industrial output as a measure to test the complementarity hypothesis, it turns out to be positively cointegrated with enterprise deposits, which means that money demand is affected by a complementarity effect (spec 2a and 2b). More precisely, money finances investment projects, a result which is consistent with the high share of own funds in total funding of investment in fixed assets in China.

Fourth, regarding the opportunity cost, enterprise deposits and both interest rates cointegrate with a negative sign and similar coefficients (spec 2a and 2b). It means that enterprise have an opportunity cost of holding money.

Fifth, regarding the credit plan, the existence of a cointegration vector including only enterprise deposits and short-term loans is strongly rejected, which precludes any argument of purely state-determined money holdings (specification 4). However, when other determinants are included, enterprise deposits cointegrate positively with short term loans (spec 1a, 2a and

[30] We do not include both variables in the same vector to avoid collinearity issue.

2b). In a market economy, loans are cointegrated to deposits because loans are funded with bank deposits. However the existence of the credit plan suggests the opposite direction: the volume of loans determines deposits. We can check if we find a cointegrated and significant relationship when credit is the dependent variable. If there were a cointegration vector when credit is explained by enterprise deposits (plus other variables) then we cannot have a clear-cut conclusion on which variable affects the other. As it turns out, enterprise deposits are not a significant explanatory variable for short term credit: the existence of a cointegration vector is systematically rejected.[31] In contrast, the short-term loan variable is a significant cointegrated explanatory variable to enterprise deposits (spec 1a, 2a and 2b). This result suggests a persistent effectiveness of the credit plan over money holdings during the period of estimation. In order to discriminate between specifications 2a and 2b, we use the standard Schwartz criterion which leads us to select specification 2a (-4.6 vs. -4.5 respectively).

To summarize, the linear results confirm that economic reforms implied increasingly autonomous enterprise decisions regarding their deposits. Deposits came to fund production and demand for transaction balances has accelerated because of monetization during the reform period. The opportunity costs of holding money began to matter. The significance of the credit variable suggests that state-owned enterprise deposits were probably determined by the credit plan. In turn, as the non-state sector expanded and credit from the banking sector was no longer guaranteed, the complementarity hypothesis gained ground: non-state enterprises saved in order to accumulate the funds necessary for investment.

D Aggregate money demand (M1)

The gradual abandonment of the concept of two circuits by policy makers has progressively created space for a more standard analysis of aggregate money demand. Therefore, we test the five hypothetical determinants in the demand for aggregate money to verify to what extent aggregate money holdings have been supply-determined. The bottom half of Table 3 summarizes the variables we use to capture the hypotheses in the standard monetary aggregate M_1.

As previously, we check the robustness of our results by testing several alternative specifications. We include five different standard measures of opportunity cost to compare with previous studies (Laurens and Maino, 2007, Bahmani-Oskoee and Wang 2007, Mehrotra

[31] The results are available upon request.

2006, Hafer and Kutan, 1994). When cointegration holds, we eliminate non-significant variables and we select the final specifications using a Schwartz criterion.

The estimations results are presented in Table 5. First, regarding the transaction motive, we find that the GDP is significantly cointegrated to M1 with a similar coefficient in all specifications. Second, the monetization trend (squared GDP) is significant and close to zero, as in the enterprise circuit.

Third, regarding the complementarity hypothesis, cointegration is rejected between the real five-year interest rate and M1 (all specifications 3 and 4). However, we find strong cointegration evidence whenever the real growth of industrial output is included (all specifications 1 and 2 except specification 1d). The positive relationship between aggregate money holdings and the real return of capital suggests that money and capital are complementary, i.e. money is accumulated before investment projects can be undertaken.

Fourth, regarding the opportunity cost, all different interest rates negatively cointegrate with M1, which suggests an opportunity cost effect (all specifications 1 and 2 except 1d). In turn, the spread between the Chinese and the US interest rate does not act as an opportunity cost, which is not surprising given the capital controls in China (specification 1d). Fifth, regarding the credit plan, the variable short-term loan is found not significant in three out of four specifications (specifications 1a, 1b, 1e). Therefore we proceed with the estimation excluding this variable. Our preferred specification is 2a, which minimizes the Schwartz criterion.

Table 5 Linear Demand for M1 (pages 58-59)

To conclude the linear investigation, our institutional approach and original dataset yield new findings that allow a better understanding of the monetary sphere in China. First, the disaggregate approach points to the fact that autonomous decision-making on money has gained ground in the production sector only. The stationarity of household money holdings suggests that there is still significant state control over households' allocation choice. Second, we find a significant role of the credit plan in the enterprise circuit but no significant effect in the monetary aggregate. This finding may help to settle the debate about the credit plan's efficiency over the period: the state appears to have been able to influence money holdings of the state-owned-enterprises, which is reflected in the circuit estimation, but the effect cannot be detected at the aggregate level. In addition, our results identify that the main motivation of

holding money is to finance investment, a determinant that was neglected in previous studies. This effect holds in the disaggregate as well as in the aggregate spheres, which underlines its importance in explaining money holdings. This new finding is consistent with the high share of own funds in total funding of investment. In this sense, the Chinese economy shares a common pattern with most emerging economies due to the absence of deep financial markets (Pentecost and Moore, 2006). Lastly, our specification confirms the monetization process that occurred in the different circuits.

To what extent do the monetary aggregates of the planned economy exhibit stable relationships to other economic variables? And how sustained are these relationships over time? To answer, we will explore whether the weight of the different determinants in the linear relationship have changed during the period of estimation or not.

V Non linear tests and estimation procedures

A Non linear specification

We examine the time evolution of the different relationships (Eq. 1). To do so, we estimate a general specification of money holdings with a Time-Varying cointegration Smooth Transition Regression model (TV cointegration STR). This model allows us to relax the restricting hypothesis of a time-constant coefficient as follows:

$$y_t = \beta_0 + \beta_1 Transactions_t + \beta_2 Monetization_t + \beta_3 Complementarity_t + \beta_4^{(1)} Opportunity_t + \beta_4^{(2)} Opportunity_t \, g(T;\gamma,c) + \beta_5 Credit\ Plan_t + u_t \quad (2)$$

where u_t is a zero-mean stationary error term and $g(T;\gamma,c)$ is a continuous transition function bounded between 0 to 1 that only affects the variable $Opportunity$. More precisely, here the coefficient of the variable $Opportunity$ is allowed to vary with time T. We adopt a smooth transition function, and more particularly the standard logistic function of order 1:

$$g(T;\gamma,c) = \frac{1}{1+\exp\left[-\gamma(T-c)\right]} \quad , \gamma > 0 \qquad (3)$$

This function has an S-shape (Figure 6). The γ parameter determines the smoothness, i.e. the speed of the transition from one regime to the other. The higher, the value of the γ parameter, the faster (i.e sharper) the transition. This function allows a smooth transition between "ex-

treme regimes" defined by the coefficients $\beta_4^{(1)}$ and $\beta_4^{(1)} + \beta_4^{(2)}$. There is an infinite number of intermediate regimes in between defined as a weighted average of the parameters ($\beta_4^{(1)} + \beta_4^{(2)}\ g(T;\gamma,c)$). For example, if we find that the estimated coefficient $\beta_4^{(2)}$ is negative, it means that the absolute value of opportunity cost is greater than at the beginning of the period. To simplify the presentation, Eq. (3) is a particular specification where the transition function only affects one explanatory variable. Of course it is possible to extend its impact to all explanatory variables. In the estimation, we allow all coefficients to vary with time, so that we are able verify the different hypotheses of the institutional background and their evolution. The intuition is the following: the disbandment of the two circuits has progressively created space for a more standard analysis of aggregate money demand. The transition has been gradual. The institutional analysis allowed us to identify the main evolutionary trends during the transition period. Finally our estimation should help us to provide a functional form of the transition towards a standard money demand relationship.

