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Is Fiscal Deficit Inflationary?

A Dynamic Panel Quantile Analysis

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Abstract

In economic theory, sustained fiscal deficits might cause inflation by means of money creation, and the economy in a higher inflation level would be more strongly impacted by an increase in deficits. Following the theoretical model of Catão and Terrones (2005), I scaled fiscal deficits by narrow money stock and examined the deficit-inflation relationship in 91 countries from 1960 to 2006. A dynamic panel quantile regression of Lin (2010) was employed, which can estimate the impact of fiscal deficits at various inflation levels and allows for a dynamic adjustment. The empirical results show that fiscal deficits will be more serious as inflation rises, and weakly or not related to inflation if it is at a low level. Therefore, fiscal consolidation would be more effective in price stabilization the higher the inflation. Moreover, the results remain robust while taking other possibly inflation-related factors into consideration. Furthermore, the impact of fiscal deficits on inflation is generally greater in developing countries, particularly when inflation is at a high level. Finally, the inflationary effect of deficits is not detected over 1990–2006.

Keywords: Fiscal deficit; Inflation; Quantile regression; Price stabilization; Dynamic panel data

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1 Introduction

In either economics or policy discussions, the topic of whether fiscal deficits cause inflation is intriguing. In macroeconomic theory, Sargent and Wallace (1981) argued that an economy might be dominated by monetary authority or fiscal authority. If an economy is dominated by monetary authority, then fiscal authority will face a budget constraint imposed by monetary authority when fiscal policy is formulated. Monetary policy can be independently implemented. Hence, money growth can be controlled and inflation will not be caused. However, if fiscal authority dominates an economy, the monetary authority cannot implement monetary policy independently and would be forced to accommodate sustained fiscal deficits by means of money creation, and inflation rises consequently. Therefore, in a "fiscal dominance" economy, sustained fiscal deficits will lead to inflation. Furthermore, Catão and Terrones (2005) argued that an economy in a higher inflation level would be impacted by an increase in deficits more strongly, because its inflation tax base is typically narrower. They also interpreted that the government can allocate seigniorage intertemporally by borrowing, so budget deficits do not have to induce inflation contemporaneously.

Alternatively, the conventional view in terms of Keynesian aggregate demand considered that an increase in government debt has a wealth effect on households, so the income will raise and the demand for goods and services will increase. Therefore, an increase in aggregate demand will raise the price level and inflation. In addition, a recently developed fiscal theory of the price level (FTPL) argued that the price level is jointly determined by fiscal and monetary policy, and equilibrium may not be as unique.

For investigating the deficit-inflation relationship, I used a dynamic panel quantile regression in 91 countries from 1960 to 2006. There are two reasons for using quantile regression. The first motivation is that in the theoretical model of Catão and Terrones (2005), fiscal deficit is scaled by narrow money stock which stands for an inflation tax base. Consequently, given a change in the deficit-to-GDP ratio, fiscal deficits would be more inflationary in a higher-inflation economy, because its inflation tax base is typically narrower. The second reason is that previous empirical studies discovered that a fiscal deficit is generally inflationary in high-average inflation countries, high-inflation periods and developing countries. Otherwise, deficits may play a weak or even non-role in the determination of inflation. However, high-average inflation countries and high-inflation periods are classified arbitrarily in previous studies. Accordingly, quantile regression can estimate the inflationary effects of fiscal deficits at various inflation levels, and the inflation levels do not need to be arbitrarily classified.

Panel data provides plenty of observations across countries over a long time horizon and allows for intrinsic dynamic adjustment, and dynamic panel quantile regression of Lin (2010), which is a two-stage fitted value approach, is employed to estimate the deficit-inflation linkage. Accordingly, the deficit-inflation relationship can be examined clearly and comprehensively.

The findings of my study are that fiscal deficits will be more inflationary the higher the inflation rate, and will weakly or not be related to inflation when inflation is at a low level. Taking one or more lagged deference dependant variables as instruments will not change the results. Therefore, fiscal consolidation would be more effective in price stabilization as inflation rises higher. In addition, scaling deficits by GDP and controlling money growth, the results are similar except that the estimates become significant as inflation at a low level. Secondly, the results remain robust when taking other possibly inflation-related factors into consideration (growth of GDP per capita, oil price inflation, openness and exchange rate regime), so the estimated deficit-inflation relationship is stable. Thirdly, the impact of fiscal deficits on inflation is generally greater among developing countries (represented by middle- and low-income countries and non-OECD countries), especially as inflation is at a high level. These findings support the theoretical model of Catão and Terrones (2005) — the economy in a higher inflation level would be impacted by fiscal deficits more strongly — and are consistent with previous empirical studies (e.g. De Haan and Zelhorst, 1990; Fischer et al., 2002; Catão and Terrones, 2005). Finally, the deficit-inflation relationship does not notably change during 1960–2006, 1970–2006 and 1980–2006, but it is not detected over 1990–2006.

The remainder of the thesis is organized as follows. Section 2 discusses the literature review. Section 3 presents the econometric model. The data description and empirical results are reported in Section 4, and Section 5 offers the concluding remarks.

2 Literature Review

Whether fiscal deficits will raise inflation is an intriguing issue that may be discussed by economists. In theory, Sargent and Wallace (1981) proposed an analytical model to cover this topic. There are two different schemes in their framework: "monetary dominance" and "fiscal dominance." The former indicates that monetary authority could implement monetary policy independently. The budget deficit is jointly determined by bonds sales to the public and seigniorage created by the monetary authority, so fiscal authority will face a budget constraint imposed by monetary authority when it formulates the fiscal policy. Therefore, monetary authority can control the money supply and inflation rates. Contrary to monetary dominance, fiscal dominance indicates that monetary authority is dominated by fiscal authority. In this scheme, fiscal authority does not care budget balance when fiscal policy is formulated. However, the demand of government bonds is limited, and the interest rate of government bonds will increase when there are too many bonds for sale. The interest rate could not be greater than the economic growth rate — otherwise government debts would grow faster than real income and render the economy to become unstable. Therefore, even though the monetary authority wants to control money growth, yet, it will still be forced to accommodate the bonds with additional base money. Ultimately, monetary authority cannot control money growth in the long run and the inflation rate will rise consequently. Accordingly, fiscal dominance supports the hypothesis that budget deficits lead to inflation, but monetary dominance does not.

Furthermore, Catão and Terrones (2005) scaled fiscal deficits by narrow money which stands for an inflation tax base, and they argued that an economy in a higher inflation level would be impacted by an increase in deficits more strongly because its inflation tax base is typically narrower. They also interpreted that the deficit-inflation relationship is dynamic under a fiscal dominance scheme. Because the government can allocate seigniorage intertemporally by borrowing, budget deficits do not have to induce inflation currently. However, budget deficits play a key role in the present value of future money accommodation (for financing government bonds), so deficits can still ultimately lead to inflation. Therefore, deficits are inflationary in the long run, but not necessarily in the short run.

Different from Sargent and Wallace (1981), the conventional view of debt provides another channel in terms of Keynesian aggregate demand to interpret why an increase in debt may cause inflation. In the main idea of the conventional view, Elmendorf and Mankiw (1999) concluded that an increase in debt has a positive wealth effect on households, so the demand for goods and services will raise and inflate the economy.

In addition, the fiscal theory of the price level (FTPL) also claims that the price level can be determined by fiscal policy (debt).[1] In a "non-Ricardian" case, both fiscal and monetary policy, which determine the government's future primary surpluses, are exogenously determined by the government itself. When the government adjusts the present value of its future primary surpluses lower than the real value of the debt, the price level will rise to lower the real value of the debt. Then, solvency at a new real value will be produced and the real debt will devaluate (Minford and Peel, 2002). Under the FTPL, fiscal policy is directly linked to the price level though the present value budget constraint.

Empirical results about the connection between fiscal deficits and inflation vary in specific country groups and periods. For the United States, Hamburger and Zwick (1981) examined the deficit-money linkage from 1954 to 1976. They concluded that budget deficits are broadly inflationary. In particular, the deficit-money linkage becomes stronger in the "Keynesian period" (1961–1974). This is due to an expansionary fiscal policy and a following interest-rate moderating monetary policy.

Dwyer (1982) used quarterly data covering 1953–1978 to test the relationships

[1] FTPL is developed by Leeper (1991), Sim (1994) and Woodford (1994, 1995). The recent developments of FTPL, see, for example, Woodford (2001), McCallum (2001), Cochrane (2001, 2005) and Leeper and Yun (2006).

between debt, price and money with a vector autoregression (VAR) model. However, there is no evidence that debts held by the public and by the Federal Reserve play a role in determining the price level and other macroeconomics variables such as interest rates and the money stock. In his results, fewer deficits would not lower the inflation rates.

Darrat (1985) investigated whether budget deficits and money growth will impact inflation. He took both budget deficits and money growth into consideration, because he regarded deficits as a non-monetary factor. He showed that both budget deficits and money growth are significantly inflationary from 1958 to 1979.

Similarly, Ahking and Miller (1985) examined the relationships between deficits, money growth and inflation, which were estimated in a VAR framework so as to treat all variables as endogenous. They separated the quarterly data (1947–1980) into three decades (1950s, 1960s and 1970s) for comparison. Budget deficits were uncovered which caused inflation during 1950s and 1970s. They provided evidence that the deficit-inflation linkage of the United States does exist during some specific periods. However, this effect is independent of money growth, which implies that inflation is not due to monetization.

King and Plosser (1985) also investigated the deficit-seigniorage relationship in terms of neoclassical macroeconomic models. They estimated the connection by both ordinary least squares (OLS) and VAR, but found little connection between fiscal deficits and seigniorage in 1953–1982. In addition to the United States, they also estimated the deficit-seigniorage connection of other 12 industrial and developing countries, but still failed to demonstrate that the relationship is broadly significant.

Other than the United States, there are also many empirical research studies about other industrial countries. Other than the aforementioned King and Plosser (1985), Giannoros and Koulluri (1986) utilized data from 1950 to 1981 to examine whether deficits lead to money growth and inflation in 10 industrial countries. The results showed that the impact of budget deficits on money supply and inflation was insignificant.

Like Giannoros and Koulluri (1986), Protopapadakis and Siegal (1987) also examined the debt-money and the debt-inflation connection for 10 major advanced countries during 1952–1987. They applied non-parametric and regression tests, and interpreted that there is no association between debt and money growth, and the association between debt growth and inflation is very weak.

Barnhart and Darrat (1988) checked the causality between fiscal deficits and money growth across seven industrial countries from 1960 to 1984. Their study rejected the hypothesis that deficits Granger-cause an increase in the money growth. Reversely, an increase in money growth does not Granger-cause an increase in deficits, either. Therefore, there is no general relationship between deficits and money growth, and fiscal deficits are not inflationary.

Since the studies about industrial countries concluded that the inflationary effect of budget deficits was broadly insignificant, some economists considered that the effect may be more significant in developing countries. De Haan and Zelhorst (1990) did a search about developing countries and concluded that government debt may induce money creation in some channels. First, political pressures may force monetary authorities to finance budget deficits, especially when the central bank is not sufficiently independent. Second, less efficiency and ability of taxation would lead to a higher optimal level of seigniorage. Third, the time-inconsistency theory suggests that the government has a motive to generate unexpected inflation in order to decrease the real value of interest-bearing debt, and it implies that the government could get a capital gain from unexpected inflation. The final channel is the aforementioned "fiscal dominance" hypothesis proposed by Sargent and Wallace (1981). Among these theories, De Haan and Zelhorst (1990) considered that the "fiscal dominance hypothesis" is the most adequate case for developing countries. Empirically, they collected data from 17 developing countries during 1961–1985 and estimated the effect of deficits on money growth with a VAR model. Unfortunately, they did not provide strong evidence to support the fiscal dominance hypothesis. However, they discovered that budget deficits are positively related to inflation during acute inflation periods with a nonparametric method.

Metin (1998) did a system cointegration analysis based on Turkish data during 1954–1986 and applied an error-correlation model to estimate the relationship between budget deficits and inflation. He uncovered that deficits lead to inflation directly in Turkey, and the current real income growth had a negative effect on inflation.

Including fiscal imbalances, output gaps, supply-side cost shock and inflation persistence, Loungani and Swagel (2003) generally discussed inflationary factors in 53 developing countries from 1964 to 1998. They showed that the fiscal balance weakly correlates to inflation, but the correlation becomes stronger in higher-average inflation countries. In addition, they found a non-linear relationship between a deficit and inflation. The impact of deficits on inflation is significant when the deficit-to-GDP ratio is above 5%. Additionally, they used money growth and exchange rate movements to represent fiscal factors and found that the relative importance of two factors varies under different exchange regimes.

For the specific groups of developing countries, there are also some empirical researches as follows. Komulainen and Pirttilä (2002) utilized VAR to test the connection between budget balances and inflation with monthly data of three transition economies (Russia, Bulgaria and Romania). But generally, deficits did not play an inflationary role. Domaç and Yücel (2005) investigated the determining factors of high inflation episodes in 15 emerging markets from 1980 to 2001. Employing a pooled probit model, Domaç and Yücel discovered that government deficits are positively significant, so expansionary fiscal policy most likely launched inflation episodes. Moreover, Coll and Pedauga (2007) placed their focus on 18 Latin American countries during 1980–2004. They took institutional and economic structural factors to explain why inflation in Latin America declined steeply in the 1990s. Their dynamic generalized method of moments (dynamic GMM) results revealed indebtedness as an inflationary factor, although it was not very robust. Meanwhile, growth in GDP per capita was negatively related to inflation.

Baldacci et al. (2004) researched "expansionary fiscal contraction" in low-income countries. Expansionary fiscal contraction means that a sustained decrease in fiscal deficits will increase the real income level. They examined the influence of reductions in fiscal deficits on other macroeconomic variables with a panel dataset in 39 low-income countries from 1990 to 2001. Their results presented that in indebted countries, fiscal deficits are inflationary and harmful to economic growth. However, in less indebted countries, fiscal deficits are insignificant to inflation and growth. Therefore, expansionary fiscal contraction is a useful policy only for high-deficit countries.

To investigate the impact of deficits generally, Karras (1994) applied a panel data model and GLS method in 32 developed and developing countries during 1950s–1980s. In his conclusion, the expansionary effect of fiscal deficits on money growth is insignificant. It means that deficits are not be monetized. In addition, the main determinant of inflation was money growth rather than fiscal deficits, and an increase in deficits lead to a reduction in output growth and investment.

Checking the deficit-seigniorage linkage, Click (1998) used OLS for estimating cross-sectional data of 90 countries from 1971 to 1990. However, he provided no evidence which indicated that an increase in domestic debt will cause seigniorage to rise.

Cottarelli et al. (1998) broadly discussed some non-monetary determinants of inflation in 47 countries from 1993 to 1996. They pointed out that based on revenue motives, the fiscal budget is a determinant of inflation. It induces the central bank to create seigniorage or inflation tax, especially when the budget is imbalanced or the financial market is less developed. Additionally, the past inflation rates influence current inflation due to its own persistence and inertia, so it used dynamic GMM as an empirical model. The result showed that fiscal deficits play a significant role in inflation, particularly when the countries' securities markets do not develop well.

Fischer et al. (2002) generally investigated the relationship between inflation, money growth, seigniorage and fiscal deficits. Their dataset is large and contains 94 countries from 1960 to 1995. According to the cross-sectional results, the fiscal deficit is positively significant to seigniorage and inflation. It indicates that deficits give the government an incentive to create seigniorage and ultimately inflate the economies. For observing shot-run effects, they employed a fixed effect model to analyze panel data. In addition, they classified countries into two groups according to their long-run average inflation rates. They discovered that only in high-average inflation countries, can fiscal deficits play a significant role in seigniorage and inflation. Otherwise, fiscal deficits have no effect. Furthermore, they selected high-inflation episodes in high-average inflation countries and found that in high-average inflation countries, fiscal deficits are positively related to inflation during high-inflation episodes, but otherwise they are insignificant.

Catão and Terrones (2005) modeled a new approach (fiscal deficit is scaled by narrow money) to theoretically prove that persistent fiscal deficits will lead to inflation, and an economy in a higher inflation level will be impacted by an increase in deficits more strongly. They collected data from 107 countries over 1960–2001, and the econometric model they used is a mean group (or a pooled mean group) estimator, which could model a non-linear relationship, allow for heterogeneity across countries, and reveal the short- and long-run influences. They showed how budget deficits can positively relate to inflation, but the inflationary effect of deficits depend on the market's financial depth, inflation tax bases and the credibility of monetary authorities. Additionally, a fiscal deficit is inflationary in developing and high-inflation countries, but not in low-inflation and developed countries.

Kwon et al. (2009) examined the debt-inflation connection with a forward looking fiscal-monetary model of inflation, and their model nested the quantity theory of money and the theory of Sargent and Wallace (1981). Because the model takes into account forward looking expectations, multiple equilibrium paths can coexist. They used the data of 71 countries from 1962 to 2004 and a dynamic GMM model to measure the effect of debt on inflation. The results showed that debt growth is strongly inflationary in indebted developing countries, and less strong in other developing countries. In the case of advanced countries, debt growth is less inflationary.

As an important determinant of inflation, the budget deficit is also considered in many inflation related research studies. For example, Desai et al. (2005) analyzed the relationship between inflation and inequality in 120 countries covering 1960–2000 through a political structure channel, and they considered that fiscal balance is an important variable. In their result, the fiscal deficit is positively associated with inflation except in advanced countries. Alfaro (2005) studied the role of openness in inflation, and she also controlled the effect of fiscal deficits. Although the robustness of deficits is not strong, the coefficient is always positive.

In light of aforementioned theoretical and empirical researches, I conclude that a fiscal deficit is generally inflationary in high-average inflation countries, high-inflation periods and developing countries. Otherwise, deficits may just play a weak or even nonexistent role in the determination of inflation. This means that high-inflation periods, high-average inflation and developing countries provide strong evidence for supporting the "fiscal dominance" hypothesis.

3 Econometric Methodology

In this section, quantile regression and how to deal with endogenous problems will be introduced. This will be followed by a discussion of quantile regression for panel data. Finally, the estimation of a dynamic quantile regression for panel data is described.

3.1 Quantile regression and endogeneity

3.1.1 The model and estimation of quantile regression

Quantile regression is an econometric technique which can estimate the parameters at a specific quantile of the population.[2] Contrary to OLS method, quantile regression provides different estimates at various quantiles, and OLS only provides an average estimate of the population.

A classic quantile regression model can be written as follows:

$$y_i = x_i^{'}\beta(\tau) + \varepsilon_i(\tau) \text{ or } Q_{y_i}(\tau|x_i) = x_i^{'}\beta(\tau),$$

where y_i is a dependent variable, $Q_{y_i}(\tau|x_i)$ is the τth quantile of y_i conditional on x_i, $\varepsilon_i(\tau)$ is an error term and $Q_{\varepsilon_i}(\tau|x_i) = 0$, x_i is an explanatory variable, and $\beta(\tau)$ is the interesting parameter at the τth quantile.

Then, we minimize the following objective function at a given τ, and the estimator $\hat{\beta}(\tau)$ can be obtained.

$$\begin{aligned}
&\sum_{\{i:y_i \geq x_i'\beta\}} \tau|y_i - x_i'\beta| + \sum_{\{i:y_i < x_i'\beta\}} (1-\tau)|y_i - x_i'\beta| \\
&= \sum_{i=1}^{n} \rho_\tau(y_i - x_i'\beta),
\end{aligned} \tag{1}$$

where $\rho_\tau(y_i - x_i'\beta) = (y_i - x_i'\beta)(\tau - \mathbf{1}_{\{y_i - x_i'\beta < 0\}})$ is a check function, and $\mathbf{1}_A$ is a indicator function. If condition "A" holds, then $\mathbf{1}_A$ is equal to 1. If "A" does not

[2]Quantile regression is proposed by Koenker and Bassett (1978).

hold, then $\mathbf{1}_A$ is equal to 0. Thus, if $y_i - x_i'\beta \geq 0$, then $\rho_\tau(y_i - x_i'\beta) = \tau(y_i - x_i'\beta)$; if $y_i - x_i'\beta < 0$, then $\rho_\tau(y_i - x_i'\beta) = (\tau - 1)(y_i - x_i'\beta)$. In equation (1), residual terms are positive in the former because observations are greater than estimates, and given a weight τ. In the latter, residual terms are negative because observations are smaller than the estimates, and are given a weight $(1 - \tau)$.

The large sample properties of quantile regression can be shown as

$$\sqrt{n}(\hat{\beta}(\tau) - \beta(\tau)) \to N(0, J^{-1}SJ^{-1}),$$

where

$$J = \nabla_{\beta(\tau)}\mathbb{E}[\varphi(x_i, y_i, \beta(\tau))] = -\mathbb{E}[x_i x_i' f_{\varepsilon_i(\tau)|x_i}(x_i'\beta(\tau))] \text{ and}$$

$$S = \mathbb{E}[\varphi(x_i, y_i, \beta(\tau))\varphi(x_i, y_i, \beta(\tau))'] = \tau(1-\tau)\mathbb{E}(x_i x_i'),$$

where $f_{\varepsilon_i(\tau)|x_i}(.)$ is the conditional probability density function of the error term $\varepsilon_i(\tau)$.

Therefore,

$$J^{-1}SJ^{-1} = \tau(1-\tau)\mathbb{E}(x_i x_i' f_{\varepsilon_i(\tau)|x_i}(x_i'\beta(\tau)))^{-1}\mathbb{E}(x_i x_i')\mathbb{E}(x_i x_i' f_{\varepsilon_i(\tau)|x_i}(x_i'\beta(\tau)))^{-1}_. \quad (2)$$

If $f_{\varepsilon_i(\tau)|x}(.) = f_{\varepsilon_i(\tau)}(.)$, this means that the probability density function of the error term $\varepsilon_i(\tau)$ is independent of x_i, and equation (2) can be simplified as

$$J^{-1}SJ^{-1} = \frac{\tau(1-\tau)}{[f_{\varepsilon_i(\tau)}(0)]^2}\mathbb{E}(x_i x_i')^{-1}_.$$

3.1.2 Endogenous problems in quantile regression

How can an endogenous problem generated in the quantile regression be interpreted at first. Consider an endogenous regression model:

$$y_i = d_i'\alpha_0 + x_i'\beta_0 + (d_i'\alpha_1 + x_i'\beta_1)\varepsilon_i(\tau), \quad (3)$$

where d_i is an endogenous variable, x_i is an exogenous variable, and $\varepsilon_i(\tau)$ is an error term. α_0, α_1, β_0 and β_1 are vectors of parameters. Then, the τth conditional quantile function of equation (3) would be

$$Q_{y_i}(\tau|d_i, x_i) = d_i^{'}\alpha(\tau) + x_i^{'}\beta(\tau), \tag{4}$$

where $\alpha(\tau) = \alpha_0 + \alpha_1 \mathrm{F}_{\varepsilon_i}^{-1}(\tau|d_i, x_i)$, $\beta(\tau) = \beta_0 + \beta_1 \mathrm{F}_{\varepsilon_i}^{-1}(\tau|d_i, x_i)$, and $\mathrm{F}_{\varepsilon_i}^{-1}(\tau|d_i, x_i)$ refers to the τth conditional quantile of ε_i. Therefore, equation (4) indicates the τth conditional quantile of y_i. Furthermore, if τ is a random variable with uniform distribution, y_i can be rewritten as

$$y_i = d_i^{'}\alpha(u_i) + x_i^{'}\beta(u_i),$$

where $u_i|d_i, x_i \sim \text{Uniform}(0, 1)$ and u_i represent unobserved factors which have an impact on y_i.

Assume that $d_i = \delta(x_i, z_i, v_i)$, where δ is a unknown function, v_i is an unobserved disturbance which is correlated with u_i, and z_i is a valid instrument which is independent of x_i and z_i. Accordingly, v_i influence d_i through δ because v_i is correlated with u_i. Thus, there is an endogenous problem in d_i, and the estimators of y_i on (d_i, x_i) would be biased and inconsistent. The instrumental variable z_i can be utilized to solve endogenous problems.

The "fitted value" approach which consists of two stages is a solution, and it is developed by Amemiya (1982) and Powell (1983). Assume that z_i is a valid instrument variable for d_i, and we can run OLS of d_i on z_i to get its OLS fitted value $\hat{d}_i$ as the first step. After getting $\hat{d}_i$, we can consider a new quantile regression model

$$y_i = \hat{d}_i^{'}\alpha(\tau) + x_i^{'}\beta(\tau) + \varepsilon_i(\tau). \tag{5}$$

Then, we run a quantile regression of y_i on $(\hat{d}_i, x_i)$ in equation (5), and the consistent estimators $\hat{\alpha}_{fv}(\tau)$ and $\hat{\beta}_{fv}(\tau)$ can be obtained.

In addition, the instrumental variable quantile regression (IVQR), which is proposed by Chernozhukov and Hansen (2005, 2006), is another solution to deal with endogenous problems for quantile regression. The procedure of IVQR is as follows.

First, we run OLS of d_i on (z_i, x_i), and we will get its least squares projection $\hat{\phi}_i$. Consider the following model:[3]

$$y_i - d_i' \alpha(\tau) = x_i' \beta(\tau) + \hat{\phi}_i' \gamma(\tau) + \varepsilon_i(\tau). \tag{6}$$

Second, define a grid of α_j where $j = 1, \ldots, J$ and plug it back into equation (6). Next, take $(y_i - d_i' \alpha_j)$ as a new regressand, run a quantile regression of $(y_i - d_i' \alpha_j)$ on $(x_i, \hat{\phi}_i)$, and search the $\hat{\alpha}_j$ which makes $\|\hat{\gamma}(\hat{\alpha}_j)\|$ minimized. And then, the estimators $\hat{\alpha}_{CH,j}(\tau)$ and $\hat{\beta}_{CH}(\hat{\alpha}_{CH,j}(\tau), \tau)$ are the results of what we are looking for.

Let

$$\hat{\theta}_{CH}(\tau) = (\hat{\alpha}_{CH}(\tau), \hat{\beta}_{CH}(\hat{\alpha}_{CH}(\tau), \tau)),$$

Chernozhukov and Hansen (2006) showed large sample properties of IVQR as

$$\sqrt{n}(\hat{\theta}_{CH}(\tau) - \theta_{CH}(\tau)) \to N(0, J_{CH}(\tau)^{-1} S_{CH}(\tau) J_{CH}(\tau)^{-1}). \tag{7}$$

In equation (7), they suggested that $J_{CH}(\tau)$ and $S_{CH}(\tau)$ can be estimated as

$$\hat{J}_{CH}(\tau) = \frac{1}{2n\mathrm{H}_n} \sum_{i=1}^{n} \mathbf{1}_{(|\hat{\varepsilon}_i(\tau)| \leq \mathrm{H}_n)} [\hat{\phi}_i', x_i']' [d_i', x_i'] \text{ and}$$

$$\hat{S}_{CH}(\tau) = \tau(1-\tau) \frac{1}{n} \sum_{i=1}^{n} [\hat{\phi}_i', x_i']' [\hat{\phi}_i', x_i'],$$

where $\hat{\varepsilon}_i(\tau) = y_i - d_i' \hat{\alpha}_{CH}(\tau) - x_i' \hat{\beta}_{CH}(\tau)$, and H_n is a kernel bandwidth.

3.2 Quantile regression for panel data

3.2.1 Panel data

The panel data is a dataset where cross-sectional observations are observed over multiple time periods, and hence panel data contains properties of both cross-section and time-series. A typical panel data model is

$$y_{it} = \eta_i + x_{it}' \beta + \varepsilon_{it}, \tag{8}$$

[3]We can also use z_i to substitute the projection $\hat{\phi}_i$ in equation (6).

where $i = 1, \ldots, n$ and $t = 1, \ldots, T$. i represents different observations, and T represents different time periods. y_{it} is an dependent variable which belongs to an individual i at time T, x_{it} is a vector of explanatory variables, and ε_{it} is an independent and identically distributed error term. η_i is a time-invariant individual effect, and how to deal with individual effect is an important econometric issue. If η_i is a fixed term, equation (8) is a fixed effect model. If η_i is a random term, equation (8) is a random effect model.

3.2.2 The model and estimation

In a quantile regression for panel data, if an individual effect η_i is fixed, Koenker (2004) proposed a method for eliminating fixed effects. Consider a panel quantile regression model

$$y_{it} = \eta_i + x_{it}^{'}\beta(\tau) + \varepsilon_{it}(\tau) \ \text{ or } \ Q_{y_{it}}(\tau|\eta_i, x_{it}) = \eta_i + x_{it}^{'}\beta(\tau).$$

Like equation (1), the objective function is

$$\sum_{k=1}^{q}\sum_{t=1}^{T}\sum_{i=1}^{n}\omega_k\rho_{\tau_k}(y_{it} - \eta_i - x_{it}^{'}\beta(\tau_k)). \tag{9}$$

Where $k = 1, \ldots, q$, and k represents various quantiles. $\rho_{\tau_k}(.)$ is a check function as in equation (1). ω_k is a weight that controls the relative influence of the τ_kth quantile. However, when the dimensions of n, T and q are too large, solving for equation (9) is difficult.

Koenker (2004) proposed a shrinkage method to eliminate fixed effects η_i, and he considered the panelized version of equation (9):

$$\sum_{k=1}^{q}\sum_{t=1}^{T}\sum_{i=1}^{n}\omega_k\rho_{\tau_k}(y_{it} - \eta_i - x_{it}^{'}\beta(\tau_k)) + \lambda\sum_{i=1}^{n}|\eta_i|. \tag{10}$$

When $\lambda \to 0$, the panel quantile regression estimators can be obtained.[4]

[4] λ is a tuning parameter, and λ is chosen as 1 in practice.

3.2.3 Large sample properties

First, we impose conditions **A1**–**A3** as follows.

A1 : y_{it} is independent of the conditional distribution functions $\mathbf{F}_{it}$ with differentiable conditional densities $0 < f_{it} < \infty$, and the derivatives f'_{it} are bounded at $\xi_{it}(\tau)$, where $\xi_{it}(\tau) = \eta_i + x'_{it}\beta(\tau)$.

A2 : D_0 and D_1 are positive definite:

$$D_0 = \lim_{n,T\to\infty} T^{-1} \begin{bmatrix} \omega'\Omega\omega\mathbb{I}'\mathbb{I} & \omega'\Omega W \otimes \mathbb{I}'X/\sqrt{n} \\ W\Omega\omega \otimes X'\mathbb{I}/\sqrt{n} & W\Omega W \otimes X'X/n \end{bmatrix} \text{ and}$$

$$D_1 = \lim_{n,T\to\infty} T^{-1} \begin{bmatrix} \sum \omega_k \mathbb{I}'\Phi_k\mathbb{I} & \omega_1\mathbb{I}'\Phi_1 X/\sqrt{n} & \dots & \omega_q\mathbb{I}'\Phi_q X/\sqrt{n} \\ \omega_1 X'\Phi_1\mathbb{I}/\sqrt{n} & \omega_1 X'\Phi_1 X/\sqrt{n} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ \omega_q X'\Phi_q\mathbb{I}/\sqrt{n} & 0 & \dots & \omega_q X'\Phi_q X/\sqrt{n} \end{bmatrix},$$

where Ω is a $q \times q$ matrix with elements $\tau_k \wedge \tau_l - \tau_k\tau_l$, and $\Phi_j = diag(f_{it}(\xi_{it}(\tau_j)))$. $\mathbb{I} = I_n \bigotimes \mathbb{1}_T$, $\mathbb{1}_T = (1,\dots,1)'$, and $\mathbb{I}$ is the matrix which identifies individual effects.

A3 :

$$\max_{1\le i\le n, 1\le t\le T} \|x_{it}\| < M.$$

Second, let

$$V_{nT}(\delta) = \sum_{k=1}^{q}\sum_{t=1}^{T}\sum_{i=1}^{n} \omega_k \big[\rho_{\tau_k}(y_{it} - \xi_{it}(\tau_k) - z'_{it}\delta_o/\sqrt{T} - x'_{it}\delta_k/\sqrt{nT}) - \rho_{\tau_k}(y_{it} - \xi_{it}(\tau_k))\big] + \lambda_T \sum_{i=1}^{n} \mid \eta_i - \delta_{oi}/\sqrt{T} \mid - \mid \eta_i \mid,$$

where

$$\hat{\delta} = \begin{bmatrix} \hat{\delta}_0 \\ \hat{\delta}_1 \\ \vdots \\ \hat{\delta}_q \end{bmatrix} = \begin{bmatrix} \sqrt{T}(\hat{\eta} - \eta) \\ \sqrt{nT}(\hat{\beta}(\tau_1) - \beta(\tau_1)) \\ \vdots \\ \sqrt{nT}(\hat{\beta}(\tau_q) - \beta(\tau_q)) \end{bmatrix}.$$

Hence, under conditions **A1**–**A3** and given $\lambda_T/\sqrt{T} \to \lambda_0$, $n^a/T \to 0$, and $a > 0$, $\hat{\delta}$ can minimize V_{Tn} and V_{Tn} has a limiting distribution

$$V_0(\delta) = -\delta^{'} B_g + \frac{1}{2}\delta^{'} D_1 \delta + \lambda_0 \delta^{'}_s.$$

B_g denotes a Gaussian vector with a zero mean and covariance D_0, $s = (s^{'}_0 0^{'}_{pq})^{'}$, and $s_0 = (sgn(\eta_i))$.

3.3 Dynamic panel quantile regression

In a dynamic panel model, dynamic terms may raise biases of estimators. Conventionally, taking dynamic terms as endogenous variables and employing lagged (or lagged differenced) dependent variables as instrument variables is a method which can help us reduce the dynamic bias.[5] The following are two approaches for dynamic panel quantile regression.

3.3.1 The IVQR approach

According to Chernozhukov and Hansen (2005, 2006), Harding and Lamarche (2009) proposed an IVQR method to deal with endogenous problems for panel data. Similarly, Galvao (2008) proposed an IVQR method for dynamic panel data. Consider a dynamic panel model

$$Q_{y_{it}}(\tau|\iota_{it}, y_{it-1}, x_{it}) = \iota_{it}^{\prime}\eta(\tau) + \alpha(\tau) y_{it-1} + x_{it}^{\prime}\beta(\tau), \tag{11}$$

where y_{it} is a dependent variable, x_{it} is an exogenous variable, y_{it-1} is the lag of a dependent variable, $\eta(\tau) = (\eta_1(\tau), \ldots, \eta_n(\tau))$ is a vector of individual effects, and ι_{it} is an indicator variable which identifies the individual effects. $\alpha(\tau)$ and $\beta(\tau)$ are parameters. However, an individual effect $\eta(\tau)$ in equation (11) is different from equation (9). In the model of Koenker (2004), an individual effect will not change with τ, but an individual effect of Galvao (2008) is a dummy variable which will change with τ.

[5] See, for example, Anderson and Hsiao (1981) and Arellano and Bond (1991).

If z_{it} is a valid instrument variable, we consider a new objective function

$$\sum_{i=1}^{n}\sum_{t=1}^{T}\rho_\tau(y_{it}-\iota_{it}'\eta(\tau)-\alpha(\tau)y_{it-1}-x_{it}'\beta(\tau)-z_{it}'\gamma(\tau)). \tag{12}$$

Unlike Chernozhukov and Hansen (2006), Galvao (2008) uses z_{it} to replace the projection of y_{it-1} on (z_{it}, x_{it}).

The estimation procedure consists of two steps. First, define a grid of α_j where $j = 1, \ldots, J$ and plug α_j into $\alpha_j(\tau)y_{it-1}$ respectively. Second, take $(y_{it} - \alpha_j(\tau)y_{it-1})$ as a new dependent variable, run a quantile regression of $(y_{it} - \alpha_j(\tau)y_{it-1})$ on $(\iota_{it}, x_{it}, z_{it})$, and search the $\hat{\alpha}_j$ among $j = 1, \ldots, J$ which makes $\|\hat{\gamma}(\hat{\alpha}_j, \tau)\|$ minimized, and the estimators $\hat{\alpha}_G(\tau)$ and $\hat{\beta}_G(\hat{\alpha}_G(\tau), \tau)$ can be obtained.

Galvao (2008) presented large sample properties as the following. Consider a closed ball with the center $\alpha(\tau)$, radius π_n, and $\pi_n \to 0$ going slowly. For any $\alpha_n(\tau) \to \alpha(\tau)(\delta_\alpha \to 0)$, rewrite objective function equation (12) as

$$\begin{aligned} V_{nT}(\delta) = \sum_{t=1}^{T}\sum_{i=1}^{n}\rho_\tau(y_{it}-\xi_{it}(\tau)-\iota_{it}'\delta_\eta/\sqrt{T}-y_{it-1}\delta_\alpha/\sqrt{nT}-x_{it}'\delta_\beta/\sqrt{nT})-z_{it}'\delta_\gamma/\sqrt{nT} \\ -\rho_\tau(y_{it}-\xi_{it}(\tau_k)), \end{aligned}$$

where $\xi_{it}(\tau_k) = \eta_i(\tau) + \alpha(\tau)y_{it-1} + x_{it}'\beta(\tau) + z_{it}'\gamma(\tau)$, and

$$\hat{\delta}_n = \begin{bmatrix} \hat{\delta}_\eta \\ \hat{\delta}_\alpha \\ \hat{\delta}_\beta \\ \hat{\delta}_\gamma \end{bmatrix} = \begin{bmatrix} \sqrt{T}(\hat{\eta}(\alpha_n,\tau)-\eta(\tau)) \\ \sqrt{nT}(\alpha_n(\tau)-\alpha(\tau)) \\ \sqrt{nT}(\hat{\beta}(\alpha_n,\tau)-\beta(\tau)) \\ \sqrt{nT}(\hat{\gamma}(\alpha_n,\tau)-\gamma(\tau)) \end{bmatrix}.$$

Under some conditions,[6] let $\psi(u) = (\tau - \mathbf{1}_{\{u<0\}})$ and $\Psi = \psi_\tau(u)(y_{it} - \xi_{it}(\tau))$ so that Galvao (2008) derives

$$\begin{bmatrix} \hat{\delta}_\alpha \\ \hat{\delta}_\beta \\ \hat{\delta}_\gamma \end{bmatrix} = \begin{bmatrix} \min \hat{\delta}_\gamma(\delta_\alpha)'A\hat{\delta}_\gamma(\delta_\alpha) \\ \bar{J}_\beta[-(Z'M_{\mathbb{I}}\Psi)-J_\alpha\delta_\alpha] \\ \bar{J}_\gamma[-(Z'M_{\mathbb{I}}\Psi)-J_\alpha\delta_\alpha] \end{bmatrix} = \begin{bmatrix} -[J_\alpha'\bar{J}_\gamma A\bar{J}_\gamma J_\alpha]^{-1}[J_\alpha'\bar{J}_\gamma A\bar{J}_\gamma(X'M_{\mathbb{I}}\Psi)] \\ -\bar{J}_\beta[(I-J_\alpha[J_\alpha'\bar{J}_\gamma A\bar{J}_\gamma J_\alpha]^{-1}J_\alpha'\bar{J}_\gamma A\bar{J}_\gamma)(X'M_{\mathbb{I}}\Psi)] \\ -\bar{J}_\gamma[(I-J_\alpha[J_\alpha'\bar{J}_\gamma A\bar{J}_\gamma J_\alpha]^{-1}J_\alpha'\bar{J}_\gamma A\bar{J}_\gamma)(X'M_{\mathbb{I}}\Psi)] \end{bmatrix}.$$

[6]For more details, see Galvao (2008).