Figure 6 Transition function with c =0. Sensitivity analysis to the slope parameter γ (page 52)

B Linearity Test and estimation

The estimation of a TV- cointegration STR model is computed in two stages.[32] The first step is to test the null hypothesis of coefficients constancy or the linearity of the model (Choi Saikkonen, 2004). If it is rejected, we can then estimate a threshold specification (Choi Saikkonen, 2004b). To explain each step more precisely, we consider the following cointegration STR specification with only one explanatory variable:

$$y_t = \beta_0 + \beta_1 x_t + \beta_2 x_t g(T;\gamma,c) + \sum_{j=-K}^{K} \pi_j \Delta x_{t-K} + u_t \quad (4)$$

where $g(T;\gamma,c)$ is a continuous logistic transition function, x_t is the explanatory variable. Finally, K lead and lag terms are added to the specification to resolve the serial and contemporaneous correlation between regressors and error terms and the error term u_t is stationary.

The statistical tests proposed by Choi and Saikkonen (2004) extend previous tests of linearity against STR models. Testing for linearity in a cointegrating STR model (equation 4)

[32] Estimation of a TV cointegrating STR model is identical to estimation of a cointegrating STR model, with the only difference being that the threshold variable is known: it is time.

can be done by testing H_0: $\gamma = 0$ or H_0: $\beta_2 = 0$. In both cases, the test is non-standard since the cointegrating STR model contains unidentified nuisance parameters under H_0 (Davies, 1987). The usual solution is to replace the transition function $g(T;\gamma,c)$, by its first-order Taylor expansion around $\gamma = 0$ and to test an equivalent hypothesis in an auxiliary regression:

$$y_t = \theta_1 x_t + \theta_2 x_t g(T;\gamma,c) + \sum_{j=-K}^{K} \rho_j \Delta x_{t-K} + \varepsilon_t \qquad (5)$$

where ε_t is the Taylor series approximation error. In these auxiliary regressions, parameters θ_2 is proportional to the smooth parameter γ of the transition function. Thus, testing the linearity against the cointegration STR model simply consists of testing H_0: $\theta_2 = 0$ in (5) for a logistic function. To do so, Choi and Saikkonen (2004) proposed to use a LM test which follows a standard chi square limiting distribution with p degrees of freedom where p is the number of explanatory variables affected by the transition function.

When the null hypothesis of linearity is rejected, a cointegrating STR model can be estimated. Standardly in a stationary context, the estimation method of a smooth transition regression model is non linear least squares (NLLS). However, Choi and Saikkonen (2004b) have studied the statistical properties of the NLLS methodology in a cointegrating STR without leads and lags. They show that under the regressor-error dependence the asymptotic distribution of the NLLS estimator for the cointegrating STR model involves a bias. To circumvent the subsequent inefficiency of NLLS estimator, they propose a Gauss–Newton type estimator that uses the NLLS estimator as an initial estimator and is based on nonlinear regressions augmented by leads and lags.

More precisely, the first step consists in estimating all the parameters without leads and lags by the NLLS methodology (see van Dijk, Terasvirta and Franses, 2002). A practical issue that deserves special attention in the estimation of the STR model is the selection of starting values of the parameters in the transition function. To improve the algorithm convergence, we apply a densely grid search to get the "good" starting value of (γ, c). [33] These estimators will be then used to obtain an efficient two step estimators based on the leads and lags modification.

[33] Given a couple of (γ, c), the estimation of the slope coefficients β_{i1} and β_{i2} is obtained by ordinary least square. We use the values of the threshold variable q_t between the first and the third quartile for the location parameter and 50 positive values in majority near zero for the smooth parameter since the transition is very quickly sharp.

The Gauss-Newton estimator is defined by:

$$\begin{bmatrix}\hat{\theta}\\ \hat{\pi}\end{bmatrix} = \begin{bmatrix}\tilde{\theta}\\ 0\end{bmatrix} + \left(\sum_{t=K+1}^{T-K} \widetilde{p_t}\widetilde{p_t}'\right)^{-1} \sum_{t=K+1}^{T-K} \widetilde{p_t}'\widetilde{u_t}$$

where $\tilde{\theta} = [\,\tilde{\beta}_0\ \tilde{\beta}_{j1}\ \tilde{\beta}_{j2}\ \tilde{\gamma}\ \tilde{c}]'$ is estimated by the NLLS methodology, $\widetilde{u_{tT}}$ are the NLLS estimated residual and $\widetilde{p_t} = \left[\tilde{K}\ (x_t)'\ \ V_t'\right]$ with $V_t = [\Delta x'_{t-K} \ldots \Delta x'_{t+K}]'$ and:

$$\tilde{K}\ (x_t) = \begin{bmatrix} 1 \\ x_t \\ x_t\ g(T;\tilde{\gamma},\tilde{c}) \\ \beta_2 x_t\ \dfrac{\delta g(T;\tilde{\gamma},\tilde{c})}{\delta\gamma} \\ \beta_2 x_t\ \dfrac{\delta g(T;\tilde{\gamma},\tilde{c})}{\delta c} \end{bmatrix}$$

Choi and Saikkonen (2004b) show that this Gauss–Newton estimator eliminates the bias and has a mixture normal distribution in the limit. This result is important because it implies the estimator efficiency and that standard hypothesis tests can be performed. In the next Section, we present the time-varying estimations results.

VI Non-linear money demand

The first step in our testing strategy is to test the linear specification of money holdings against an alternative specification with time-varying coefficients. Under the null hypothesis, we use the optimal cointegration relationships obtained in each circuit in the linear estimations (Spec 2a in Table 4 and Table 5). We test the linear specification against the alternative TV-cointegrating STR model in Eq. 4. If linearity is rejected, the second step consists in estimating a time-varying relationship.

A The Enterprise circuit

In specification 2a we already capture a determinist non-linearity through the inclusion of the monetization trend (the square of the transaction variable). This approach is usual in the literature and satisfying to account for the acceleration of income elasticity during the monetization process. Now we would like to relax the stability hypothesis upon the other determinants.

Therefore, in specification 2a, we allow the coefficients of three variables to vary with time: short-term loans, the complementarity hypothesis, and opportunity cost.[34]

We follow Choi and Saikkonen (2004) and test linearity against the TV-cointegrating STR including from one to three leads and lags (K=1 to 3). As in Choi and Saikkonen (2004), we reject the hypothesis of linearity if the LM test rejects the null for at least one value of K. Results in Table 6 indicate that linearity is rejected with all lags (t_1 = 8.9, 8.1, 9.0 respectively, which follows a $\chi^2(3) = 7.81$ at a 5% significant level). To check the robustness, we also test specifications allowing only two coefficients to vary. The conclusion is not affected. We can proceed with the estimation.

Table 6 reports the estimated value of the parameters: the location parameter, c, the smooth parameter, γ, and the coefficients in the extreme regimes.[35] Two preliminary comments are already possible. First, all coefficients are significant in regime 2, which means that they have all been modified over the period. Second, the value of γ is 0.66, implying a relatively smooth slope. Lastly, the location parameter is c= 35.7 which indicates that the transition has taken place 36 quarters after the beginning of our sample, i.e. during the nineties after the 1993 reform.

Figure 7 shows the evolution over time of the coefficients of the demand for money in the enterprise circuit. In order to show more precisely the transition mechanism, we plot the coefficient of the different determinants with a focus on the period 1990 through 2000. The impact of the coefficients changes over the period, with an obvious overall transition between 1993 and 1997. Lee and Chien (2008) who estimated a standard demand for money detected a structural change in 1993. Our location parameter is therefore consistent with their finding although we show that the reform process lasted four years until 1997.

Regarding the credit plan, its influence over money holdings in the enterprise circuit has faded away from $\beta_1 = 0.26$ to $\beta_1 + \beta_2$ =0.02. This is a strong finding because it means that the credit plan has been completely dissolute at the end of the 1990s. In sum, in the 2000s, monetary policy has not significantly relied on this quantitative tool to control money holdings in the productive sector.