$\bar{J}_\gamma J_\alpha$ is invertible, so

$$\hat{\delta}_\gamma = 0 + O_p(1) + o_p(1).$$

Define $\hat{\theta}_G(\tau) = (\hat{\alpha}_G(\tau), \hat{\beta}_G(\hat{\alpha}_G(\tau), \tau), \gamma_G(\tau))$, and hence the large sample properties can be shown as

$$\sqrt{nT}(\hat{\theta}_G(\tau) - \theta_G(\tau)) \to \mathcal{N}((K', L')S(K', L')),$$

where $S = \tau(1-\tau)\mathbb{E}[(Z', M_{\mathbb{I}})(Z', M_{\mathbb{I}})']$, $K = (J'_\alpha \bar{J}'_\gamma A[\alpha(\tau)]\bar{J}_\gamma J_\alpha)^{-1} J'_\alpha \bar{J}'_\gamma A[\alpha(\tau)]\bar{J}_\gamma)$, and $L = \bar{J}_\beta(I - J_\alpha K)$.

Empirically, (K', L') and S can be estimated as $\hat{J}_G(\tau)$ and $\hat{S}_G(\tau)$:

$$\hat{J}_G(\tau) = \frac{1}{2nT\mathrm{H}_{nT}} \sum_{i=1}^{n} \sum_{t=1}^{T} \mathbf{1}_{(|\hat{u}_{it}(\tau)| \leq \mathrm{H}_{nT})}[z'_{it}, x'_{it}, \iota'_{it}]'[y_{it-1}, x'_{it}, \iota'_{it}]$$

$$\hat{S}_G(\tau) = \tau(1-\tau)\frac{1}{nT} \sum_{i=1}^{n} \sum_{t=1}^{T} [z'_{it}, x'_{it}, \iota'_{it}]'[z'_{it}, x'_{it}, \iota'_{it}],$$

where $\hat{u}_{it}(\tau) = y_{it} - \iota'_{it}\hat{\eta}_G(\tau) - y_{it}\hat{\alpha}_G(\tau) - x'_{it}\hat{\beta}_G(\tau)$, and H_{nT} is a kernel bandwidth.

3.3.2 The fitted value approach

Lin (2010) solved the endogenous problems by using a fitted value and utilized the shrinkage method proposed by Koenker (2004) to eliminate an individual effect. Consider the following model,

$$Q_{y_{it}}(\tau|\eta_i, y_{it-1}, x_{it}) = \eta_i + \alpha(\tau)y_{it-1} + x'_{it}\beta(\tau). \tag{13}$$

Contrary to equation (11), individual effects η_i are fixed, which means η_i will not change with τ such as in Koenker (2004). y_{it} is an dependent variable, y_{it-1} is a dynamic term, and x_{it} is a covariate. $\alpha(\tau)$ and $\beta(\tau)$ are interesting parameters.

Similarly, assume z_{it} is a valid instrument variable, and we can estimate the parameters by a two-step procedure. First, run OLS of y_{it-1} on z_{it}, and we can obtain the fitted value of y_{it-1}: $\hat{y}_{it-1}$. Substitute $\hat{y}_{it-1}$ for y_{it-1} in equation (13), and the model will become

$$Q_{y_{it}}(\tau|\eta_i, \hat{y}_{it-1}, x_{it}) = \eta_i + \alpha(\tau)\hat{y}_{it-1} + x'_{it}\beta(\tau). \tag{14}$$

Second, we have to solve the following objective function for estimating parameters in equation (14):

$$\sum_{k=1}^{q}\sum_{t=1}^{T}\sum_{i=1}^{n}\omega_k\rho_{\tau_k}(y_{it} - \eta_i - \alpha(\tau)\hat{y}_{it-1} - x_{it}^{'}\beta(\tau_k)) + \lambda\sum_{i=1}^{n}|\eta_i|.$$

As in equation (9), $k = 1, \ldots, q$ and k represents various quantiles, $\rho_{\tau_k}(.)$ is a check function, and ω_k is a weight which controls the relative influence of the τ_kth quantile. Again, when $\lambda \to 0$, the dynamic panel quantile regression estimators $(\hat{\alpha}_L(\tau), \hat{\beta}_L(\tau))$ can be obtained. The fitted value approach of Lin (2010) is applied in my thesis, because a fixed effects model is a common choice for macroeconomists (Judson and Owen, 1999).

For estimating the variance-covariance matrix of $\hat{\beta}(\tau)$, bootstrapping is utilized here.[7] Bootstrapping is a re-sampling method, which can help us obtain properties of an estimator from an approximating distribution. In practice, we could sample from observations $\{y_i, x_i, i = 1, \ldots, n\}$ according to i, and hence a new sub-sample $\{y_i^*, x_i^*\}$ can be obtained. Then, we run a quantile regression of y_i^* on x_i^*, and the estimator $\hat{\beta}^*(\tau)$ can be obtained. Next, we resample and run the regression as above, and we can get a number of $\hat{\beta}^*(\tau, b)$, where $b = 1, \ldots, B$ and B is a number of re-sampling times. For example, if we do a re-sampling B times, we can obtain estimators $\hat{\beta}^*(\tau, 1), \hat{\beta}^*(\tau, 2), \ldots, \hat{\beta}^*(\tau, B)$. And then, the variance-covariance matrix of $\hat{\beta}(\tau)$ can be estimated as

$$\widehat{Var}(\hat{\beta}(\tau)) = \frac{1}{B-1}\sum_{b=1}^{B}(\hat{\beta}^*(\tau, b) - \bar{\hat{\beta}}^*(\tau))(\hat{\beta}^*(\tau, b) - \bar{\hat{\beta}}^*(\tau))',$$

where $\bar{\hat{\beta}}^*(\tau) = B^{-1}\sum_{b=1}^{B}\hat{\beta}^*(\tau, b)$.

[7] Bootstrapping is proposed by Efron (1979). The application of bootstrapping to quantile regression, see Buchinsky (1995, 1998).

4 Empirical Results

This section is organized as follows. At first, data descriptions, sources and characteristics are summarized. And later on, average long term data is used in cross-sectional analysis. And finally, panel data is used to estimate empirical results which consist of baseline, extensive, country group-specific and period specific analysis.

4.1 Data

The main dataset consists of a panel of 91 countries (see Appendix A) from 1960 to 2006, and the main sources are the IMF's International Financial Statistics (IFS) and the Penn World Table version 6.3 (PWT 6.3). Some gaps are filled with the World Bank's World Development Indicators (WDI), Desai et al. (2003),[8] Mitchell (2007a–c) and the United Nations' National Accounts Statistics database.

Inflation is measured by the annual change rate in the consumer price index. Fiscal deficits are nominal central government deficits scaled by narrow money stock (M1) and nominal GDP, so I calculated the deficit-to-money ratio as fiscal deficits over M1 and the deficit-to-GDP ratio as fiscal deficits over nominal GDP. The money growth rate is the annual change in the money stock (M1). The growth rate of real GDP per capita is the annual change in the real GDP per capita, which represents real economic growth. The oil price is the average crude price of petroleum in local currency, and oil price inflation is its annual change. The benefit of measuring the oil price in local currency is that each country could face various oil prices. Finally, openness is measured by the average of the import- and export-to-GDP ratio. (For detailed data sources and descriptions: see Appendix B.)

Table 1 provides a summary of the characteristics of the original data of selected countries over the period from 1960–2006 (panel A), 1970–2006 (panel B), 1980–2006 (panel C) and 1990–2006 (panel D). We can see that from 1960–2006 to 1990–2006,

[8]I thank Dr. Raj M. Desai for generously sharing their dataset.

Table 1: Descriptive statistics of selected countries

	mean	quantile 0.25	median	quantile 0.75	standard deviation	minimum	maximum	number of countries
(A) 1960–2006								
inflation rate (%)	27.27	2.69	6.16	12.88	307.09	-100.00	10945.70	91
deficits/money (%)	23.83	5.67	18.08	33.93	39.35	-180.64	1056.96	91
deficits/GDP (%)	3.36	0.98	2.80	4.92	5.61	-22.24	204.56	91
money growth rate (%)	29.50	6.73	13.17	21.66	275.45	-99.90	11673.40	91
growth of real GDP per capita (%)	2.39	-0.01	2.47	4.92	5.87	-42.95	68.87	91
oil price inflation (%)	84.64	-0.54	4.87	24.36	3273.49	-63.42	213153.20	91
openness (%)	34.22	19.30	27.81	42.43	24.68	0.15	228.47	91
(B) 1970–2006								
inflation rate (%)	31.05	3.29	7.44	14.44	336.16	-100.00	10945.70	96
deficits/money (%)	25.82	5.96	19.08	36.34	42.67	-180.64	1056.96	96
deficits/GDP (%)	3.63	1.04	2.95	5.28	6.00	-21.98	204.56	96
money growth rate (%)	31.19	7.15	14.11	23.35	274.36	-62.55	11673.40	96
growth of real GDP per capita (%)	2.20	-0.34	2.29	4.75	5.92	-41.11	60.37	96
oil price inflation (%)	101.68	-1.62	11.42	31.01	3591.80	-63.42	213153.20	96
openness (%)	36.72	21.08	30.04	46.49	25.01	0.15	228.47	96
(C) 1980-2006								
inflation rate (%)	39.89	2.73	6.67	13.96	392.18	-100.00	10945.70	101
deficits/money (%)	26.92	5.62	19.17	38.57	48.69	-221.44	1056.96	101
deficits/GDP (%)	3.57	0.96	2.85	5.37	6.57	-22.66	204.56	101
money growth rate (%)	38.78	6.53	13.50	23.19	322.70	-62.55	11673.40	101
growth of real GDP per capita (%)	1.87	-0.45	2.08	4.37	5.39	-36.18	56.40	101
oil price inflation (%)	176.93	20.34	30.74	46.94	5789.44	-19.34	301488.60	101
openness (%)	38.23	22.11	31.97	49.84	25.26	0.15	228.47	101
(D) 1990-2006								
inflation rate (%)	24.89	2.44	5.70	11.82	276.81	-13.85	7485.49	98
deficits/money (%)	23.66	3.33	15.47	35.00	44.10	-180.64	551.36	98
deficits/GDP (%)	2.83	0.62	2.38	4.54	6.51	-21.98	204.56	98
money growth rate (%)	27.45	6.80	13.32	23.09	230.26	-29.67	6724.82	98
growth of real GDP per capita (%)	2.26	0.08	2.38	4.60	5.14	-36.18	56.40	98
oil price inflation (%)	12.86	-6.43	10.24	32.10	24.84	-40.27	104.42	98
openness (%)	40.64	24.55	34.01	53.22	25.09	0.15	228.47	98

Source: the International Financial Statistics, Mitchell (2007a–c), the Penn World Table 6.3, Desai et al. (2003), the World Development Indicators and the United Nations' National Accounts Statistics database.

the average inflation rates are 27.27%, 31.05%, 39.89% and 24.89%, and the standard deviations of the inflation rate are 307.09, 336.16, 392.18, and 276.81 respectively. Inflation tends to be higher and more volatile since 1960, and it becomes lower and more stable after 1990. Compared with the median of inflation rate, 6.16%, 7.44%, 6.67% and 5.70% respectively, the average inflation rates are higher. This means that the average is prone to be affected by extreme observations. Quantile regression can avoid the estimated outcomes affected by extreme observations.

The deficit-to-money ratio is similar. From 1960–2006 to 1990–2006, the average deficit-to-money ratios are 23.83%, 25.82%, 26.92% and 23.66%, and the standard deviations are 39.35, 42.67, 48.69 and 44.10 respectively. On the other hand, the average deficit-to-GDP ratios are 3.36%, 3.63%, 3.57% and 2.83%, and the standard deviations are 5.61, 6.00, 6.57 and 6.51 respectively. As we can see, both the deficit-to-money ratio and the deficit-to-GDP ratio tend to be larger and become smaller after 1990, and yet the volatility is still large after 1990.

The average money growth rates are 29.50%, 31.19%, 38.78% and 27.45% from 1960–2006 to 1990–2006 respectively, and the standard deviations are 275.45, 274.36, 322.70 and 230.26. Similarly, both the growth rates and volatility reach a peak in the 1980s, and decline after 1990. About the other controlled variables, the growth rate of the real GDP per capita declines until 1980–2006, and becomes rapid after 1990. The oil price inflation rises higher until reaching a peak during 1980–2006, and sharply drops in 1990–2006. Finally, openness is consistently growing higher, and volatility is stable.

Next, for comparing countries in various development levels, I classify country groups according to the income level and OECD membership which are based on the World Bank list of economies (July 2009) (see Appendix C). However, the classification "OECD" consists of countries which are not only OECD members but also in a high-income level. Some OECD members in middle- or low-income levels are excluded such as Turkey, and the group of high-income countries contains OECD

Table 2: Descriptive statistics of specific income groups (1960–2006)

	mean	quantile 0.25	median	quantile 0.75	standard deviation	minimum	maximum	number of countries
(A) high-income countries								
inflation rate (%)	7.02	2.15	3.95	7.71	16.22	-20.63	373.82	33
deficits/money (%)	19.65	3.16	12.47	28.16	38.14	-110.26	613.14	33
deficits/GDP (%)	2.73	0.67	2.22	4.55	4.49	-22.24	26.74	33
money growth rate (%)	12.90	5.43	10.02	15.42	23.02	-76.85	430.17	33
growth of real GDP per capita (%)	2.95	0.98	2.80	4.90	4.27	-21.97	27.81	33
oil price inflation (%)	15.34	-2.84	1.98	19.49	47.00	-63.42	405.31	33
openness (%)	40.91	23.27	33.98	49.08	30.09	4.63	228.47	33
(B) middle- and low-income countries								
inflation rate (%)	38.80	3.54	8.04	16.47	384.01	-100.00	10945.70	58
deficits/money (%)	26.20	7.91	20.26	36.13	39.84	-180.64	1056.96	58
deficits/GDP (%)	3.72	1.15	3.12	5.02	6.13	-21.98	204.56	58
money growth rate (%)	38.94	8.14	15.46	25.00	344.25	-99.90	11673.40	58
growth of real GDP per capita (%)	2.07	-0.78	2.09	4.96	6.59	-42.95	68.87	58
oil price inflation (%)	124.07	0.00	7.11	30.13	4099.92	-60.09	213153.20	58
openness (%)	30.42	17.42	25.10	37.61	20.03	0.15	122.23	58

Source: the International Financial Statistics, Mitchell (2007a–c), the Penn World Table 6.3, Desai et al. (2003), the World Development Indicators and the United Nations' National Accounts Statistics database.

classification. Therefore, high-income or OECD countries represent economies in higher development, and middle- and low-income or non-OECD countries represent developing economies.

Table 2 is a summary of the characteristics of the original data in a high-income country group (panel A) and a middle- and low-income country group (panel B). We can see that in high-income countries, the average inflation is 7.02% and its standard deviation is 16.22. In middle- and low-income countries, the average inflation rate is 38.80% and 384.01. Accordingly, inflation is lower and more stable in high-income countries.

Table 3: Descriptive statistics of OECD and non-OECD countries (1960–2006)

	mean	quantile 0.25	median	quantile 0.75	standard deviation	minimum	maximum	number of countries
(A) OECD countries								
inflation rate (%)	6.36	2.33	4.12	7.97	7.06	-13.85	84.22	24
deficits/money (%)	14.99	2.80	10.56	22.81	22.38	-72.42	160.32	24
deficits/GDP (%)	2.56	0.63	2.01	4.12	3.95	-22.24	20.79	24
money growth rate (%)	11.59	5.60	9.47	15.28	12.87	-62.55	192.09	24
growth of real GDP per capita (%)	2.90	1.16	2.74	4.61	3.27	-13.56	21.37	24
oil price inflation (%)	14.65	-2.49	2.70	19.42	44.95	-63.42	292.31	24
openness (%)	30.02	20.79	28.28	36.24	14.64	4.63	92.15	24
(B) non-OECD countries								
inflation rate (%)	34.76	3.03	7.31	15.15	357.58	-100.00	10945.70	67
deficits/money (%)	26.99	7.72	20.36	37.50	43.43	-180.64	1056.96	67
deficits/GDP (%)	3.65	1.14	3.10	5.08	6.07	-21.98	204.56	67
money growth rate (%)	35.91	7.61	14.63	24.27	320.69	-99.90	11673.40	67
growth of real GDP per capita (%)	2.21	-0.64	2.24	5.11	6.54	-42.95	68.87	67
oil price inflation (%)	109.71	-0.07	5.96	28.44	3814.75	-60.09	213153.20	67
openness (%)	35.73	18.74	27.59	46.28	27.24	0.15	228.47	67

Source: the International Financial Statistics, Mitchell (2007a–c), the Penn World Table 6.3, Desai et al. (2003), the World Development Indicators and the United Nations' National Accounts Statistics database.

Scaling by money stock, the average and standard deviation of the deficit-to-money ratio is 19.65% and 38.14 in high-income countries, and 26.20% and 39.84 in middle- and low-income countries. Then, scaling by GDP, the average and standard deviation of the deficit-to-GDP ratio are 2.73% and 4.49 in high-income countries, and 3.72% and 6.13 in middle- and low-income countries. Obviously, whether scaling by money or GDP, the fiscal deficit is more critical in middle- and low-income countries.

The average money growth rate is 12.90% in high-income countries and 38.94% in middle- and low-income countries. Its standard deviation is 23.02 in high-income countries and an astounding 344.25 in middle- and low-income countries. Apparently, money growth gets better control in high-income countries. The average growth rate of real GDP per capita and its standard deviation are 2.95% and 4.27 in high-income countries, and 2.07% and 6.59 in middle- and low-income countries. The long-term economic growth is higher and more stable in high-income countries. The average oil price inflation is 15.34% in high-income countries, but is 124.07% in middle- and low-income countries. It might be because exchange rates devaluate in middle- and low-income countries greater than in high-income countries. And finally, high-income countries are more open and have a higher dependence on trade.

Table 3 provides a summary of the descriptive statistics of the original data in OECD countries (panel A) and non-OECD countries (panel B). We can see that the characteristics of variables do not change a lot. The average inflation rate and its standard deviation are 6.36% and 7.06 in OECD countries, and 34.76% and 357.58 in non-OECD countries. This means that inflation is at a higher level and more volatile in non-OECD countries.

The average fiscal deficits scaling by money are 14.99% and 26.99% in OECD and non-OECD countries respectively, and the standard deviations are 22.38 and 43.43. Scaling by GDP, the average fiscal deficits are 2.56% and 3.65% in OECD and non-OECD countries, and the standard deviations are 3.95 and 6.07 respectively. Similarly, a fiscal deficit is a more critical problem in non-OECD countries.

About other variables, the average money growth rate is 11.59% in OECD countries and 35.91% in non-OECD countries and its standard deviation is 12.87 in high-income countries and 320.69 in non-OECD countries. Money growth is well controlled in non-OECD countries. The average growth rate of real GDP per capita and its standard deviation are 2.90% and 3.27 in OECD countries, and 2.21% and 6.54 in non-OECD countries. Similarly, the long-term growth rate is higher and more stable in OECD countries. The average oil price inflation is 14.65% in OECD countries and 109.71% in non-OECD countries. And finally, openness in OECD countries is higher than in non-OECD countries, and this means that OECD countries are more dependent on trade.

In general, we can find that from 1960–2006 to 1980–2006, the macroeconomic performance and related variables deteriorate and become more volatile, and they develop into better and more stable entities after 1990. Openness is the only variable that consistently goes higher. On the other hand, whether classifying countries by income level or OECD membership, macroeconomic variables, including inflation and fiscal deficits, perform better and are more stable in countries in higher development, and perform worse and are more unstable in countries in lower development.

4.2 Cross-sectional results

First, the deficit-inflation linkage is examined with the long-term average data over the period covering 1960–2006. Given a specific quantile τ, the empirical model of quantile regression is

$$\pi_i = x_i^{'}\beta(\tau) + \varepsilon_i(\tau), \tag{15}$$

where π_i is the logarithm of the average of annual inflation (log(inflation)), and inflation is measured by the percent change in the CPI index. Taking the logarithmic transformation could normalize the data and reduce the effect of the extreme data. x_i is a vector of explanatory variables, including intercepts and fiscal deficits. $\beta(\tau)$ is a vector of parameters at a specific quantile τ, and $\varepsilon_i(\tau)$ is an error term.

The cross-sectional results are shown in Table 4. Table 4 reports the coefficients at various quantiles from 0.1 to 0.9, and also reports the results of OLS for comparison. For calculating a confidence interval, bootstrapping is employed to estimate stand errors, and the number of re-sampling times is 1000. We can find that the deficit-inflation relationship is weak and not robust in the long-term average data, and this result is consistent with some previous empirical studies, such as those observed by Click (1998) and Kwon et al. (2009).

First, the theoretical model of Catão and Terrones (2005) is followed. They modeled the deficit-inflation relationship with scaling deficits by narrow money which stands for the size of the inflation tax base. The results are reported in panel (A) of Table 4 and plotted on the upper part of Figure 1. The black solid and black dotted lines indicate coefficients at various quantiles and the 95% confidence interval respectively. The grey solid line is the OLS estimate. We can see that from quantiles 0.1 to 0.9, the coefficients of the average deficit-to-money ratio are 0.5287, 0.5869, 0.5803, 0.7813, 0.7457, 0.6716, 0.8603, 0.8144 and 1.7967. From quantiles 0.1 to 0.5, the coefficients are significant at the 1% level, and significant at the 5% level at quantile 0.6 and 0.7. However, the coefficient is insignificant at quantile 0.8. Although it seems that the long-term average deficits become inflationary as long-term average inflation rises, it is not significant enough at the top quantile. On the other hand, the OLS coefficient is 0.8687 at the 1% level of significance; it indicates that average deficit-to-money ratios have a positive impact on average inflation.

Second, the standard specification of scaling fiscal deficits by GDP rather than money is estimated. The results are shown in panel (B) of Table 4 and plotted in on the middle part of Figure 1. The same black solid and the black dotted lines indicate coefficients at various quantiles and the 95% confidence interval respectively. The grey solid line is the OLS estimate. We can see that the coefficients of the average deficit-to-GDP ratios are 4.7201, 4.2520, 3.7353, 3.2610, 2.9507, 2.1895, 1.7003, 3.3068, 4.5772 and 8.1045 from quantiles 0.1 to 0.9. They are significant at the 1% level from quantiles 0.1 to 0.3 and at the 5% level at quantile 0.4, but insignificant from quantiles 0.5 to 0.9. The OLS coefficient is 0.8687 at the 1% level of significance. Compared with scaling deficits by money, the deficit-to-GDP ratio is significant at fewer quantiles and shows that the long-term relationship is weak. However, the OLS estimator is still positively significant.

Finally, with the standard specification of scaling fiscal deficits by GDP, the average money growth rates are controlled in equation (15), such as Kwon et al. (2009). As inflation, the average money growth is transformed into a logarithmic form. The results are shown in panel (C) of Table 4 and the lower part of Figure 1. The meanings of the black solid line, the black dotted line, and the grey solid line are defined above. From quantiles 0.1 to 0.9, the coefficients of the average deficit-to-GDP ratio are 2.5915, 1.1392, 1.0395, -0.1321, 0.1123, 0.5190, 0.6264, 0.5740 and -0.1386, and the coefficients of the average money growth are 0.6631, 1.2118, 1.2456, 1.2775, 1.2526, 1.2569, 1.2467, 1.3152 and 1.3279. All of the coefficients of the deficit-to-GDP ratio are insignificant, and all of the coefficients of the money growth are significant at a 1% level except quantile 0.1, where the coefficient is significant at the 10% level. The OLS estimates of the deficit-to-GDP ratio and the money growth are 0.6031 and 1.1724 respectively. The same, the deficit-to-GDP ratio is insignificant and the money growth is at a 1% level of significance.

Compared with previous studies, Click (1998) discovered that domestic debt has no effect on seigniorage with long-term average data, and therefore fiscal variables are not inflationary. Kwon et al. (2009) found a weak relationship between public debt and inflation over the long term. On the other hand, Fischer et al. (2002) showed that fiscal deficits positively affect inflation in the long-term average data in a full sample.

Accordingly, only when the long-term average money growth is not controlled, the OLS estimators are consistent with Fischer et al. (2002). Otherwise, the estimated results are weak or nonexistent. Hence, my cross-sectional results show that the fiscal deficit is weakly associated with inflation and not robust in the long-term average data, so it tends to be in line with Click (1998) and Kwon et al. (2009).

As Kwon et al. (2009) illustrated, in the long run, debt must be solved with a fiscal surplus or be monetized ultimately, and which one is chosen is determined by the policy regime (Sargent, 1982). However, the policy regime could be different in each country and change over time, so it is difficult to find a statistical linkage of fiscal variables and inflation in long-term average data.

4.3 Dynamic panel results

4.3.1 The baseline analysis

Since long-term average cross-sectional data cannot clarify the relationship between fiscal deficits and inflation, the panel data provides another approach to estimating the deficit-inflation relationship in the long-run. Panel data estimation contains individual time-invariant terms for controlling country-specific effects, and could allow for an intrinsically dynamic adjustment to distinguish the long-run effect. Empirically, given a specific quantile τ, the dynamic panel quantile regression model is

$$\pi_{it} = \eta_i + \alpha(\tau)\pi_{it-1} + \sum_{j=0}^{p} x'_{it-j}\beta_j(\tau) + \varepsilon_{it}(\tau), \tag{16}$$

where π_{it} is the logarithm of one plus annual inflation (log(1+inflation)), and inflation is measured by an annual change in the CPI index. η_i is a time-invariant individual effect, x_{it-j} refers to current and lagged fiscal deficits, and $\varepsilon_{it}(\tau)$ is an error term. $\alpha(\tau)$ and $\beta_j(\tau)$ are the parameters to be estimated, and $\sum_{j=0}^{p}\beta_j(\tau)$ is what we are concerned with. Dynamic panel quantile regression of Lin (2010), which is a two-stage fitted value approach, is employed to estimate equation (16), and lagged differenced dependant variables are taken as instruments.

Lagged inflation is included on the right-hand side to capture persistence and dynamic adjustment. The fiscal deficit is scaled by narrow money, which is modeled by Catão and Terrones (2005). They scaled the deficit by narrow money rather than by GDP, because the former (narrow money) stands for the size of the inflation tax base. Thus, given a change in the deficit-to-GDP ratio, the economy in higher inflation would be impacted by deficits more strongly, because its inflation tax base is typically more narrow. In addition, the fiscal deficits do not necessarily impact on inflation contemporaneously since the government can borrow and allocate seigniorage intertemporally. Therefore, the fiscal deficit is considered to be a distributed-lag due to the dynamic relationship. Accordingly, the deficit-inflation relationship is nonlinear and dynamic, so the summations of the coefficients, $\sum_{j=0}^{p}\beta_j(\tau)$, is what we are concerned with. I choose $p = 3$ because p is smaller or equal to 3 in most empirical studies.[9] For allowing the dynamic terms, the observations from 1960 to 1963 are dropped.

With the data of full samples (91 countries) over a period of 1960–2006,[10] the results of taking one instrumental variable ($\Delta\pi_{it-1}$) is shown in Table 5 and the upper part of Figure 2. Standard errors are estimated by bootstrapping, and the number of resampling times is 1000.

For comparing the results of dynamic panel quantile regression, the estimates of dynamic GMM of Arellano and Bond (1991) (D-GMM L) are reported as well, where lagged levels of the dependent variable are taken as instruments. On the other hand, for comparison, I also take lagged differenced dependent variables as instruments in dynamic GMM (D-GMM D). Additionally, the number of instruments in D-GMM L and D-GMM D is in line with the number of instruments in dynamic panel quantile regression, and the differenced exogenous variables are also taken as instruments in GMM.

In Table 5, $\sum_{j=0}^{3}\text{deficit/money}_{t-j}$ is the summation of the coefficients of current and all lagged deficits ($\sum_{j=0}^{p}\beta_j(\tau)$), and that is what we are most concerned with. From quantiles 0.1 to 0.9, the summations of the coefficients are 0.0094 0.0165, 0.0236, 0.0272, 0.0312, 0.0369, 0.0452, 0.0660 and 0.1128. They are insignificant at quantile 0.1, significant at the 5% level at quantile 0.2 and significant at the 1% level at quantiles 0.3–0.9. We can find that the summation of the coefficients becomes larger as the quantile rises. It means that fiscal deficits have no impact on inflation when the inflation is at a low level, but deficits would be more inflationary as inflation rises. The coefficients of D-GMM L and D-GMM D are 0.0438 and 0.0853

[9]For example, Karras (1994) chose $p = 3$, Fischer et al. (2002) chose $p = 2$ and Catão and Terrones (2005) chose $p \leq 3$.

[10]Data of inflation and deficit-to-money ratio are both stationary over 1960–2006. The t-statistics of the Levin-Lin-Chu test (one lag) for inflation and deficit-to-money ratio are -29.95 and -25.93 respectively.

respectively, and both are significant at the 1% level. However, the outcome of D-GMM L the estimator is closer to the outcome of quantile regression and roughly equal to the average of coefficients at nine quantiles. The outcome of D-GMM D is apparently greater than the outcomes of D-GMM L and near to the coefficient of quantile regression at quantile 0.9.

As we can see, the estimates of fiscal deficits are shown on the upper part of Figure 2. The horizontal and vertical axes indicate quantiles and coefficients respectively. The black solid line represents the coefficients of the dynamic panel quantile regression, and the black dotted lines represent 95% confidence interval of the quantile regression. The gray solid and the gray dotted lines indicate the coefficients of D-GMM L and D-GMM D respectively. Obviously, the estimates of quantile regression are positively related to the quantile, and insignificant at low quantile (0.1).

Accordingly, the impact of fiscal deficits at various inflation levels could be observed by quantile regression, and the "high inflation rate" or "high inflation episodes" need not to be defined arbitrarily. On the other hand, the dynamic GMM estimators only show the average impact of deficits on inflation.

Compared with previous literature studies, my empirical results confirm the findings of many empirical research on the deficit-inflation relationship (De Haan and Zelhorst, 1990; Fischer et al., 2002; Catão and Terrones, 2005; Domaç and Yücel, 2005) — fiscal deficits will be more inflationary the higher the inflation rate, and they will play a weak or non-existent role in inflation when inflation is at a low level. Therefore, fiscal consolidation would become more effective in price stabilization as inflation rises.

In addition, the estimates of lagged inflation are also reported in Table 5. From quantile 0.1 to 0.9, the coefficients are 0.2266, 0.3102, 0.3299, 0.3677, 0.3735, 0.3697, 0.4447, 0.4531 and 0.5687. They are significant at the 5% level at quantiles 0.2 and 0.3, and significant at the 1% level from quantile 0.4 to 0.9. Hence, lagged inflation is significant and positively related to current inflation. This means that inflation is persistent, and the relationship between lagged and current inflation tends to be stronger when inflation is higher. Only at a low level, will the lagged inflation not affect current inflation, and inflation is not persistent.

Next, there are more lagged difference inflation terms taken as instrumental variables in equation (16). The results of taking two instrumental variables ($\Delta\pi_{it-1}$ and $\Delta\pi_{it-2}$) are shown in Table 6 and the middle part of Figure 2, and the results of taking three instrumental variables ($\Delta\pi_{it-1}$, $\Delta\pi_{it-2}$ and $\Delta\pi_{it-3}$) are shown in Table 7 and the lower part of Figure 2.

With two instrumental variables, the summations of the coefficients of deficit-to-money ratios are 0.0089, 0.0151, 0.0228, 0.0277, 0.0305, 0.0344, 0.0441, 0.0650 and 0.1137 from quantile 0.1 to 0.9. They are insignificant at quantile 0.1, significant at the 5% level at quantile 0.2 and significant at the 1% level at quantiles 0.3–0.9. The estimates of D-GMM L and D-GMM D are 0.0421 and 0.0636 respectively, and both are significant at the 1% level. With three instrumental variables, the summations of the coefficients of deficit-to-money ratios are 0.0112, 0.0145, 0.0229, 0.0268, 0.0301, 0.0364, 0.0454, 0.0656 and 0.1124 from quantile 0.1 to 0.9. The same, they are insignificant at quantile 0.1, significant at the 5% level at quantile 0.2 and significant at the 1% level at quantiles 0.3–0.9. The estimates of D-GMM L and D-GMM D are 0.0345 and 0.0473 respectively, and both are significant at the 1% level.

Compared with one instrumental variable, taking two and three instrumental variables have very similar results in quantile regression — fiscal deficits will be more inflationary as inflation rises, and fiscal deficits play no role in inflation when inflation is at a low level. Therefore, the number of al variables would not change the results. Similarly, taking two and three instruments do not change the estimates of D-GMM L a lot. However, the estimates of D-GMM D will change when more instruments are taken, so D-GMM D is not as stable as quantile regression and

D-GMM L.

By means of a quantile regression, the advantage of scaling deficits by narrow money, which is suggested by Catão and Terrones (2005), is apparent. Given a change in the deficit-to-GDP ratio, the economy in higher inflation would be impacted by deficits more strongly. Furthermore, the more standard specifications, which scales fiscal deficits by GDP, are estimated with the data of the same 91 countries over the period spanning form 1960–2006.[11] The results are reported in Table 8 and the estimates of the deficit-to-GDP ratios are plotted on the upper part of Figure 3. From quantile 0.1 to 0.9, the summations of the coefficients of the lagged and current deficit-to-GDP ratios are 0.1704, 0.1537, 0.1734, 0.1841, 0.1936, 0.2208, 0.2843, 0.3651 and 0.5961. The deficit-to-GDP ratio is also more inflationary when inflation is higher. Although it is significant at the 1% level at quantiles 0.1–0.7 and at the 5% level at quantile 0.8, however, it is insignificant at quantile 0.9. The D-GMM L and D-GMM D coefficient are 0.3798 and 0.6236 respectively, and both are significant at the 1% level. As we can see in Figure 3, it is observable that the deficit-to-GDP ratio is insignificant at quantile 0.9 because its volatility is too large.

Different from scaling deficits by narrow money, the deficit-to-GDP ratio is significant at a low quantile (0.1) and insignificant at a top quantile (0.9), although it is also more inflationary as inflation goes higher. Therefore, this outcome is not in line with previous studies, which show that the impact of fiscal deficits is stronger when inflation is high.

However, if money growth rates are included in x_{it-j} (refer to the model proposed by Kwon et al., 2009, and many empirical works such as Darrat, 1985, Giannaros and Kolluri, 1986, Karras, 1994, and most papers which employ VAR),[12] the results are ameliorated and shown in Table 9 and the estimates of the deficit-to-GDP ratios

[11]Data of the deficit-to-GDP ratio is stationary over 1960–2006, and the t-statistic of the Levin-Lin-Chu test (one lag) for the deficit-to-GDP ratio is -25.45.

[12]Data of the money growth rate is stationary over 1960–2006, and the t-statistic of the Levin-Lin-Chu test (one lag) for money growth is -29.68.

are plotted on the lower part of Figure 3.[13] (As inflation, money growth is also transformed into a logarithmic form (log(1+money growth)).) From quantile 0.1 to 0.9, the summations of coefficients of the deficit-to-GDP ratios are 0.1147, 0.1473, 0.1545, 0.1829, 0.1885, 0.2104, 0.2170, 0.2208 and 0.2416. They are significant at the 1% level at quantiles 0.1–0.8 and significant at the 5% level at quantile 0.9. Although the deficit-to-money ratio is insignificant at quantile 0.1, the summation of coefficients of deficit-to-GDP ratios still becomes larger as the quantile goes higher. Therefore, when standard specifications (deficit-to-GDP ratio) are estimated, the money growth rates should be controlled. The D-GMM L and D-GMM D estimators are 0.5190 and 0.5372 respectively, and both are significant at the 1% level. These two estimators also support that fiscal deficit is inflationary.

In summary, the dynamic panel results over 1960–2006 show that as inflation rises, the fiscal deficits will be more inflationary, and fiscal deficits will play a weak or non-existing role in inflation when inflation is at a low level. Whether I scale deficits by money, or scale deficits by GDP and control money growth, the results will not change. Therefore, we can know that fiscal consolidation would become more effective in price stabilization as inflation rises.