Regarding the complementarity hypothesis, we find that the coefficient is significant, positive, and increases from $\beta_1 = 0.53$ to $\beta_1 + \beta_2$ =0.91. More precisely it is the first de-

[34] Despite a large range of initial parameters, the inclusion of four variables in the transition does not yield a correct algorithm convergence.

terminant over the entire period and its weight has increased. This time evolution means that the main motivation of enterprises' money holdings has been to finance investment and this motivation has become greater over the period.

Regarding the opportunity cost, the coefficient of the interest rate is negative (first regime coefficient $\beta_1 = -0.88$) implying an opportunity cost of holding money, from the beginning, in the enterprise circuit. In the second regime, it is still significantly negative and only slightly smaller in absolute terms than before, with a coefficient of $\beta_1 + \beta_2$ =-0.60.

Figure 8 plots the monetization process in the enterprise circuit. The chart confirms that the growth of money balances has not decreased relatively to the volume of transactions in the enterprise circuit. It is consistent with the finding that money is complementary to capital in China.

To check the robustness of our results, we estimate an alternative model. Since the interest rate coefficient has the smallest variation in proportion, we impose its stability. We consistently obtain the same qualitative dynamics: the complementarity hypothesis significantly increases while the credit plan influence disappears.[36] The location parameter is similar (c= 38) which confirms that the transition has taken place during the nineties after the 1993 reform.

To conclude, the reason for holding money in the productive sector is to finance investment projects. This is due to limited access to credit, which explains why we find that the credit plan is not an effective monetary instrument anymore. Most enterprises finance investment with their own funds and are therefore not sensitive to credit tightening. The increasing influence of this motivation during the 2000s can probably be explained by low real interest rate, implying that enterprises have earned a higher real return when money financed investment rather than interest-bearing assets. It can also explain why the opportunity cost has not gained weight during the period in the enterprise circuit.

Table 6 Non-Linear Demand for Money in the Enterprise Circuit (page 60)
Figure 7 Time-Varying Coefficients of the Demand for Money in the Enterprise Circuit Link (page 52)
Figure 8 Time-Varying Coefficients of the Demand for M1 (page 53)

35 For the sake of parsimony, we present only the results including one lead and lag. Other results are available upon request.

[36] Imposing the stability of another coefficient does not alter the evolution patterns. The results are available upon request.

B Aggregate money demand (M1)

We allow every coefficient to vary except the monetization trend. The results reported in Table 7 indicate that linearity is rejected with lags 2 and 3 (t_1 = 7.74 and 10.35, respectively, which follow a $\chi^2(3) = 6.25$ at a 10% significant level). It is also rejected in the specifications with only two time-varying coefficients.

As previously, all coefficients are significant in regime 2, which means that they have all been modified over the period. The value of γ is 0.28, implying a smoother transition than in the enterprise circuit. This smoother transition is clear in Figure 8 which plots the evolution of all coefficients for the period 1990 through 2000. The beginning of the transition in the case of M1 is consistent with the previous case of the enterprise circuit, which confirms the influence of the financial and monetary reform in 1993. Because the transition is smoother in the aggregate, the transition ends around 2000.

Regarding the transaction motive, the coefficient of GDP decreases from $\beta_1 = 0.13$ to $\beta_1 + \beta_2$ =0.5. This decrease is less pronounced when the coefficient of GDP is summed up to the positive coefficient of the monetization trend. Figure 9 pictures the monetization process. We observe that the growth of deposits has almost not decreased relatively to the volume of transaction over time.

Regarding the complementarity hypothesis, its increasing influence found in the enterprise circuit is confirmed. The coefficient strongly increases from $\beta_1 = 1.08$ to $\beta_1 + \beta_2$ =1.6. In the case of M1, it is also the first determinant of money holdings and the estimator is significantly high in comparison with other developing economies.[37] It means that it is a salient feature of the Chinese economy. We find that money has increasingly worked as a complement to capital over the period.

Regarding the opportunity cost effect, contrary to the enterprise circuit, the opportunity cost is almost zero before the transition ($\beta_1 = -0.04$) and becomes significant and negative only later ($\beta_1 + \beta_2 = -0.19$). This means that the deposit interest rate has worked as a significant opportunity cost only in the 2000s. However the estimated coefficient is low in comparison with the complementarity effect (-0.19 versus 1.6). Thus, the opportunity cost of holding money is still not a prominent incentive to choose the level of money holdings. It is interesting to observe that our linear results indicated a significant opportunity cost over the

[37] For example, the coefficient was estimated at 0.057 and 0.07 for India and Pakistan by Pentecost and Moore (2006) Thornton and Pouydal (1990) respectively.

entire period (the linear estimated coefficient value was -0.12, i.e. inside the interval between the two extreme regimes). As mentioned above, previous studies also find a significant opportunity cost during the 1990s (Bahman-Oskoee and Wang, 2007). Our non-linear result that the interest rate starts being significant only in the 2000s underlines the importance to properly account for linearity.

The qualitative dynamics are confirmed in a specification imposing a stable coefficient upon GDP: the interest rate is close to zero and becomes negative and significant only after the reform, while the complementarity effect increases (Table 7).

In sum, the non-linear estimation underscores the emergence of opportunity costs only after the wave of financial reforms in the 1990s; even after the dissolution of the credit plan, the interest rate is still a minor monetary policy instrument in China; and our result highlight the increasing role of self-finance to explain money holdings in China. This last finding reflects the documented increasing gap between real economic growth and the slow development of financial intermediation in China (Podpiera 2006, OECD 2005). The limited access to loanable funds combined with the low real interest rates gives an incentive to accumulate money in order to finance investment. This pattern obviously limits the scope of the monetary policy, a policy implication that we comment on in the conclusions.

Table 7 Non-Linear Aggregate Demand for Money (M1) (page 60)
Figure 9 Monetization Trend of the Demand for Agregate Money (M1) (page 53)

VII Conclusions

This paper estimates long run, equilibrium money demand functions for China from 1984 to 2010, explicitly taking into consideration the changes in the institutional characteristics of China's financial system and allowing for a non-linear functional form. Given the slow progress of reform in the monetary system, a central question of the paper is to what extent China has a meaningful demand for money.

To do justice to the origins of China's current monetary system, we examine the disaggregate money balances in both household and enterprise circuits. Then we estimate the demand for M1. To do so, we use a constructed dataset with quarterly frequency spanning from 1984 to 2010. Given the seasonal patterns in several series, we use the seasonal unit-root test developed by Hylleberg et al. (1990) to disentangle seasonal peaks from a pure random

walk. Lastly, we use the cointegrating Time-Varying Smooth Transition Regression (TV-STR) model proposed by Choi and Saikkonen (2004). Our novel procedure and extensive dataset yield new results.

First, in the household circuit, the consideration of seasonal unit roots yields statistical evidence of persistent state control over household decision on the allocation of money holdings. Contrary to *standard* stationary tests used in much of the earlier literature which (mis)conclude that currency in circulation (m_0) is non-stationary, our seasonal unit-root test reveals that m_0 and household deposits are stationary. They vary steadily along an upward trend. This property suggests that household have an infinite demand for money at prevailing interest rates.

In contrast, economic reforms resulted in a profit-oriented corporate sector, a fact that has given enterprises an incentive to gain autonomy on their money holdings. Our non-linear methodology finds that in the enterprise circuit the credit plan has ceased being a significant driver of money holdings in the 2000s. In turn, we find that the main motivation to hold money balances is to finance investment, a factor that was ignored by the earlier literature. This motivation has become more prominent over the period, which can be explained by the limited access to credit and the low real interest rate in China.