4.3.2 The extensive analysis

For testing if the deficit-inflation relationship is suitably stable, other possible explanatory variables are taken into consideration in equation (16). If the deficit-inflation relationship is sufficiently robust, it should not change after controlling for other explanatory variables. Then, the empirical model would be

$$\pi_{it} = \eta_i + \alpha(\tau)\pi_{it-1} + \sum_{j=0}^{p} x'_{it-j}\beta_j(\tau) + w'_{it}\gamma(\tau) + \varepsilon_{it}(\tau), \tag{17}$$

where w_{it} is a set of exogenous controlled variables excluding deficits, and $\gamma(\tau)$ is its parameter to be estimated. Other notations are defined above.

[13] Corresponding to fiscal deficits, money growth is also lagged three periods.

Other exogenous variables are the growth rate of real GDP per capita, oil price inflation, openness and the exchange rate regime. The growth rate of real GDP per capita is the annual change in real GDP per capita, and oil price inflation is the annual change in the average crude price of petroleum in local currency. Because these two variables are both covering the annual change rate, they are transformed into a logarithmic form (log(1+growth) and log(1+oil price inflation)) as inflation. Openness is defined as an average of the import- and export-to-GDP ratio, and the exchange rate regime is represented by a de facto index of Reinhart and Rogoff (2004).[14]

First, the growth rate of real GDP per capita is considered as a controlled variable in equation (17), and the results are reported in Table 10 and the estimates of fiscal deficits are plotted on the upper part of Figure 4. The meanings of the black solid and the black dotted line are estimates of quantile regression and its 95% confidence interval, and the gray solid and the gray dotted line indicate coefficients of D-GMM L and D-GMM D. The deficit-inflation relationship does not change after controlling the growth. From quantile 0.1 to 0.9, the coefficients are 0.0101, 0.0153, 0.0227, 0.0262, 0.0294, 0.0353, 0.0429, 0.0635 and 0.1120. They are insignificant at quantile 0.1, significant at the 5% level at 0.2, and significant at quantiles 0.3–0.9. Fiscal deficit is still more inflationary as the quantile is higher.

On the other hand, the coefficients of growth are -0.0795, -0.1028, -0.1065, -0.1286, -0.1560, -0.1982, -0.2430, -0.3062 and -0.5654 from quantiles 0.1 to 0.9, and they are insignificant at quantile 0.1 and significant at the 1% level at quantiles 0.2–0.9. The D-GMM L and D-GMM D estimators are -0.4001 and -0.2630, and both are significant at the 1% level. For this reason, growth is negatively related to inflation, and the higher the inflation rate the stronger the relationship. It means that inflation decline with growth in real GDP per capita, and the higher the inflation the more

[14] All variables are stationary over 1960–2006, and the t-statistic of the Levin-Lin-Chu test (one lag) for the growth rate of real GDP per capita, oil price inflation and openness are -41.73, -42.71, and -13.73 respectively.

helpful the growth.

Second, oil price inflation is also a well-known inflationary factor. Theoretically, Ball and Mankiw (1995) proposed a model to describe supply-side shocks, such as an increase in the relative price of oil, could affect the aggregate price level. Consequently, the movement of the oil price is considered as a controlled variable in several empirical research studies on inflation (Longani and Swagel, 2001; Catão and Terrones, 2005).[15]

The results of controlling growth of GDP per capita and oil price inflation are shown in Table 11 and the estimates of fiscal deficits are plotted on the lower part of Figure 4. The summations of the coefficients of deficit-to-money ratios are 0.0108, 0.0223, 0.0251, 0.0288, 0.0329, 0.0380, 0.0489, 0.0651 and 0.0793 from quantiles 0.1 to 0.9. They are insignificant at quantile 0.1, and significant at the 1% level at quantiles 0.2–0.9. Accordingly, the results of deficits do not change, and the deficits still tend to be inflationary as inflation goes higher. Next, from quantile 0.1 to 0.9, the coefficients of oil price inflation are 0.0481, 0.0391, 0.0449, 0.0595, 0.0739, 0.1010, 0.1319, 0.1875 and 0.3059. They are all significant at the 1% level. Thus, the oil price shock is actually an inflationary factor, and the higher the inflation rates the more associated they are with oil price shock.

Third, trade openness is taken as an explanatory variable. Romer (1993) argued that trade openness could lower the time-inconsistent problem of the monetary policy, so trade openness should be negatively associated with inflation. Empirically, many research studies have supported that the openness-inflation relationship is negative (Romer, 1993; Lane, 1997; Alfaro, 2005). Investigating the deficit-inflation relationship, Catão and Terrones (2005) also considered openness as a controlled variable.

[15]Longani and Swagel (2001) measured the average oil prices in dollars, so the oil price is the same for each country in their estimation. I consider that measurement in the local currency is more reasonable, because each country can face various energy prices. Nevertheless, whether measuring in dollars or local currency, the results would not change a lot.

Taking growth of GDP per capita, oil price inflation and trade openness in equation (17), the results in Table 12 show that the coefficients of openness a little vary among estimators of D-GMM L, D-GMM D and quantile regression. The D-GMM L coefficient is -0.0791 and significant at the 1% level, but the D-GMM D coefficient is -0.0157 and insignificant. On the other hand, the estimates of quantile regression are 0.0042, -0.0030, -0.0070, -0.0100, -0.0118, -0.0162, -0.0174, -0.0148 and -0.0188, but all are insignificant. Although these three estimators are in line with the predicted sign, only the D-GMM L estimator is significant. Therefore, there are some areas of evidence which support that openness could reduce inflation, but it is not as robust.

On the other hand, Table 12 and the upper part of Figure 5 show that the results of deficits are stable. From quantiles 0.1 to 0.9, the summations of the coefficients of the deficit-to-money ratios are 0.0166, 0.0213, 0.0243, 0.0286, 0.0317, 0.0379, 0.0484, 0.0638 and 0.0780. They are significant at the 5% level at quantile 0.1, and significant at the 1% level at quantiles 0.2–0.9. There is a little difference with the above results, which show that the fiscal deficit is insignificant at quantile 0.1, but the fiscal deficit is significant at the 5% level after considering for openness. However, the summation of the coefficient is small and the value is near the results above. In addition, the summation of the coefficients still becomes larger as quantile grows higher, and it represents that fiscal deficits tend to lead to inflation when inflation is higher. It is still consistent with the above results.

Finally, the exchange rate regime is also a possible factor related to inflation. Conventional wisdom suggests that the fixed exchange rate regime could provide more monetary discipline, because policy makers have incentives to control the money supply or implement a stable monetary policy. Historically, many countries have used a fixed exchange rate as a nominal anchor for lowering inflation (Calvo and Végh, 1999). I use the exchange rate regime index of Reinhart and Rogoff (2004) as an explanatory variable.[16] Ranging from 0 to 6, the smaller the

[16]Reinhart and Rogoff (2004) classified the exchange regime according to data on market-

dummy the more fixed the exchange rate. In addition, the index is not available for a full sample, so the number of countries drops to 81 (see Appendix D).

After considering the growth of GDP per capita, oil price inflation, trade openness and the exchange rate regime, the estimated outcome is shown in Table 13 and the estimates of fiscal deficits are plotted on the lower part of Figure 5. We can see that the coefficients of the exchange rate regime are 0.0050, 0.0075, 0.0088, 0.0098, 0.0116, 0.0148, 0.0171, 0.0203 and 0.0248 from quantiles 0.1 to 0.9, and all are significant at the 1% level. Moreover, the D-GMM L and D-GMM D coefficients are 0.0157 and 0.0101 respectively, and both are significant at the 1% level. Hence, the estimated results support the conventional wisdom that the fixed exchange rate could reduce inflation, and the higher the inflation rate, the more correlated they are to the exchange rate regime.

On the other hand, the summations of the coefficients of deficit-to-money ratios are 0.0168, 0.0229, 0.0306, 0.0321, 0.0355, 0.0382, 0.0437, 0.0539 and 0.0693 from quantile 0.1 to 0.9. They are significant at the 5% level at quantile 0.1 and 0.2, and significant at the 1% level from quantile 0.3 to 0.9. The D-GMM L and D-GMM D coefficients are 0.0398 and 0.0826 at the 1% level of significance. The higher the inflation, the more correlated they are with fiscal deficits. Therefore, the results of fiscal deficit do not change after other explanatory variables are controlled.

Therefore, controlling for other possible inflation-related factors (growth of real GDP per capita, oil price inflation, openness and exchange rate regime) will not change the estimated deficit-inflation relationship. The dynamic panel results are stable and show that as inflation goes higher, inflation will be more associated with fiscal deficits. When inflation is at a low level, fiscal deficit is weakly associated or not related to inflation. Correspondingly, fiscal consolidation would be more helpful to price stabilization as inflation increases.

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determined parallel exchange rates, and their index is the de facto exchange regime classification rather than the official classification.

4.3.3 The country group-specific analysis

The above results are estimated with a full sample. However, the inflationary effect of fiscal deficits could vary across different country groups. According to previous empirical studies, the fiscal deficits might play a stronger role for inflation in developing countries, but play a weaker or even none role for inflation in developed economies (Giannaros and Kolluri, 1986; Protopapadakis and Siegel, 1987; Barhart and Darrat, 1988; De Haan and Zelhorst, 1990; Catão and Terrones, 2005; Kwon et al., 2009).

Therefore, I break down the full sample into two country groups of high-income vs. middle- and low-income countries and OECD vs. non-OECD countries to estimate equation (16),[17] where the high-income and OECD country groups represent the countries of a higher development level.[18] This breakdown is based on the classification of the World Bank list of economies (July 2009). In addition, the classification of "OECD" in this case are the OECD members which are in the high-income group. Therefore, the high-income group contains the OECD group.[19]

First, the results of high-income countries are shown in Table 14 and the upper part of Figure 6. The results of middle- and low-income countries is shown in Table 15 and the lower part of Figure 6. As we can see, from quantile 0.1 to 0.9, the summations of the coefficients of current and lagged deficit-to-money ratios of high-income countries are 0.0094, 0.0188, 0.0232, 0.0224, 0.0272, 0.0349, 0.0441, 0.0581

[17]Exogenous controlled variables (the growth rate of real GDP per capita, oil price inflation, openness and the exchange rate regime) are not considered here.

[18]Data of inflation and deficit-to-money ratio are both stationary in high-income, middle- and low-income, OECD and non-OECD countries. The t-statistics of the Levin-Lin-Chu test (one lag) for inflation in high-income, middle- and low-income, OECD and non-OECD countries are -16.51, -24.19, -12.27 and -25.95 respectively. The t-statistics of the Levin-Lin-Chu test (one lag) for the deficit-to-money ratio in high-income, middle- and low-income, OECD and non-OECD countries are -14.77, -21.55, -11.90 and -23.25 respectively.

[19]The classification "OECD" is broadly consistent with the "advanced economies" of Catão and Terrones (2005). Cyprus is in their "advanced economies" but not in my "OECD" classification, and Hungary and Korea are not included in Catão and Terrones' evaluation but are included in mine.

and 0.0712. The summation of the coefficients becomes larger when the quantile goes higher as above, but the coefficient is only significant at the 5% level at quantiles 0.8 and 0.9, and significant at the 10% level at quantiles 0.2, 0.3 and 0.7. On the other hand, the summations of the coefficients of current and lagged deficit-to-money ratios of middle- and low-income countries are 0.0210, 0.0235, 0.0301, 0.0291, 0.0328, 0.0369, 0.0434, 0.0733 and 0.1362 from quantiles 0.1 to 0.9. We can see that the higher the quantile, the larger the summation of the coefficients. They are insignificant at quantile 0.1 and significant at the 5% level at the other quantiles except for quantile 0.7, where the estimate is significant at the 10% level.

Second, the results of the OECD countries are shown in Table 16 and the upper part of Figure 7, and the results of non-OECD countries are shown in Table 17 and the lower part of Figure 7. Accordingly, the summations of the coefficients of OECD countries are 0.0142, 0.0217, 0.0215, 0.0224, 0.0288, 0.0365, 0.0412, 0.0378 and 0.0436 from quantile 0.1 to 0.9. They are significant at the 1% level at quantiles 0.2, 0.3 and 0.6–0.8, significant at the 5% level at quantiles 0.1, 0.4 and 0.5, and significant at the 10% level at quantile 0.9. The coefficient is still larger as the quantile goes higher. On the other hand, the summations of the coefficients of non-OECD countries are 0.0181, 0.0246, 0.0286, 0.0302, 0.0339, 0.0386, 0.0480, 0.0748 and 0.1148 from quantiles 0.1 to 0.9. The coefficient becomes larger as the quantile goes higher, and they are significant at the 5% level at quantiles 0.2–0.7 and significant at the 1% level at quantiles 0.8 and 0.9. Compared the summations of the coefficients of the current and lagged deficit-to-money ratios, we can see that fiscal deficits impact middle- and low-income or non-OECD countries more strongly than high-income or OECD countries, especially at a high inflation level.

In conclusion, we can find that in whatever country group, the higher the quantile, the larger the summation of the coefficients. However, in higher development countries such as in high-income and OECD countries, fiscal deficits play a weaker role in inflation. Contrarily, the impact of fiscal deficits on inflation is generally greater in developing countries, which becomes more apparent when inflation is at a high level. In addition, in developing countries, fiscal deficits play no role only when inflation is at a low level (quantile 0.1).

Compared with the aforementioned previous research whose estimates of OECD or advanced countries are small and insignificant, the estimates of OECD countries are significant except for quantile 0.9 in my study. Nevertheless, the estimates of OECD countries are all smaller than the estimates of non-OECD countries, and both the D-GMM L and D-GMM D estimators are negative and insignificant. Hence, the inflationary effect of fiscal deficits is not robust and may not exist in OECD countries.

There are some explanations for various inflationary effects of fiscal deficits. In developing countries, a smaller taxable capacity, political instability, a less independent central bank, and limited access to domestic and external debt financing could lower the relative costs of seigniorage and inflation tax, so the governments tend to rely on monetary accommodation. On the other hand, in higher development countries, financial depths are deeper, so public bonds could be absorbed and the governments would depend less on monetization (De Haan and Zelhorst, 1990; Cukierman et al. 1992; Alesina and Summers 1993; Aisen and Veiga, 2008).

4.3.4 The subsample period analysis and central bank independence

For examining whether the parameters are robust or not, I ran regressions for three sub-sample periods: 1970–2006, 1980–2006 and 1990–2006, which contained 96, 101 and 98 countries respectively.[20] These three sub-sample periods are divided arbitrarily, because the main results above are estimated over the period from 1960–2006. Equation (16) is estimated as follows.[21] As the observations of the main

[20] Recall that the datasets of the main results over 1960–2006 contains 91 countries.

[21] As the country group-specific analysis, exogenous controlled variables are not considered here. Data of inflation and the deficit-to-money ratio are both stationary over 1970–2006, 1980–2006 and 1990–2006. The t-statistics of the Levin-Lin-Chu test (one lag) for inflation over 1970–2006, 1980–2006 and 1990–2006 are -27.61, -25.17 and -293.28; and the t-statistics of the Levin-Lin-Chu test (one lag) for the deficit-to-money ratio is over 1970–2006, 1980–2006 and 1990–2006 are -25.32,

results, the observations during 1970–1973, 1980–1983 and 1990–1993 are dropped.

First, the results covering 1970–2006 are shown in Table 18 and the upper part of Figure 8. From quantile 0.1 to 0.9, the summations of the coefficients of current and lagged deficit-to-money ratios are 0.0039, 0.0119, 0.0178, 0.0222, 0.0266, 0.0315, 0.0440, 0.0634 and 0.1072 respectively, and insignificant at quantile 0.1 and 0.2, and significant at a 10% level at quantile 0.3, significant at a 5% level above quantile 0.4, and significant at a 1% level at quantile 0.8 and 0.9. The estimates of D-GMM L and D-GMM D are 0.0453 and 0.0704, and both are significant at a 1% level.

Second, the results covering 1980–2006 are shown in Table 19 and the lower part of Figure 8. From quantile 0.1 to 0.9, the summations of the coefficients of current and lagged deficit-to-money ratios are -0.0014, 0.0051, 0.0098, 0.0140, 0.0182, 0.0219, 0.0291, 0.0448 and 0.0961 respectively, and insignificant from quantile 0.1 to 0.4. They are significant at a 10% level at quantiles 0.5 and 0.8, and significant at a 5% level above quantile 0.6, 0.7 and 0.9. The estimates of D-GMM L and D-GMM D are 0.0414 and 0.0958, and both are significant at a 1% level.

Third, the results covering 1990–2006 are shown in Table 20 and the upper part of Figure 9. From quantile 0.1 to 0.9, the summations of the coefficients of the current and lagged deficit-to-money ratio are -0.0234, -0.0198, -0.0139, -0.0118, -0.0106, -0.0071, -0.0037, -0.0016 and 0.0190, and negatively significant at a 5% level from quantile 0.1 to 0.4, which is significant at a 10% level at quantile 0.5 and 0.8 and is insignificant at quantile 0.4, 0.5 and 0.9. The estimates of D-GMM L and D-GMM D are 0.0253 and 0.0330 respectively. The former is significant at a 5% level and the latter is significant at a 1% level. However, the estimates of quantile regression are insignificant, so the results are not robust.

Compared with the main results covering 1960–2006 (see Table 5 and Figure 2), we know that the results covering 1970–2006 are broadly unchanged. The results covering 1980–2006 shifts slightly downward, but they are still similar with the main

-25.74 and -25.05 respectively.

results. The higher the quantile, the larger and more significant are the coefficients. However, the results covering 1990–2006 appreciably shift downward, and the sign of the coefficients at the low quantile becomes significantly negative, which is opposite to the theoretical prediction. In addition, although the signs of the coefficients D-GMM L and D-GMM D are both positive, the results are not robust.

Therefore, the outcomes for various sub-sample periods confirm the results that fiscal deficits would be more inflationary as inflation is higher. Yet, after 1990, the inflationary effect of fiscal deficits is not detected, which means that the "fiscal dominance" hypothesis does not hold after the 90s.

A reasonable conjecture is that central banks around the world became more independent after the 90s (Crowe and Meade, 2007; Cukierman, 2008),[22] because a less independent central bank might be more possibly forced to finance budget deficits by money creation (fiscal dominance). Hence, the deficit-inflation relationship might emerge after controlling the effect of central bank independence.

For capturing the effect of central bank independence, I take the central bank independence index as controlled variable to estimate the deficit-inflation relationship after 90s again. Ranging from 0 to 1, the smaller the dummy the less independent the central bank. However, the central bank independence index is only up to the year 2000 and not available to a full sample during 1990–2006.[23] Due to the limitation of data availability, I investigated the deficit-inflation relationship during 1990–2000 and the number of countries drops to 57 (see Appendix E).[24]

After controlling the effect of central bank independence, the results over 1990–2000 are reported in Table 21 and plotted in the lower part of Figure 9. From quantile

[22]In my horizons, although some studies have investigated the deficit-inflation relationship for various sub-sample periods, no studies have estimated data from the 1990s to the 2000s.

[23]The central bank independence index is developed by Cukierman et al. (1992), but the data they provided is only up to the year 1988. Based on the measurement of Cukierman et al. (1992), Polillo and Guillén (2005) updated the data to the year 2000. The index I used here is calculated by Polillo and Guillén (2005).

[24]All variables are stationary over 1990–2000, and the t-statistic of the Levin-Lin-Chu test (one lag) for inflation and deficit-to-money ratio are -95.88 and -12.24 respectively.

0.1 to 0.9, the summations of the coefficients of the current and lagged deficit-to-money ratio are -0.0210, -0.0169, -0.0059, -0.0023, -0.0010, -0.0006, 0.0023, 0.0075 and 0.0193 respectively, and all of them are insignificant. The estimates of D-GMM L and D-GMM D are -0.0547 and -0.0574 respectively, and the former is insignificant and the latter is only significant at a the 10% level.

Accordingly, different from the prediction, the deficit-inflation relationship is still not detected after controlling the effect of central bank independence. Therefore, rather than central bank independence, there are other reasons for why “fiscal dominance” does not hold after 90s, such as a better coordination between the fiscal and monetary policy.

5 Conclusions

Sustained fiscal deficits might cause inflation by means of money creation, and the economy in a higher inflation level would be more strongly impacted by deficits. In this study, I investigated the deficit-inflation relationship with a panel dataset which covers 91 countries over 1960–2006. Empirically, I followed the theoretical model of Catão and Terrones (2005) to scale fiscal deficits by narrow money and considered fiscal deficits distributed-lag. Furthermore, a new econometric method, dynamic panel quantile regression of Lin (2010) was utilized for eliminating biases raised by the dynamic term and estimating the impacts of fiscal deficits at various inflation levels with a panel dataset.

Empirical results of the dynamic panel quantile regression show that sustained fiscal deficits will be more inflationary the higher the inflation, and play a weak or no role in inflation when inflation is at a low level. The estimated relationship remains while taking one or more lagged deference dependant variables as instruments. Scaling deficits by GDP and controlling money growth, the results are similar except that the estimates become significant at a low quantile (0.1). Accordingly, fiscal consolidation would be more effective in price stabilization as inflation rises higher. Also, the results remain robust while controlling the growth of GDP per capita, oil price inflation, openness and the exchange rate regime, so the deficit-inflation relationship can be stable. Compared with higher developed countries (represented by high-income and OECD countries), the impact of fiscal deficits on inflation is generally greater among developing countries (represented by middle- and low-income and non-OECD countries), which becomes more apparent when inflation is at a high level. Finally, the deficit-inflation relationship does not notably change during 1960–2006, 1970–2006 and 1980–2006. However, it is not detected over 1990–2006.

Dynamic panel quantile regression can help us observe the impacts of fiscal deficits at various inflation levels and allows for intrinsic dynamic adjustment. It is an outstanding econometric method for investigating the deficit-inflation relationship, and therefore the relationship becomes clearer.

Table 4: Cross-sectional results over 1960–2006

dependent variable: average inflation										
		quantile								
	OLS	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
(A)										
intercept	0.8038***	0.5273***	0.5497***	0.6352***	0.6687***	0.7211***	0.8067***	0.9077***	1.0556***	1.1622***
	(0.0671)	(0.0418)	(0.0394)	(0.0529)	(0.0487)	(0.0612)	(0.0704)	(0.0982)	(0.1183)	(0.1990)
average deficit/money	0.8687***	0.5287***	0.5869***	0.5803***	0.7813***	0.7457***	0.6716**	0.8603**	0.8144	1.7967*
	(0.2136)	(0.1465)	(0.1459)	(0.2116)	(0.2053)	(0.2365)	(0.3297)	(0.4118)	(0.5407)	(0.9735)
(B)										
intercept	0.8521***	0.4736***	0.5655***	0.6486***	0.7006***	0.8317***	0.9160***	0.9686***	1.1076***	1.2607***
	(0.0703)	(0.0478)	(0.0417)	(0.0411)	(0.0641)	(0.0903)	(0.0930)	(0.1098)	(0.1408)	(0.2240)
average deficit/GDP	4.7201***	4.2520***	3.7353***	3.2610***	2.9507**	2.1895	1.7003	3.3068	4.5772	8.1045
	(1.5965)	(1.1891)	(0.8453)	(0.8604)	(1.2634)	(2.0928)	(2.8107)	(3.4130)	(4.3226)	(6.2514)
(C)										
intercept	-0.4520***	-0.1403	-0.5977**	-0.5678***	-0.5579***	-0.5066***	-0.5113***	-0.4849***	-0.5360***	-0.4291**
	(0.0801)	(0.3432)	(0.2499)	(0.1226)	(0.0839)	(0.0692)	(0.0736)	(0.0862)	(0.1301)	(0.1675)
average deficit/GDP	0.6031	2.5915	1.1392	0.1848	-0.1321	0.1123	0.5190	0.6264	0.5740	-0.1386
	(0.7813)	(2.0766)	(1.3133)	(1.0395)	(0.9156)	(0.7143)	(0.5302)	(0.5106)	(0.5944)	(0.9388)
average money growth	1.1724***	0.6631*	1.2118***	1.2456***	1.2775***	1.2526***	1.2569***	1.2467***	1.3152***	1.3279***
	(0.0656)	(0.3396)	(0.2516)	(0.1163)	(0.0688)	(0.0517)	(0.0606)	(0.0714)	(0.1032)	(0.1233)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

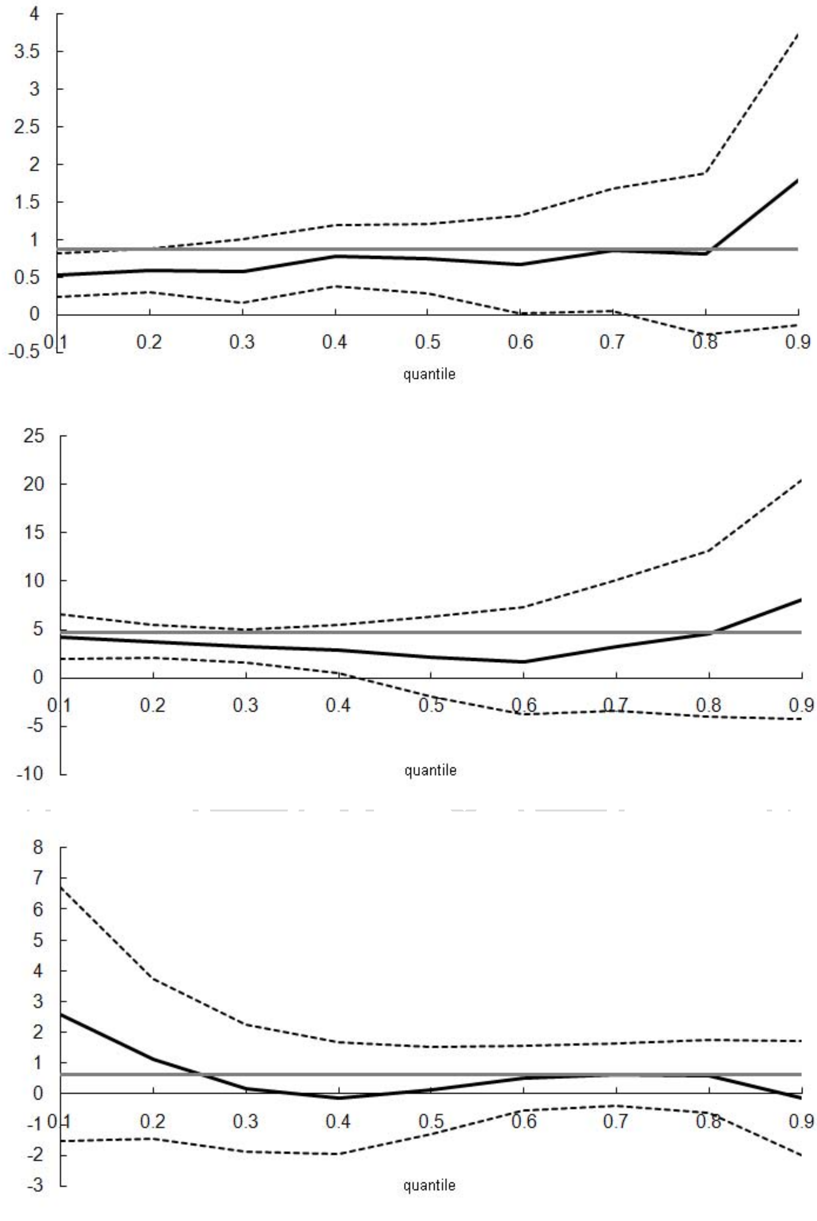


Figure 1: Cross-sectional results over 1960–2006

The upper is the estimates of average deficit/money. The middle is the estimates of average deficit/GDP. The lower is the estimates of average deficit/GDP and average money growth is controlled. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of OLS.

Table 5: Dynamic panel results over 1960–2006 I (A)

dependent variable: inflation											
			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0038*	0.0210***	0.4900	0.4970	0.5003	0.5024	0.5057	0.5110	0.5142	0.5232	0.5369
	(0.0022)	(0.0021)	(3.1146)	(3.1148)	(3.1147)	(3.1147)	(3.1148)	(3.1147)	(3.1146)	(3.1147)	(3.1147)
inflation_{t-1}	0.7294***	0.2176***	0.2266	0.3102**	0.3299**	0.3677***	0.3735***	0.3697***	0.4447***	0.4531***	0.5687***
	(0.0204)	(0.0348)	(0.1669)	(0.1452)	(0.1318)	(0.1261)	(0.1188)	(0.1165)	(0.1234)	(0.1394)	(0.1342)
deficit/money_t	0.0687***	0.0626***	-0.0026	0.0025	0.0073*	0.0105**	0.0134***	0.0142**	0.0178**	0.0259***	0.0263*
	(0.0039)	(0.0034)	(0.0063)	(0.0044)	(0.0044)	(0.0044)	(0.0050)	(0.0058)	(0.0077)	(0.0082)	(0.0135)
$\text{deficit/money}_{t-1}$	0.0105***	0.0372***	0.0048	0.0073**	0.0073**	0.0074***	0.0090***	0.0114***	0.0129**	0.0119	0.0448***
	(0.0037)	(0.0036)	(0.0058)	(0.0031)	(0.0031)	(0.0027)	(0.0030)	(0.0043)	(0.0051)	(0.0095)	(0.0135)
$\text{deficit/money}_{t-2}$	-0.0403***	-0.0166***	0.0071	0.0030	0.0046	0.0036	0.0042	0.0015	0.0044	0.0121***	0.0145**
	(0.0037)	(0.0034)	(0.0044)	(0.0031)	(0.0033)	(0.0032)	(0.0034)	(0.0038)	(0.0041)	(0.0045)	(0.0059)
$\text{deficit/money}_{t-3}$	0.0049	0.0021	0.0000	0.0037	0.0045	0.0056	0.0046	0.0098**	0.0102**	0.0161**	0.0272***
	(0.0040)	(0.0034)	(0.0068)	(0.0039)	(0.0038)	(0.0039)	(0.0045)	(0.0049)	(0.0050)	(0.0068)	(0.0083)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	0.0438***	0.0853***	0.0094	0.0165**	0.0236***	0.0272***	0.0312***	0.0369***	0.0452***	0.0660***	0.1128***
	(0.0080)	(0.0074)	(0.0105)	(0.0075)	(0.0079)	(0.0087)	(0.0104)	(0.0127)	(0.0152)	(0.0203)	(0.0257)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 6: Dynamic panel results over 1960–2006 I (B)

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0046^{**}	0.0157^{***}	0.6664	0.6753	0.6775	0.6817	0.6838	0.6864	0.6921	0.6994	0.7189
	(0.0021)	(0.0019)	(2.6058)	(2.6058)	(2.6057)	(2.6057)	(2.6057)	(2.6057)	(2.6057)	(2.6057)	(2.6058)
inflation_{t-1}	0.7228^{***}	0.4166^{***}	0.1993^{*}	0.2777^{***}	0.3070^{***}	0.3029^{***}	0.3376^{***}	0.3868^{***}	0.4134^{***}	0.4447^{***}	0.4506^{***}
	(0.0160)	(0.0207)	(0.1115)	(0.0962)	(0.0908)	(0.0820)	(0.0761)	(0.0874)	(0.0820)	(0.0746)	(0.0856)
deficit/money_t	0.0688^{***}	0.0635^{***}	-0.0033	0.0020	0.0080^{*}	0.0106^{**}	0.0134^{***}	0.0153^{**}	0.0183^{**}	0.0308^{***}	0.0224
	(0.0039)	(0.0035)	(0.0064)	(0.0043)	(0.0048)	(0.0046)	(0.0051)	(0.0064)	(0.0089)	(0.0088)	(0.0160)
$\text{deficit/money}_{t-1}$	0.0106^{***}	0.0258^{***}	0.0120^{*}	0.0081^{**}	0.0084^{**}	0.0106^{***}	0.0109^{***}	0.0111^{**}	0.0147^{**}	0.0184^{*}	0.0456^{***}
	(0.0036)	(0.0034)	(0.0063)	(0.0034)	(0.0034)	(0.0034)	(0.0042)	(0.0049)	(0.0058)	(0.0108)	(0.0145)
$\text{deficit/money}_{t-2}$	-0.0406^{***}	-0.0270^{***}	0.0073^{*}	0.0046^{*}	0.0039	0.0032	0.0029	0.0019	-0.0001	-0.0006	0.0043
	(0.0036)	(0.0033)	(0.0038)	(0.0028)	(0.0032)	(0.0031)	(0.0035)	(0.0042)	(0.0049)	(0.0076)	(0.0130)
$\text{deficit/money}_{t-3}$	0.0033	0.0013	-0.0071	0.0004	0.0025	0.0032	0.0032	0.0061	0.0112^{**}	0.0163^{*}	0.0413^{***}
	(0.0039)	(0.0034)	(0.0084)	(0.0039)	(0.0040)	(0.0041)	(0.0045)	(0.0050)	(0.0055)	(0.0096)	(0.0121)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	0.0421^{***}	0.0636^{***}	0.0089	0.0151^{**}	0.0228^{***}	0.0277^{***}	0.0305^{***}	0.0344^{***}	0.0441^{***}	0.0650^{***}	0.1137^{***}
	(0.0077)	(0.0070)	(0.0104)	(0.0073)	(0.0080)	(0.0088)	(0.0102)	(0.0123)	(0.0149)	(0.0206)	(0.0259)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$ and $\Delta\pi_{it-2}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2}, π_{it-3} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$, $\Delta\pi_{it-3}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 7: Dynamic panel results over 1960–2006 I (C)

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0066***	0.0099***	0.5964	0.6061	0.6088	0.6111	0.6130	0.6155	0.6205	0.6304	0.6517
	(0.0020)	(0.0019)	(3.4057)	(3.4059)	(3.4058)	(3.4059)	(3.4058)	(3.4059)	(3.4058)	(3.4058)	(3.4056)
inflation$_{t-1}$	0.7197***	0.5998***	0.2420**	0.3064***	0.3258***	0.3553***	0.3947***	0.4459***	0.4718***	0.4609***	0.4626***
	(0.0141)	(0.0181)	(0.1151)	(0.0950)	(0.0828)	(0.0780)	(0.0818)	(0.0865)	(0.0769)	(0.0774)	(0.0691)
deficit/money$_t$	0.0653***	0.0670***	-0.0009	0.0032	0.0077*	0.0118***	0.0128**	0.0188***	0.0198**	0.0324***	0.0273
	(0.0038)	(0.0037)	(0.0069)	(0.0042)	(0.0044)	(0.0042)	(0.0050)	(0.0065)	(0.0085)	(0.0081)	(0.0180)
deficit/money$_{t-1}$	0.0090**	0.0164***	0.0120**	0.0111***	0.0105***	0.0099**	0.0096*	0.0100	0.0149**	0.0142	0.0438***
	(0.0036)	(0.0035)	(0.0058)	(0.0035)	(0.0038)	(0.0045)	(0.0057)	(0.0063)	(0.0076)	(0.0137)	(0.0146)
deficit/money$_{t-2}$	-0.0417***	-0.0361***	0.0017	-0.0009	0.0020	0.0030	0.0037	-0.0003	0.0029	0.0047	0.0128
	(0.0036)	(0.0034)	(0.0047)	(0.0034)	(0.0041)	(0.0049)	(0.0055)	(0.0059)	(0.0071)	(0.0106)	(0.0116)
deficit/money$_{t-3}$	0.0018	0.0000	-0.0016	0.0011	0.0028	0.0022	0.0040	0.0080	0.0078	0.0143*	0.0286***
	(0.0038)	(0.0036)	(0.0082)	(0.0043)	(0.0041)	(0.0044)	(0.0048)	(0.0055)	(0.0055)	(0.0081)	(0.0087)
$\sum_{j=0}^{3}$deficit/money$_{t-j}$	0.0345***	0.0473***	0.0112	0.0145**	0.0229***	0.0268***	0.0301***	0.0364***	0.0454***	0.0656***	0.1124***
	(0.0074)	(0.0071)	(0.0105)	(0.0072)	(0.0074)	(0.0083)	(0.0105)	(0.0127)	(0.0146)	(0.0193)	(0.0265)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$, $\Delta\pi_{it-2}$ and $\Delta\pi_{it-3}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2}, π_{it-3}, π_{it-4} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$, $\Delta\pi_{it-3}$, $\Delta\pi_{it-4}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

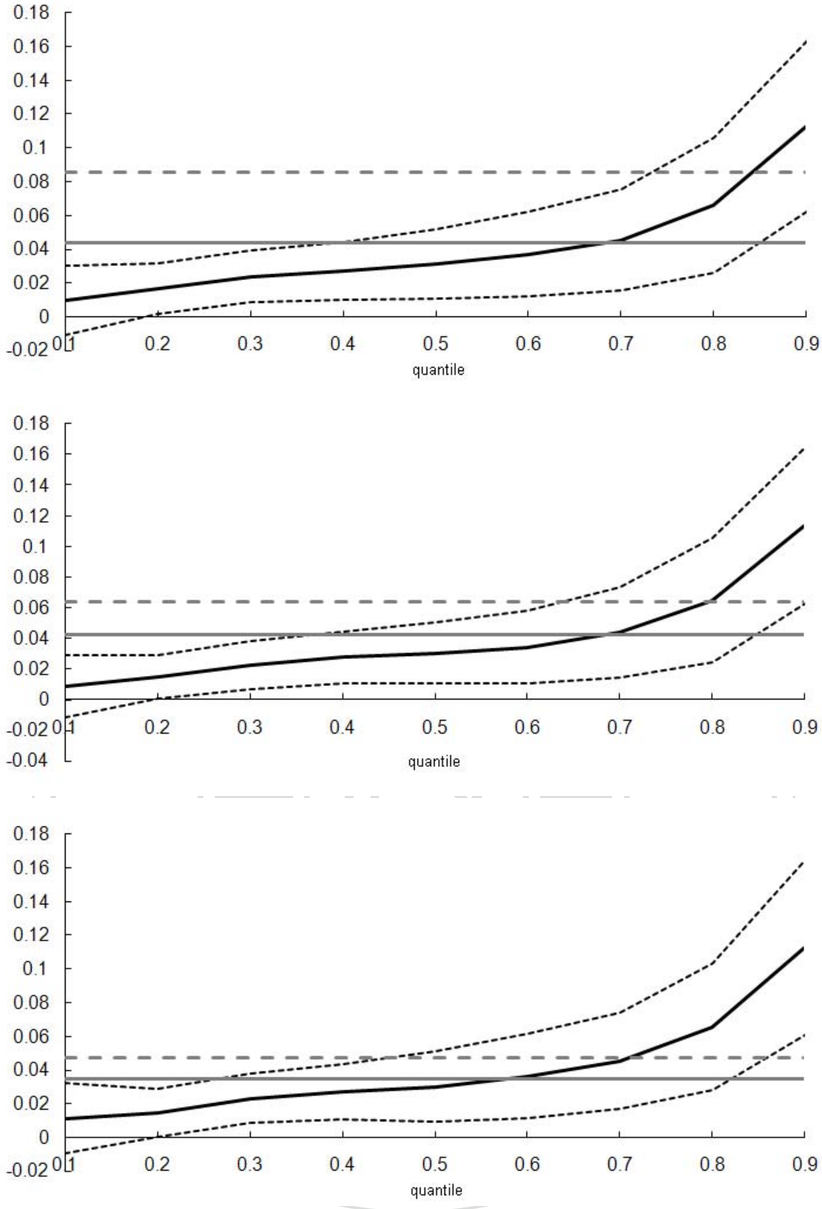


Figure 2: Dynamic panel results over 1960–2006 I

The estimates of $\sum_{j=0}^{3}\text{deficit/money}_{t-j}$. The upper is estimated with one instrument. The middle is estimated with two instruments. The lower is estimated with three instruments. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