Lastly, in our final aggregate money demand estimation, we find that the deposit interest rate has gained only a minor role as a monetary instrument during the 2000s. This is probably due to the fact that money is a complement rather than a substitute to capital in China. In fact, aggregate estimation confirms the increasing influence of the complementarity effect upon money holdings.

Our results have policy implications. The later in the period, the more the demand for money fits standard theory in China. As a consequence, we suspect that China's central bank had good reasons to adopt money supply targeting by 1999 only. However, the environment of negative or low real interest rates has limited the scope of monetary policy. On the one hand, market-based interest rates are necessary to turn the infinite money demand of households into a rational allocation choice of their money balances. This will extend the central bank's influence upon the real economy. The further development of government and corporate bonds market may advance the transition toward market-based interest rates. On the other hand, the Chinese banking system has only played a limited intermediary role between savings and productive investments. Consequently, the monetary policy can not use the credit channel to influence the real economy in the short run. Moreover, a properly regulated bank-

ing system is also likely to be more efficient in allocating savings to investment than self-finance is. Lastly, the Chinese banking system has not yet reaped the benefits of the extraordinary dynamism of the real sector. In contrast, bank loans have kept on financing poor-performing projects, a fact that has led to considerably deterioration in bank balance sheets and is posing a serious threat to the project of harmonious growth in China.