Table 8: Dynamic panel results over 1960–2006 II (A)

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0031	0.0031***	0.3509	0.3609	0.3660	0.3696	0.3728	0.3762	0.3812	0.3897	0.4033
	(0.0023)	(0.0023)	(6.1837)	(6.1838)	(6.1838)	(6.1837)	(6.1837)	(6.1837)	(6.1838)	(6.1840)	(6.1838)
inflation_{t-1}	0.6993***	0.1419***	0.2008	0.2834**	0.2978**	0.3123**	0.3331***	0.3673***	0.4029***	0.4347***	0.5848***
	(0.0198)	(0.0323)	(0.1646)	(0.1399)	(0.1221)	(0.1246)	(0.1224)	(0.1153)	(0.1206)	(0.1425)	(0.1897)
deficit/GDP_t	0.4234***	0.3326***	-0.0048	0.0162	0.0173	0.0504	0.0491	0.0507	0.0467	0.0418	0.0261
	(0.0261)	(0.0227)	(0.0422)	(0.0289)	(0.0283)	(0.0331)	(0.0355)	(0.0386)	(0.0430)	(0.0553)	(0.1826)
deficit/GDP_{t-1}	0.2308***	0.3506***	0.0822**	0.0592**	0.0590***	0.0644***	0.0739***	0.0907***	0.1104**	0.1355*	0.3374**
	(0.0250)	(0.0225)	(0.0419)	(0.0278)	(0.0229)	(0.0245)	(0.0265)	(0.0317)	(0.0439)	(0.0776)	(0.1715)
deficit/GDP_{t-2}	-0.2843***	-0.0791***	0.0487*	0.0394*	0.0472***	0.0170	0.0105	-0.0063	0.0324	0.0449***	0.0526
	(0.0253)	(0.0234)	(0.0281)	(0.0205)	(0.0141)	(0.0180)	(0.0198)	(0.0247)	(0.0244)	(0.0235)	(0.0617)
deficit/GDP_{t-3}	0.0099	0.0195	0.0443	0.0390	0.0499**	0.0523*	0.0601*	0.0858**	0.0948*	0.1430**	0.1801*
	(0.0270)	(0.0229)	(0.0303)	(0.0248)	(0.0242)	(0.0304)	(0.0350)	(0.0415)	(0.0503)	(0.0564)	(0.0993)
$\sum_{j=0}^{3}\text{deficit/GDP}_{t-j}$	0.3798***	0.6236***	0.1704***	0.1537***	0.1734***	0.1841***	0.1936***	0.2208***	0.2843***	0.3651**	0.5961
	(0.0609)	(0.0536)	(0.0654)	(0.0583)	(0.0566)	(0.0639)	(0.0718)	(0.0838)	(0.0946)	(0.1487)	(0.3877)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 9: Dynamic panel results over 1960–2006 II (B)

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0048**	0.0065***	0.6264	0.6186	0.6145	0.6104	0.6088	0.6049	0.6043	0.6076	0.6158
	(0.0023)	(0.0019)	(3.3176)	(3.3176)	(3.3177)	(3.3176)	(3.3175)	(3.3176)	(3.3176)	(3.3177)	(3.3176)
inflation$_{t-1}$	0.6498***	0.0170	0.2159*	0.3452***	0.4150***	0.4789***	0.4956***	0.5839***	0.6215***	0.6332***	0.6759***
	(0.0242)	(0.0400)	(0.1169)	(0.1104)	(0.1137)	(0.1176)	(0.1199)	(0.1096)	(0.1079)	(0.1120)	(0.1405)
deficit/GDP$_t$	0.3602***	0.2440***	0.0308	0.0338	0.0239	0.0391	0.0399	0.0802	0.0919	0.1208*	0.0626
	(0.0252)	(0.0220)	(0.0256)	(0.0258)	(0.0301)	(0.0369)	(0.0485)	(0.0596)	(0.0651)	(0.0667)	(0.0607)
deficit/GDP$_{t-1}$	0.2521***	0.3006***	0.0641	0.1030**	0.1108**	0.1297***	0.1381***	0.1248***	0.1024**	0.0859	0.2213***
	(0.0237)	(0.0201)	(0.0460)	(0.0513)	(0.0539)	(0.0447)	(0.0351)	(0.0398)	(0.0509)	(0.0600)	(0.0774)
deficit/GDP$_{t-2}$	-0.1885***	-0.0495**	-0.0389	-0.0430	-0.0061	-0.0171	-0.0219	-0.0446	-0.0228	-0.0196	-0.0570
	(0.0239)	(0.0213)	(0.0489)	(0.0586)	(0.0631)	(0.0596)	(0.0536)	(0.0458)	(0.0394)	(0.0483)	(0.0685)
deficit/GDP$_{t-3}$	0.0951***	0.0422**	0.0587**	0.0535*	0.0260	0.0313	0.0325	0.0501	0.0455	0.0336	0.0147
	(0.0260)	(0.0215)	(0.0261)	(0.0291)	(0.0300)	(0.0321)	(0.0368)	(0.0401)	(0.0389)	(0.0396)	(0.0616)
money growth$_t$	0.1854***	0.2322***	0.0780**	0.1224***	0.1655***	0.1996***	0.2482***	0.2930***	0.3446***	0.4176***	0.5198***
	(0.0117)	(0.0106)	(0.0322)	(0.0418)	(0.0533)	(0.0627)	(0.0724)	(0.0790)	(0.0870)	(0.0944)	(0.0988)
money growth$_{t-1}$	-0.0230*	0.1581***	0.0730***	0.1114***	0.1328***	0.1671***	0.1949***	0.2150***	0.2484***	0.2684***	0.2703***
	(0.0123)	(0.0144)	(0.0267)	(0.0243)	(0.0225)	(0.0252)	(0.0281)	(0.0306)	(0.0319)	(0.0310)	(0.0442)
money growth$_{t-2}$	-0.1106***	0.0362***	0.0509**	0.0893***	0.1128***	0.1318***	0.1492***	0.1681***	0.1915***	0.1963***	0.1994***
	(0.0113)	(0.0122)	(0.0203)	(0.0178)	(0.0180)	(0.0180)	(0.0183)	(0.0192)	(0.0203)	(0.0259)	(0.0346)
money growth$_{t-3}$	-0.1110***	-0.0308***	0.0268**	0.0568***	0.0842***	0.0883***	0.0999***	0.1009***	0.1054***	0.1187***	0.1465***
	(0.0106)	(0.0095)	(0.0125)	(0.0167)	(0.0137)	(0.0130)	(0.0149)	(0.0212)	(0.0279)	(0.0350)	(0.0464)
$\sum_{j=0}^{3}$deficit/GDP$_{t-j}$	0.5190***	0.5372***	0.1147***	0.1473***	0.1545***	0.1829***	0.1885***	0.2104***	0.2170***	0.2208***	0.2416**
	(0.0585)	(0.0489)	(0.0439)	(0.0424)	(0.0439)	(0.0469)	(0.0500)	(0.0565)	(0.0588)	(0.0675)	(0.1104)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

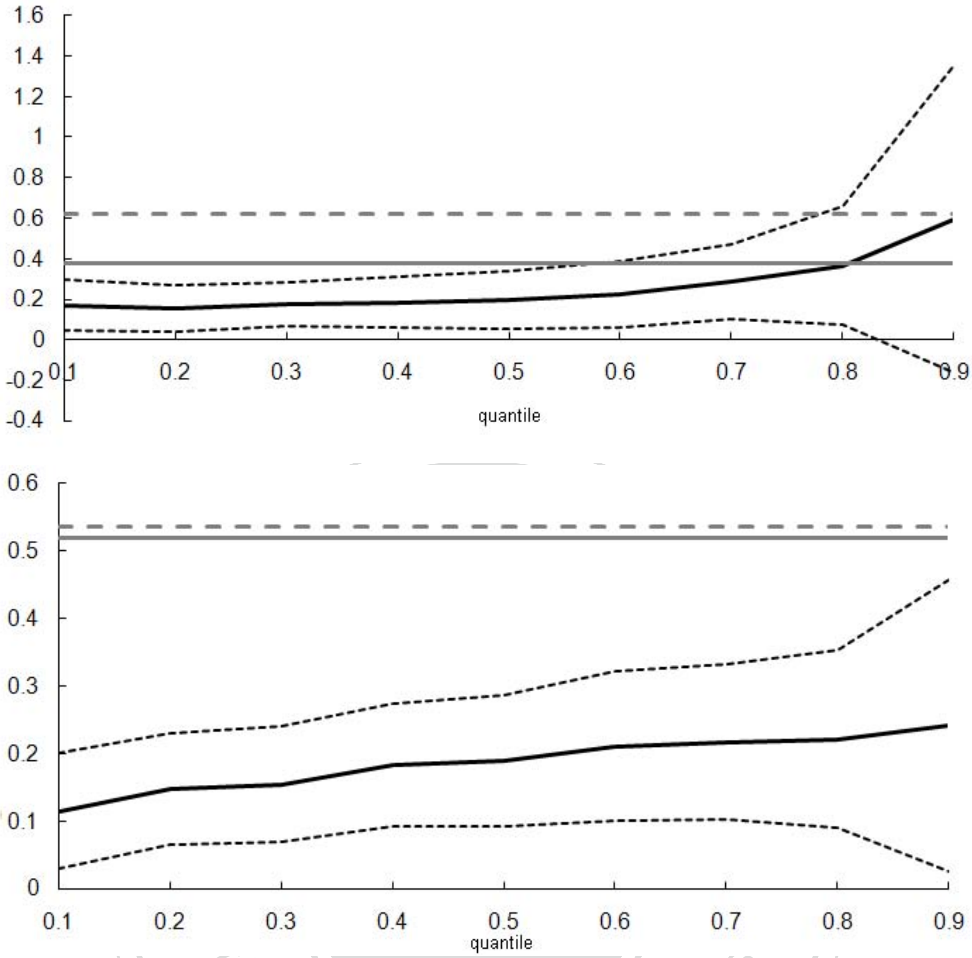


Figure 3: Dynamic panel results over 1960–2006 II

The estimates of $\sum_{j=0}^{3}$deficit/GDP$_{t-j}$ with instruments $\Delta\pi_{it-1}$. The upper is the result without other controlled variables. The lower is the result of controlling money growth rates. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

Table 10: Dynamic panel results over 1960–2006 III (A)

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0082***	0.0239***	1.0836	1.0924	1.0951	1.0982	1.1017	1.1077	1.1144	1.1208	1.1346
	(0.0022)	(0.0021)	(2.7128)	(2.7129)	(2.7130)	(2.7130)	(2.7130)	(2.7130)	(2.7129)	(2.7131)	(2.7132)
inflation$_{t-1}$	0.7281***	0.2139***	0.2527	0.3026**	0.3325**	0.3518***	0.3735***	0.3573***	0.3833***	0.4460***	0.6085***
	(0.0203)	(0.0344)	(0.1652)	(0.1409)	(0.1298)	(0.1327)	(0.1264)	(0.1187)	(0.1302)	(0.1340)	(0.1438)
deficit/money$_t$	0.0670***	0.0616***	-0.0018	0.0003	0.0060	0.0096**	0.0130***	0.0141**	0.0131	0.0163*	0.0254*
	(0.0039)	(0.0034)	(0.0058)	(0.0045)	(0.0043)	(0.0040)	(0.0048)	(0.0059)	(0.0082)	(0.0096)	(0.0136)
deficit/money$_{t-1}$	0.0090**	0.0365***	0.0059	0.0067**	0.0063*	0.0069**	0.0069**	0.0087**	0.0126**	0.0162*	0.0411***
	(0.0037)	(0.0036)	(0.0053)	(0.0030)	(0.0033)	(0.0031)	(0.0030)	(0.0042)	(0.0054)	(0.0093)	(0.0136)
deficit/money$_{t-2}$	-0.0404***	-0.0165***	0.0062	0.0036	0.0036	0.0036	0.0034	0.0037	0.0073**	0.0143***	0.0167***
	(0.0036)	(0.0034)	(0.0042)	(0.0030)	(0.0032)	(0.0035)	(0.0035)	(0.0035)	(0.0033)	(0.0040)	(0.0058)
deficit/money$_{t-3}$	0.0056	0.0027	-0.0002	0.0046	0.0068*	0.0061*	0.0060	0.0088*	0.0099*	0.0167**	0.0288***
	(0.0040)	(0.0034)	(0.0068)	(0.0039)	(0.0037)	(0.0037)	(0.0048)	(0.0046)	(0.0054)	(0.0071)	(0.0104)
growth of real GDP per capita	-0.4001***	-0.2630***	-0.0795	-0.1028***	-0.1065***	-0.1286***	-0.1560***	-0.1982***	-0.2430***	-0.3062***	-0.5654***
	(0.0474)	(0.0404)	(0.0489)	(0.0250)	(0.0278)	(0.0341)	(0.0381)	(0.0441)	(0.0538)	(0.0671)	(0.1352)
$\sum_{j=0}^{3}$deficit/money$_{t-j}$	0.0412***	0.0843***	0.0101	0.0153**	0.0227***	0.0262***	0.0294***	0.0353***	0.0429***	0.0635***	0.1120***
	(0.0079)	(0.0073)	(0.0101)	(0.0076)	(0.0082)	(0.0089)	(0.0109)	(0.0128)	(0.0159)	(0.0212)	(0.0258)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2}, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 11: Dynamic panel results over 1960–2006 III (B)

dependent variable: inflation											
			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0002	0.0160***	0.2540	0.2586	0.2636	0.2674	0.2719	0.2784	0.2799	0.2848	0.3041
	(0.0020)	(0.0019)	(12.3507)	(12.3507)	(12.3506)	(12.3506)	(12.3506)	(12.3506)	(12.3505)	(12.3505)	(12.3507)
inflation$_{t-1}$	0.6547***	0.2023***	0.2056	0.3011**	0.3124**	0.3195***	0.3050**	0.2771**	0.3511***	0.4105***	0.5083***
	(0.0184)	(0.0314)	(0.1621)	(0.1475)	(0.1291)	(0.1183)	(0.1188)	(0.1082)	(0.0944)	(0.0907)	(0.1529)
deficit/money$_t$	0.0575***	0.0542***	-0.0042	0.0065	0.0089**	0.0111***	0.0133***	0.0168***	0.0178***	0.0213***	0.0191*
	(0.0035)	(0.0031)	(0.0060)	(0.0044)	(0.0041)	(0.0039)	(0.0051)	(0.0059)	(0.0067)	(0.0065)	(0.0103)
deficit/money$_{t-1}$	0.0090***	0.0337***	0.0066	0.0066**	0.0066*	0.0067**	0.0087***	0.0082**	0.0076	0.0135*	0.0219*
	(0.0033)	(0.0033)	(0.0053)	(0.0027)	(0.0039)	(0.0034)	(0.0029)	(0.0034)	(0.0047)	(0.0082)	(0.0120)
deficit/money$_{t-2}$	-0.0341***	-0.0139***	0.0072*	0.0049	0.0026	0.0047	0.0051	0.0055	0.0075**	0.0113***	0.0107*
	(0.0033)	(0.0031)	(0.0040)	(0.0032)	(0.0030)	(0.0036)	(0.0038)	(0.0034)	(0.0033)	(0.0029)	(0.0058)
deficit/money$_{t-3}$	0.0072**	0.0035	0.0012	0.0043	0.0070*	0.0063	0.0058	0.0075	0.0159***	0.0190***	0.0276***
	(0.0036)	(0.0031)	(0.0057)	(0.0035)	(0.0041)	(0.0040)	(0.0050)	(0.0058)	(0.0056)	(0.0052)	(0.0098)
growth of real GDP per capita	-0.3282***	-0.2222***	-0.0606	-0.0931***	-0.1194***	-0.1261***	-0.1439***	-0.1861***	-0.2130***	-0.2715***	-0.3953***
	(0.0426)	(0.0370)	(0.0451)	(0.0273)	(0.0260)	(0.0241)	(0.0371)	(0.0348)	(0.0372)	(0.0574)	(0.0947)
oil price inflation	0.1704***	0.1422***	0.0481***	0.0391***	0.0449***	0.0595***	0.0739***	0.1010***	0.1319***	0.1875***	0.3059***
	(0.0063)	(0.0057)	(0.0111)	(0.0078)	(0.0088)	(0.0104)	(0.0149)	(0.0197)	(0.0321)	(0.0488)	(0.0823)
$\sum_{j=0}^{3}$deficit/money$_{t-j}$	0.0396***	0.0775***	0.0108	0.0223***	0.0251***	0.0288***	0.0329***	0.0380***	0.0489***	0.0651***	0.0793***
	(0.0071)	(0.0067)	(0.0095)	(0.0075)	(0.0079)	(0.0088)	(0.0107)	(0.0126)	(0.0144)	(0.0164)	(0.0187)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2}, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