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Figures

Figure 1 Enterprise and Household Circuits in the Centrally Planned Economy

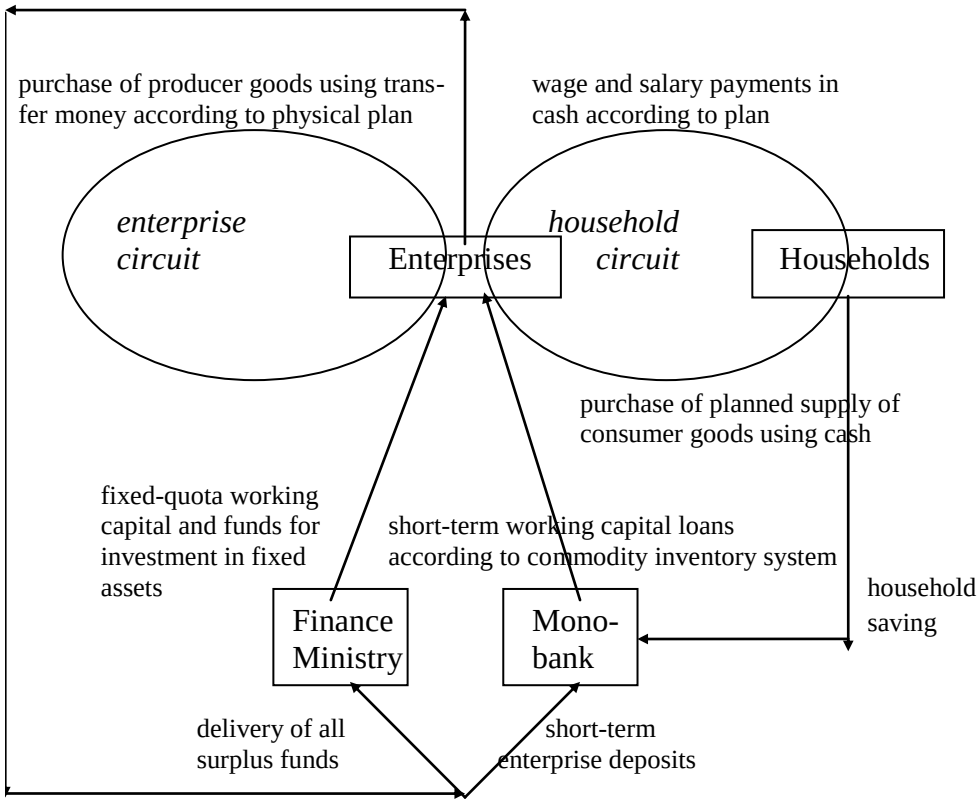


Figure 2 Enterprise and Household Circuits after Reform

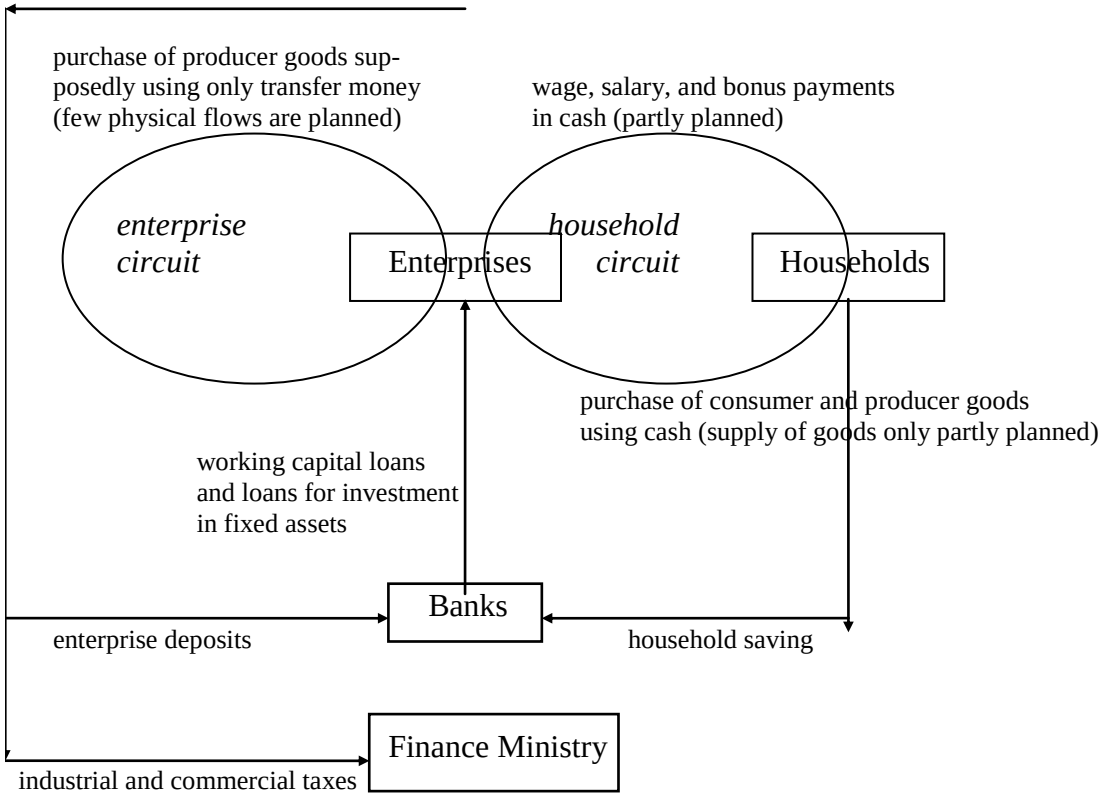
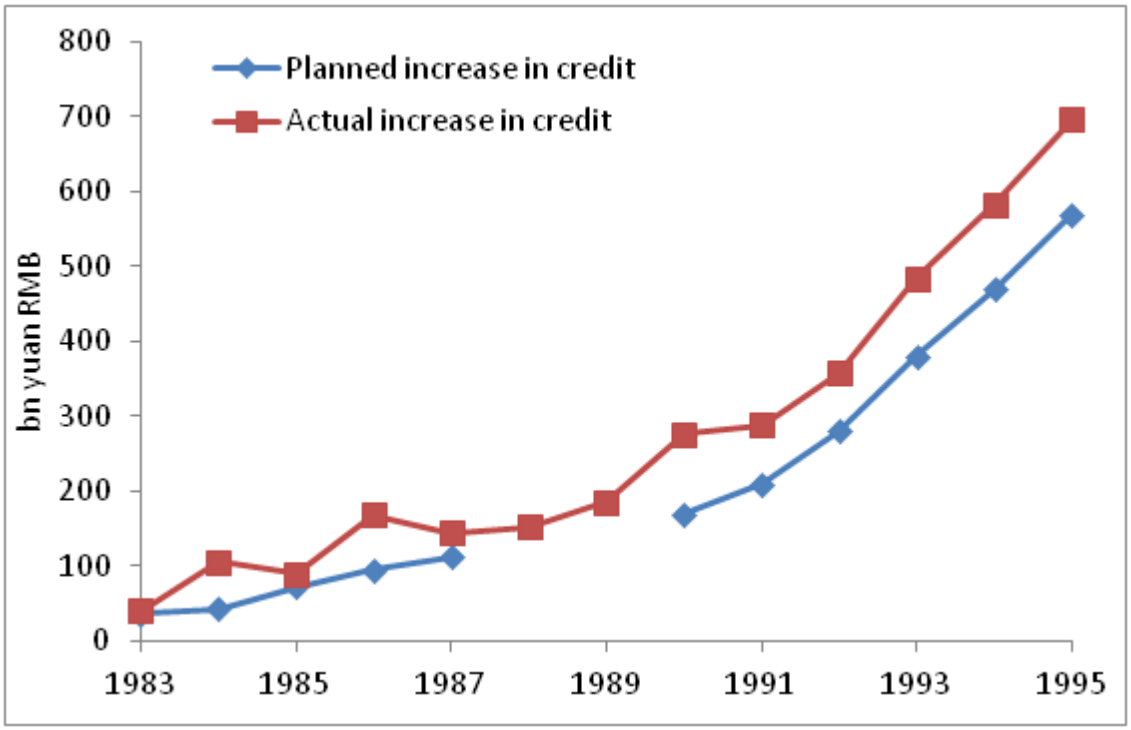
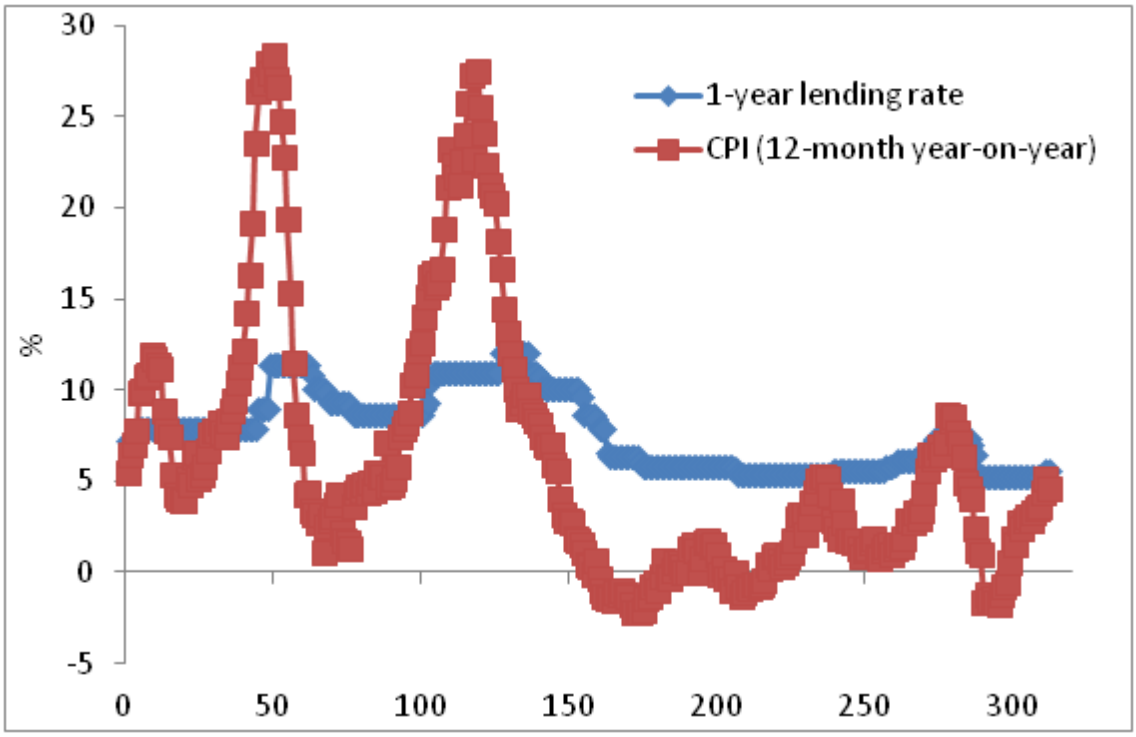


Figure 3 State Banks: Planned vs. Actual Change in Credit



Note: Fan (1993) is the source for all planned change in credit data 1983-1992, NPC 31 March 1993, 11 March 1994, and 18 March 1995 for 1993, 1994 and 1995. The actual change in credit data in Fan 1993 (who presents data for the years 1983 to 1992) differs slightly from the one used here (from the Statistical Yearbook and China Financial Statistics) in an unsystematic fashion in the years 1983-85 and 1992. Potential reasons are different years for the inclusion of the Construction Bank of China in the state bank balance sheet in the early 1980s, and possibly the inclusion of other financial institutions than state banks in Fan (1993) in 1992. It is assumed here that the planned credit figure covers state banks only, which may no longer be true in the 1990s; if planned credit in the mid-1990s were to include all financial institutions in China, then the actual credit figure in this graph is too low (since it only covers state banks).

Figure 4 Lending Rate and CPI



Monthly observations: Observation 1 is January 1985, observation 336 December 2010.

Figure 5 Selection of data (in billion Yuan, current prices if not mentioned otherwise)

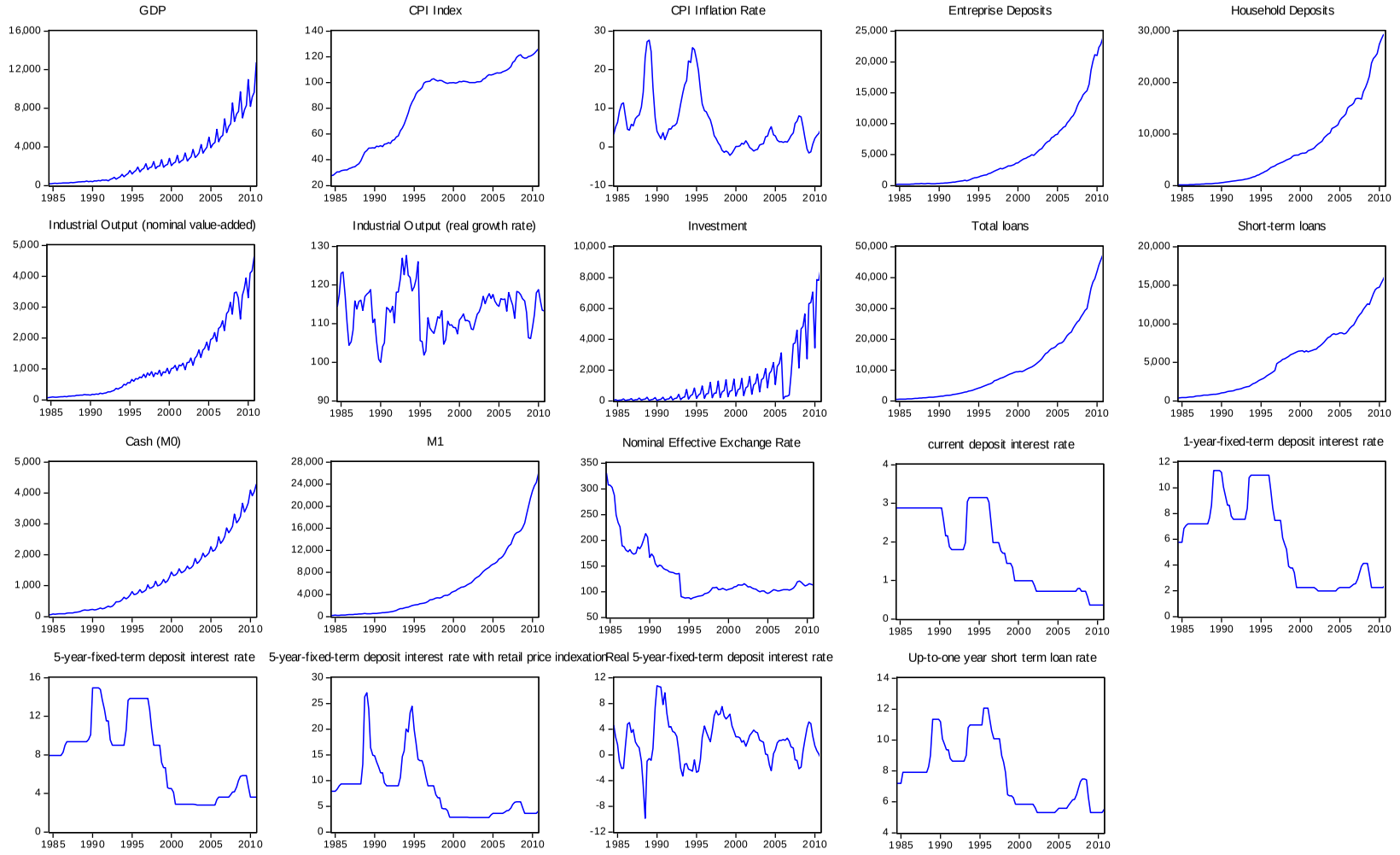


Figure 6 Transition function with c =0. Sensitivity analysis to the slope parameter γ

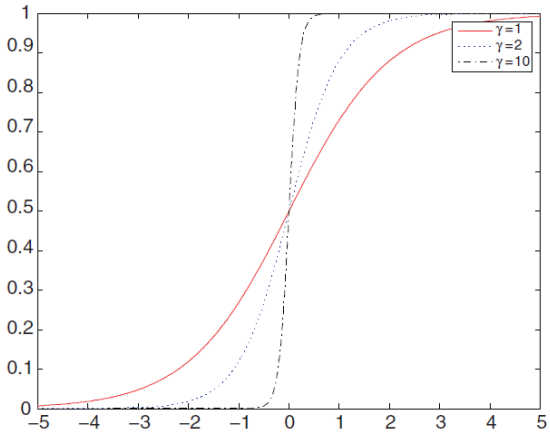


Figure 7 Time-Varying Coefficients of the Demand for Money in the Enterprise Circuit

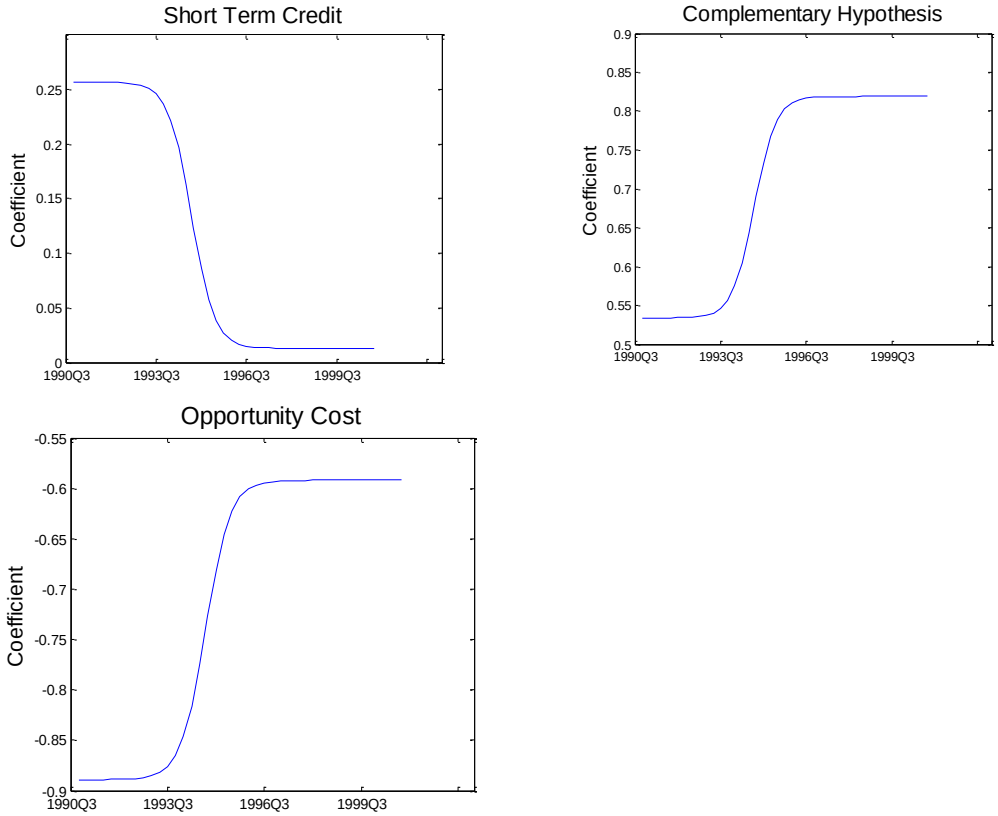


Figure 8 Time-Varying Coefficients of the Demand for M1

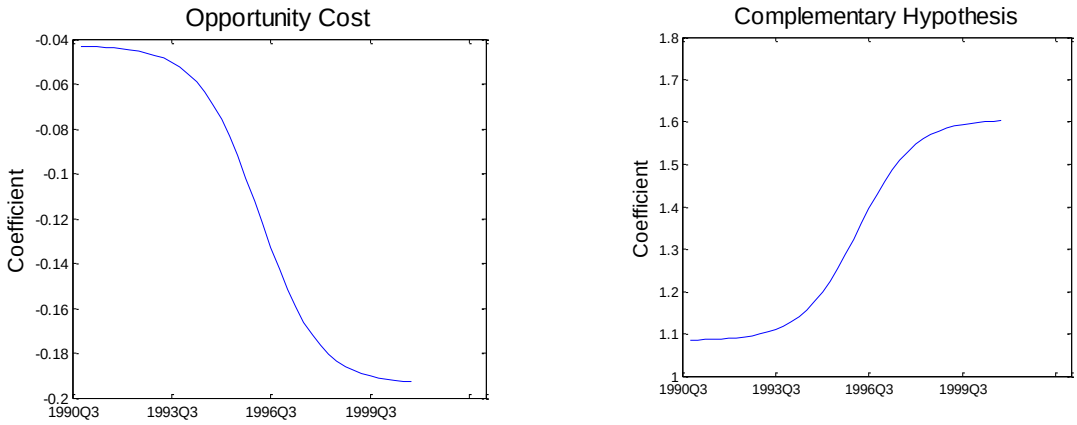
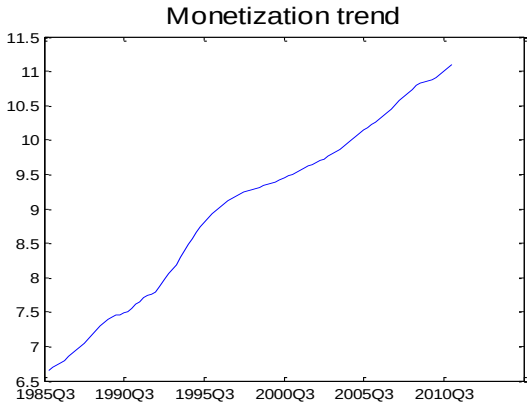


Figure 9 Monetization Trend of the Demand for Agregate Money (M1)



Tables

Table 1 Disbursements and Receipts of Cash by State Banks

		In % of total disbursements (or receipts) per annum														
		1	2	3	4	5	6	7	8		10	11	12	13	14	15
Disburse-ments	Total (b yuan)	Sal., wages	Agr. proc.	Admin . units				RCC	TVE ent.	Self-empl.	Sa-vings	UCC	Remitt .	Others	Curr. in circul.	D - R
Receipts					Goods	Services	Tax								(b yuan)	(b yuan)
1978 D	135.26	45.6	9.5	6.5	X	X	X	21.9	X	X	9.6	X	2.8	4.0		
R	133.60	X	X	X	71.3	7.9	0.4	4.1	X	X	10.7	X	2.0	3.7	21.20	1.66
1985 D	569.48	31.4	14.7	6.4	X	X	X	19.2	3.0	1.0	17.7	X	1.6	5.0		
R	549.91	X	X	X	52.1	5.8	0.7	10.6	1.5	0.7	22.6	X	1.5	4.6	98.78	19.57
1986 D	684.39	31.5	14.8	6.0	X	X	X	17.9	3.2	1.0	19.2	X	1.6	4.8		
R	661.33	X	X	X	49.6	5.8	0.7	10.5	1.5	0.6	25.1	X	1.4	4.7	121.84	23.06
1987 D	901.57	27.9	13.2	5.9	X	X	X	16.9	3.6	1.3	23.4	0.8	1.5	5.7		
R	877.96	X	X	X	44.4	5.6	0.7	10.2	1.7	0.8	29.2	0.8	1.5	5.1	145.45	23.61
1988 D	1349.0	23.6	11.1	5.9	X	X	X	14.3	3.4	1.3	30.1	1.4	1.5	7.4		
R	1281.1	X	X	X	40.7	5.1	0.6	8.2	1.8	0.9	33.8	1.1	1.5	6.3	213.40	67.95
1989 D	1526.8	24.1	10.1	6.1	X	X	X	11.8	3.0	1.3	32.9	1.5	1.5	7.8		
R	1505.8	X	X	X	36.4	5.2	0.7	7.3	1.6	0.8	38.0	1.4	1.5	7.0	234.40	21.00
1990 D	1747.1	23.9	10.0	6.3	X	X	X	11.1	2.9	1.2	33.3	1.5	1.6	8.1		
R	1717.1	X	X	X	33.1	5.6	0.7	7.9	1.6	0.8	40.2	1.6	1.7	6.7	264.44	30.04
1991 D	2199.9	22.1	8.5	6.3	X	X	X	11.1	3.0	1.3	36.1	1.6	1.6	8.3		
R	2146.5	X	X	X	30.8	5.6	0.7	7.7	1.7	0.9	41.9	1.9	1.9	6.9	317.78	53.34
1992 D	3240.6	18.8	5.7	6.4	X	X	X	10.3	3.0	1.4	41.1	1.9	1.8	9.5		
R	3124.8	X	X	X	26.6	5.3	0.6	6.6	1.7	0.8	45.4	2.0	2.0	8.8	433.60	115.82
1993 D	5041.3	15.8	4.5	6.8	X	X	X	8.4	2.7	1.5	45.3	2.6	1.7	10.7		
R	4888.4	X	X	X	23.0	5.0	0.6	5.9	1.8	0.9	48.5	2.6	1.7	10.2	586.47	152.87
1994 D	7267.1	15.4	4.3	6.5	X	X	X	6.1	2.8	1.7	47.4	2.9	1.7	11.2		
R	7124.7	X	X	X	20.2	4.8	0.5	4.7	2.1	1.2	51.7	3.2	1.8	9.8	728.86	142.39
1995 D	9672.6	13.3	3.7	5.8	X	X	X	4.8	2.7	1.9	51.1	3.0	1.7	12.0		
R	9732.2	X	X	X	17.8	4.3	0.5	3.8	2.2	1.5	54.3	3.7	1.9	10.0	788.54	59.68

Notes:
1: Salaries and wages
2: Procurement of agricultural and sideline products
3: Management expenses of administrative units
4: Sales of goods
5: Sales of services
6: Tax income
7: Rural credit cooperatives (cash disbursements vs. receipts)
8: Township and village enterprises (expenditures vs. receipts in cash)
9: Business-related expenses vs. receipts of self-employed
10: Savings withdrawals vs. deposits
11: Urban credit cooperatives, since 1994 “other banking institutions” (cash disbursements vs. receipts)
12: Remittances (outgoing vs. incoming)
13: Other disbursements vs. receipts
X: Entry not meaningful or values below 0.05%.

Sources: *China Financial Statistics 1952-1987*; *Finance Yearbook 1994*; *Statistical Yearbook 1996*.

Table 2 Standard and Seasonal Unit Root Tests

	Dickey Fuller	Phillips Perron	KPSS	HEGY				
				γ_1	γ_2	γ_3	γ_4	$\gamma_3 \cap \gamma_4$
GDP	-1.86 (c)	-7.55*** (c)	0.18** (c)	-1.97 (e)	-2,31	0.30	-3.35***	5.68*
Industrial Output	-2.32 (c)	-4.35*** (c)	0.18** (c)	-2.40 (e)	2.73*	-1.90	-1.78*	3,46
Entreprise Deposits	-0.43 (b)	-0.56 (b)	1.16***(b)	-1.75 (e)	-9.27***	-2.90	-5.58**	22.3***
Household deposits	-1.43 (b)	-4.56*** (b)	0.30*** (c)	-3.22** (d)	-2.83*	-2,59	-4,6	15.7***
Cash (m_0)	-2.02 (c)	-1.98 (c)	0.29*** (c)	-2.83* (d)	-2,05	-3,09	-2.82**	9.65**
M1	-2.12 (c)	-2.02 (c)	0.25*** (c)	-1.94 (e)	-10.8***	-2.58	-5.63***	21.4***
CPI Index	-3.28* (c)	-1.99** (a)	0.07 (c)	-3.25* '(c)	-6.12***	-1.57*	-9.53***	50.7***
Current deposit interest rate	-2.39 (c)	-2.18 (c)	0.14** (c)	-2.38 (c)	-7.33***	-3.78***	-6.12***	33.6***
1-year-fixed-deposit interest rate	-1.05 (a)	-1.07 (a)	0.92*** (b)	-2.02 (c)	-7.18***	-3.45***	-6.76***	36.5***
5-year fixed-term deposit interest rate	-3.43** (c)	-2.78 (c)	0.10 (c)	-2.70 (c)	-5.57***	-2.57**	-8.16***	43.7***
5 year fixed-term deposit interest rate with retail prices indexation	-3.72** (b)	-3.41*** (b)	0.06 (b)	-4.09*** (b)	-4.15***	-3.33***	-4.19***	14.0***
Real 5-year-fixed-term deposit interest rate	-2.24 (c)	-0.84 (a)	0.12* (c)	-4.25*** (b)	-4.32***	-3.04***	-4.65***	15.5***
Up-to-one-year short term loan rate	-2.36 (c)	-2.14 (c)	0.13* (c)	-1.82 (b)	-4.72***	-3.52***	-3.80***	13.7***
Real growth rate of industial output	-3.77*** (b)	-3.88*** (b)	0.08 (b)	-2.75* (c)	-5.58***	-7.14***	-6.11***	44.9***
Real growth of disposable income	-6.37*** (b)	-6.45*** (b)	0.11 (b)	-4.90** (c)	-6.74***	-9.21***	-1.58*	47.2***
US vs. China Interest rate spread	-2.02** (a)	-1.94** (a)	0.10 (b)	-2.34** (a)	-5.61***	-4.85***	-7.65***	-
CPI Inflation rate	-2.56 (c)	-3.32** (b)	0.11 (b)	-3.28*(c)	-6.16***	-2.02**	-9.58***	53.5***
Investment	-3.52** (c)	-9.40*** (c)	0.06 (c)	-3.74** (e)	-4.05***	-6.24***	-4.77***	45.5***
Household Disposable Income	-1.17 (b)	-1.36 (b)	1.13*** (b)	-0.99 (d)	-3.99***	-6.01***	-1.34	19.0***
Living Expenditures	2.58 (a)	-2.61 (c)	0.23*** (c)	-1.08 (d)	-3.94***	-4.43***	2.74***	13.6***
Total Loans	-1.72 (b)	-2.02 (c)	0.26*** (c)	-1.90 (c)	-9.18***	-3.61***	5.38***	25.4***
Short-term Loans	-2.45 (b)	-2.88** (b)	0.27*** (c)	-1.81 (b)	-4.72***	-3.53***	-3.80***	13.9***
Retail Sales	-3.10 * (c)	-4.20*** (c)	0.11* (c)	-2.54 (e)	-2,38	-3.53***	-3.28***	12.7***

As usual, all variables in small letters denote variables in logarithm. Specification including: (a) no intercept no trend, (b) intercept, (c) intercept and trend (d) intercept and seasonal dummy, (e) intercept, trend and seasonal dummy. Null hypothesis : unit root in Dickey Fuller and Philips Perron tests; stationarity in KPSS.

Table 3 Explanatory Variables

Transaction	***Monetization***	***Complementarity***	***Opportunity cost***	***Credit plan***
		Enterprise circuit (enterprise deposits)		
nominal industrial production, investment	squared nominal industrial production, squared investment	real growth of industrial output, real 5-year deposit interest rate	1-year deposit interest rate, 1-year loan interest rate	short-term loans
		Aggregate money demand (M1)		
GDP	squared GDP	real growth of industrial output, real 5-year deposit interest rate	1-year deposit interest rate, 1-year loan interest rate, 5-year deposit interest rate, five-year deposit interest rate indexed to inflation, NEER, spread	short-term loans

Table 4 Linear Demand for Money in the Enterprise Circuit

Enterprise deposits	Spec 1a	Spec 1b	Spec 2a	Spec 2b	Spec 3a	Spec 3b	Spec 3c	Spec 3d	Spec 4
Cointegration test	-4.7*		-4.4*	-4.4*	-2.9	-2.8	-3.3	-3.3	-0.5
Nominal industrial production	0.08 (3.5)	included	0.09 (4.8)	0.04 (2.7)					
Investment					included	included	included	included	
Short term loans	0.16 (1.6)	included	0.11 (1.6)	0.21 (2.7)	included	included	included	included	included
Real growth of industrial output			0.45 (4.3)	0.62 (5.9)	included	included			
Real 5-year deposit interest rate	-0.001 (-2.1)	included	0.45 (4.35)				included	included	
1-year deposit interest rate		included		-0.22 (-12.1)	included		included		
1-year loan interest rate	-0.52 (-12.2)		-0.51 (13.7)			included		included	
Squared nominal industrial production	0.0005 (1.9)	included	0.0004 (1.9)	0.001 (4.9)					
Squared investment					included	included	included	included	
Schwartz criterion			-4.61	-4.53					

"*" : cointegrated at 10% (Philips and Ouliaris critical values). "included" denotes variables initially included in a vector in which cointegration was rejected. A Schwartz criterion is used to select the optimal cointegration relationship.

Table 5 Linear Demand for M1

M1	Spec 1a	Spec 1b	Spec 1c	Spec 1d	Spec 1e	Spec 2a	Spec 2b	Spec 2c	Spec 2d	Spec 2e
Cointegration tests	-6.2***	-6.0***	-4.7**	-4.2	-5.9***	-6.1***	-5.9***	-4.7**	-4.1*	-5.8***
GDP	0.15 (6.7)	0.17 (7.2)	0.07 (2.4)	included	0.14 (5.6)	0.13 (19)	0.15 (20.3)	0.18 (9.9)	0.13 (13)	0.13 (17)
ST loans	-0.04 (-0.5)	-0.09 (-1)	0.3 (4.6)	included	-0.05 (-0.6)					
Real growth of indus output	1 (9.6)	0.91 (8.5)	1.1 (8.6)	included	1 (9.7)	1 (9.7)	0.93 (8.9)	1.14 (8)	1.15 (7.7)	1 (9.7)
Real 5-year deposit interest rate										
1-year deposit interest rate	-0.12 (-7.5)					-0.12 (-10)				
1-year loan interest rate		-0.28 (-7.6)					-0.25 (-10)			
NEER			0.1 (1.7)					0.2 (3.1)		
US-China Spread				included					0.003 (2.0)	
5-year nominal interest rate					-0.1 (-5.9)					-0.09 (-8.4)
Squared GDP	-0.0003 (-1.4)	-0.0007 (-9.2)	0.0003 (0.9)	included	-0.002 (-1)	-0.0002 (-2.1)	-0.0004 (-3.6)	-0.0008 (-2.7)	-0.00009 (-0.5)	-0.0001 (-1)
Schwartz riterion						-4.6	-4.5			-4.44

"*, **, ***" : cointegrated at 10% , 5%, 1% (Philips and Ouliaris critical values). "included" denotes variables initially included in a vector in which cointegration was rejected. A Schwartz criterion is used to select the optimal cointegration relationship.

Table 5 Cont': Linear demand for M1

M1	Spec 3a	Spec 3b	Spec 3c	Spec 3d	Spec3e	Spec 4a	Spec 4b	Spec 4c	Spec 4d	Spec 4e
Cointegration tests	-2.4	-2.6	-3.2	-2.9	-3	-2.4	-2.6	-3.7	-3.5	-3
GDP	included	included	included	included	included	included	included	included	included	included
ST loans	included	included	included	included	included					
Real growth of indus output										
Real 5-year deposit interest rate	included	included	included	included	included	included	included	included	included	included
1-year deposit interest rate	included					included				
1-year loan interest rate		included					included			
NEER			included					included		
US-China Spread				included					included	
5-year nominal interest rate					included					included
Squared GDP	included	included	included	included	included	included	included	included	included	included
Schwartz riterion										

"*, **, ***" : cointegrated at 10%, 5%, 1% (Philips and Ouliaris critical values)

Table 6 Non-Linear Demand for Money in the Enterprise Circuit

	Specification		Specification 2	
	β_1	β_2	β_1	β_2
1-year loan interest rate	-0,88	0.30	-0.62	
	(-21.3)	(6.94)	(-34.0)	
Real growth rate of industrial output	0.53	0.28	0.48	0.76
	(5.14)	(2.48)	(4.52)	(7.91)
Short term loans	0.□6	-0.24	0.42	-0.42
	(5.15)	(-4.01)	(9.10)	(-7.69)
Industrial output	0,069		-0.11	
	(1.53)		(-2.87)	
Squared Industrial output	0.004		0.007	
	(4.67)		(10.2)	
[γ,c]	[0.658; 35.7]		[0.522; 38.6]	
t1 [K= 1; 2; 3]	[8.9; 8.1; 9.0]		| 6.3; 2.1; 0.2]	

β_1 and β_2 are coefficient values, t-student are in parenthesis. Lead =1.

Table 7 Non-Linear Aggregate Demand for Money (M1)

	Specification 1		Specification 2	
	β_1	β_2	β_1	β_2
1-year deposit interest rate	-0,04	-0.15	0.006	-0.15
	(-8.53)	(-35.2)	(1.66)	(-45.5)
Real growth rate of industrial output	1,08	0.52	1.51	0.05
	(42.8)	(34.4)	(81.1)	(29.2)
GDP	0.13	-0.08	0.32	
	(20.9)	(-29.7)	(235)	
Squared GDP	0.035		-0.0005	
	(27.0)		(-26.2)	
[γ,c]	□0.278 ; 41.6]		[0.66; 45.7]	
t1 [K= 1; 2; 3]	[5.9; 7.2; 10.0]		[4.6; 6.7; 8.5]	

β_1 and β_2 are coefficient values, t-student are in parenthesis. Lead =3.

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