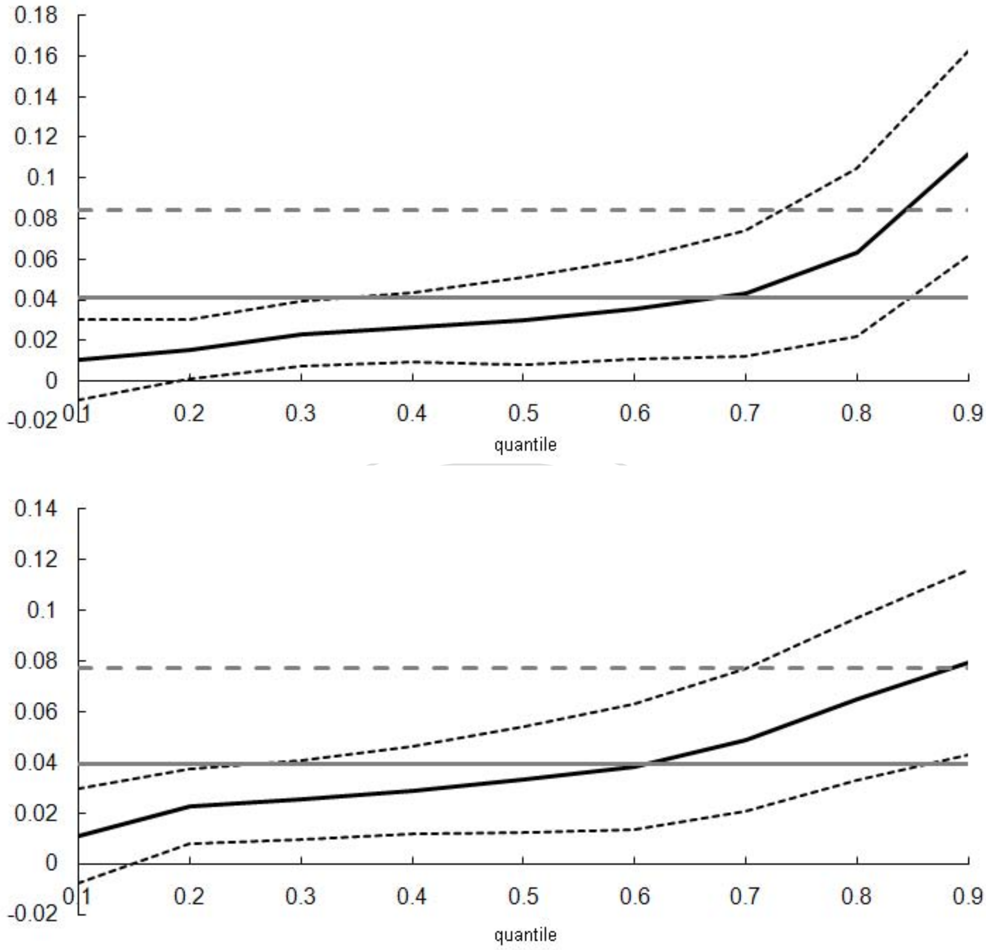


Figure 4: Dynamic panel results over 1960–2006 III

The estimates of $\sum_{j=0}^{3}$deficit/money$_{t-j}$ with instruments $\Delta\pi_{it-1}$. The upper is the results of controlling the growth of real GDP per capita. The lower is the results of controlling the growth of real GDP per capita and oil price inflation. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

Table 12: Dynamic panel results over 1960–2006 IV (A)

dependent variable: inflation											
			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0278***	0.0215**	0.4929	0.5024	0.5081	0.5135	0.5202	0.5263	0.5299	0.5328	0.5534
	(0.0105)	(0.0091)	(5.7715)	(5.7715)	(5.7715)	(5.7715)	(5.7716)	(5.7715)	(5.7715)	(5.7713)	(5.7714)
inflation_{t-1}	0.6503***	0.2026***	0.1996	0.2910**	0.3223**	0.3137***	0.2803**	0.2792**	0.3255***	0.4161***	0.5082***
	(0.0185)	(0.0314)	(0.1576)	(0.1467)	(0.1282)	(0.1169)	(0.1218)	(0.1113)	(0.0976)	(0.0902)	(0.1538)
deficit/money_t	0.0569***	0.0541***	0.0001	0.0054	0.0070*	0.0110***	0.0124**	0.0163***	0.0146**	0.0215***	0.0172
	(0.0035)	(0.0031)	(0.0052)	(0.0040)	(0.0038)	(0.0040)	(0.0050)	(0.0058)	(0.0072)	(0.0072)	(0.0110)
$\text{deficit/money}_{t-1}$	0.0089***	0.0336***	0.0096**	0.0079***	0.0089**	0.0070**	0.0085**	0.0077**	0.0089*	0.0119	0.0236**
	(0.0033)	(0.0033)	(0.0041)	(0.0030)	(0.0040)	(0.0036)	(0.0035)	(0.0035)	(0.0049)	(0.0085)	(0.0119)
$\text{deficit/money}_{t-2}$	-0.0340***	-0.0139***	0.0056*	0.0038	0.0019	0.0048	0.0047	0.0061*	0.0084**	0.0114***	0.0104*
	(0.0033)	(0.0031)	(0.0033)	(0.0030)	(0.0031)	(0.0036)	(0.0036)	(0.0032)	(0.0035)	(0.0030)	(0.0057)
$\text{deficit/money}_{t-3}$	0.0068*	0.0034	0.0013	0.0042	0.0065	0.0058	0.0061	0.0077	0.0165***	0.0191***	0.0268***
	(0.0036)	(0.0031)	(0.0050)	(0.0038)	(0.0041)	(0.0039)	(0.0051)	(0.0056)	(0.0058)	(0.0051)	(0.0099)
growth of real GDP per capita	-0.3251***	-0.2220***	-0.0903**	-0.0942***	-0.1237***	-0.1278***	-0.1441***	-0.1797***	-0.2152***	-0.2750***	-0.4011***
	(0.0425)	(0.0370)	(0.0409)	(0.0287)	(0.0260)	(0.0251)	(0.0416)	(0.0378)	(0.0388)	(0.0606)	(0.0959)
oil price inflation	0.1738***	0.1429***	0.0521***	0.0401***	0.0473***	0.0608***	0.0752***	0.1008***	0.1329***	0.1879***	0.3034***
	(0.0064)	(0.0058)	(0.0109)	(0.0082)	(0.0092)	(0.0101)	(0.0149)	(0.0190)	(0.0323)	(0.0493)	(0.0849)
openness	-0.0791***	-0.0157	0.0042	-0.0030	-0.0070	-0.0100	-0.0118	-0.0162	-0.0174	-0.0148	-0.0188
	(0.0296)	(0.0257)	(0.0134)	(0.0102)	(0.0098)	(0.0097)	(0.0099)	(0.0106)	(0.0120)	(0.0132)	(0.0166)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	0.0386***	0.0772***	0.0166**	0.0213***	0.0243***	0.0286***	0.0317***	0.0379***	0.0484***	0.0638***	0.0780***
	(0.0071)	(0.0067)	(0.0085)	(0.0074)	(0.0080)	(0.0087)	(0.0108)	(0.0124)	(0.0148)	(0.0173)	(0.0196)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2}, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 13: Dynamic panel results over 1960–2006 IV (B)

dependent variable: inflation											
			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	-0.0050	0.0009	0.3312	0.3406	0.3411	0.3445	0.3498	0.3506	0.3547	0.3547	0.3600
	(0.0117)	(0.0103)	(4.8439)	(4.8439)	(4.8439)	(4.8439)	(4.8439)	(4.8439)	(4.8438)	(4.8436)	(4.8436)
inflation$_{t-1}$	0.6251***	0.2105***	0.4662***	0.4164***	0.4656***	0.4673***	0.4321***	0.4250***	0.3997***	0.4369***	0.5170***
	(0.0189)	(0.0324)	(0.0666)	(0.0707)	(0.0604)	(0.0606)	(0.0654)	(0.0536)	(0.0465)	(0.0491)	(0.1061)
deficit/money$_t$	0.0595***	0.0583***	0.0003	0.0070	0.0119***	0.0151***	0.0182***	0.0203***	0.0182***	0.0209***	0.0129
	(0.0037)	(0.0033)	(0.0048)	(0.0059)	(0.0042)	(0.0043)	(0.0048)	(0.0049)	(0.0045)	(0.0058)	(0.0107)
deficit/money$_{t-1}$	0.0096***	0.0361***	0.0011	0.0074*	0.0083**	0.0080**	0.0055	0.0049	0.0047	0.0038	0.0204*
	(0.0035)	(0.0036)	(0.0044)	(0.0039)	(0.0039)	(0.0038)	(0.0044)	(0.0046)	(0.0058)	(0.0084)	(0.0110)
deficit/money$_{t-2}$	-0.0376***	-0.0166***	0.0105**	0.0067**	0.0048	0.0064	0.0049	0.0056	0.0117***	0.0116***	0.0096**
	(0.0035)	(0.0034)	(0.0044)	(0.0033)	(0.0036)	(0.0040)	(0.0041)	(0.0037)	(0.0034)	(0.0038)	(0.0045)
deficit/money$_{t-3}$	0.0083**	0.0049	0.0050	0.0017	0.0055	0.0025	0.0069	0.0073	0.0090	0.0176**	0.0264**
	(0.0038)	(0.0033)	(0.0048)	(0.0047)	(0.0042)	(0.0048)	(0.0056)	(0.0058)	(0.0063)	(0.0076)	(0.0111)
growth of real GDP per capita	-0.3366***	-0.2412***	-0.0419	-0.0339	-0.1078***	-0.1147***	-0.1311***	-0.1326***	-0.1630***	-0.1896***	-0.2798***
	(0.0487)	(0.0429)	(0.0358)	(0.0331)	(0.0328)	(0.0293)	(0.0316)	(0.0335)	(0.0431)	(0.0581)	(0.1076)
oil price inflation	0.1738***	0.1434***	0.0474***	0.0416***	0.0511***	0.0596***	0.0739***	0.0894***	0.1137***	0.1585***	0.2452***
	(0.0067)	(0.0062)	(0.0093)	(0.0098)	(0.0102)	(0.0117)	(0.0140)	(0.0172)	(0.0279)	(0.0492)	(0.0943)
openness	-0.0857***	-0.0221	-0.0136	-0.0188	-0.0205*	-0.0232**	-0.0276**	-0.0299**	-0.0335***	-0.0338***	-0.0382***
	(0.0320)	(0.0283)	(0.0136)	(0.0120)	(0.0115)	(0.0116)	(0.0116)	(0.0116)	(0.0117)	(0.0118)	(0.0140)
exchange rate regime	0.0157***	0.0101***	0.0050***	0.0075***	0.0088***	0.0098***	0.0116***	0.0148***	0.0171***	0.0203***	0.0248***
	(0.0021)	(0.0019)	(0.0018)	(0.0020)	(0.0021)	(0.0024)	(0.0027)	(0.0027)	(0.0026)	(0.0027)	(0.0040)
$\sum_{j=0}^{3}$deficit/money$_{t-j}$	0.0398***	0.0826***	0.0168**	0.0229**	0.0306***	0.0321***	0.0355***	0.0382***	0.0437***	0.0539***	0.0693***
	(0.0051)	(0.0064)	(0.0081)	(0.0089)	(0.0081)	(0.0095)	(0.0113)	(0.0123)	(0.0137)	(0.0154)	(0.0220)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2}, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$, Δw_{it} and Δx_{it-j}, where $j = 0, \ldots, 3$.

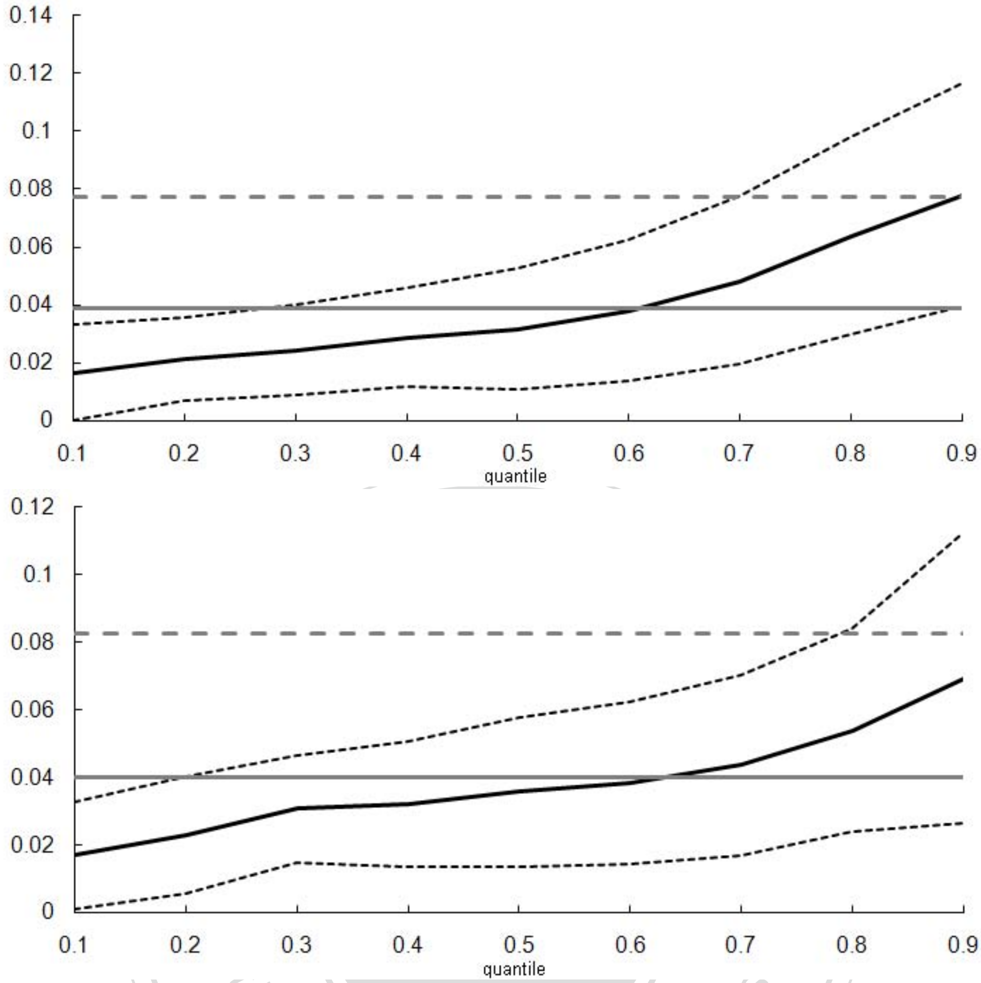


Figure 5: Dynamic panel results over 1960–2006 IV

The estimates of $\sum_{j=0}^{3}$deficit/money$_{t-j}$ with instruments $\Delta\pi_{it-1}$. The upper is the results of controlling the growth of real GDP per capita, oil price inflation and openness. The lower is the results of controlling the growth of real GDP per capita, oil price inflation, openness and the exchange rate regime. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

Table 14: Dynamic panel results of high-income countries over 1960–2006

dependent variable: inflation											
			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0098***	0.0163***	0.0864	0.0892	0.0896	0.0906	0.0896	0.0873	0.0898	0.0928	0.1106
	(0.0012)	(0.0013)	(0.6272)	(0.6273)	(0.6274)	(0.6273)	(0.6275)	(0.6273)	(0.6273)	(0.6274)	(0.6276)
inflation_{t-1}	0.3611***	0.0113	0.1431	0.1381	0.2089	0.2803	0.4194*	0.6381**	0.7149***	0.8199***	0.6461**
	(0.0334)	(0.0427)	(0.1555)	(0.1712)	(0.1779)	(0.1990)	(0.2464)	(0.2622)	(0.2527)	(0.2565)	(0.2790)
deficit/money_{t}	0.0166***	0.0073**	0.0004	0.0069	0.0109**	0.0123*	0.0170*	0.0253**	0.0286***	0.0296***	0.0325***
	(0.0030)	(0.0029)	(0.0082)	(0.0059)	(0.0056)	(0.0072)	(0.0089)	(0.0103)	(0.0100)	(0.0091)	(0.0100)
$\text{deficit/money}_{t-1}$	0.0347***	0.0375***	0.0057	0.0083**	0.0075**	0.0072*	0.0056	0.0087	0.0118	0.0112	0.0172
	(0.0030)	(0.0027)	(0.0059)	(0.0037)	(0.0035)	(0.0044)	(0.0063)	(0.0083)	(0.0098)	(0.0120)	(0.0139)
$\text{deficit/money}_{t-2}$	-0.0028	0.0104***	-0.0009	-0.0003	0.0003	-0.0032	-0.0014	-0.0026	-0.0011	0.0086	0.0068
	(0.0033)	(0.0031)	(0.0060)	(0.0055)	(0.0043)	(0.0047)	(0.0053)	(0.0043)	(0.0056)	(0.0069)	(0.0094)
$\text{deficit/money}_{t-3}$	-0.0092***	0.0008	0.0042	0.0038	0.0045	0.0061	0.0060	0.0034	0.0049	0.0087	0.0148
	(0.0031)	(0.0029)	(0.0075)	(0.0067)	(0.0072)	(0.0073)	(0.0077)	(0.0087)	(0.0115)	(0.0147)	(0.0194)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	0.0392***	0.0559***	0.0094	0.0188*	0.0232*	0.0224	0.0272	0.0349	0.0441*	0.0581**	0.0712**
	(0.0046)	(0.0044)	(0.0091)	(0.0108)	(0.0127)	(0.0158)	(0.0191)	(0.0219)	(0.0237)	(0.0257)	(0.0321)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 15: Dynamic panel results of middle- and low-income countries over 1960–2006

dependent variable: inflation

			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0089**	0.0276***	0.6030	0.6128	0.6180	0.6225	0.6304	0.6351	0.6425	0.6470	0.6593
	(0.0035)	(0.0033)	(9.2791)	(9.2790)	(9.2789)	(9.2789)	(9.2791)	(9.2791)	(9.2793)	(9.2793)	(9.2794)
inflation_{t-1}	0.7366***	0.2332***	0.1976	0.2946*	0.3354**	0.3784**	0.3308**	0.3521***	0.3801***	0.4809***	0.6304***
	(0.0253)	(0.0445)	(0.2305)	(0.1780)	(0.1556)	(0.1481)	(0.1357)	(0.1254)	(0.1346)	(0.1572)	(0.2077)
deficit/money_t	0.0767***	0.0752***	0.0022	0.0034	0.0084	0.0091	0.0095	0.0109	0.0112	0.0208	0.0255
	(0.0054)	(0.0046)	(0.0090)	(0.0066)	(0.0068)	(0.0065)	(0.0068)	(0.0076)	(0.0101)	(0.0158)	(0.0397)
$\text{deficit/money}_{t-1}$	0.0042	0.0386***	0.0099	0.0105**	0.0090*	0.0067	0.0097**	0.0069	0.0098	0.0193	0.0598***
	(0.0052)	(0.0052)	(0.0082)	(0.0042)	(0.0053)	(0.0047)	(0.0038)	(0.0062)	(0.0100)	(0.0173)	(0.0165)
$\text{deficit/money}_{t-2}$	-0.0495***	-0.0223***	0.0126**	0.0065*	0.0069	0.0075*	0.0078*	0.0077	0.0083*	0.0155***	0.0205**
	(0.0051)	(0.0048)	(0.0051)	(0.0039)	(0.0047)	(0.0043)	(0.0042)	(0.0049)	(0.0050)	(0.0054)	(0.0086)
$\text{deficit/money}_{t-3}$	0.0029	0.0002	-0.0038	0.0030	0.0058	0.0057	0.0058	0.0114*	0.0141*	0.0177*	0.0305*
	(0.0055)	(0.0047)	(0.0072)	(0.0048)	(0.0045)	(0.0047)	(0.0058)	(0.0067)	(0.0073)	(0.0092)	(0.0177)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	0.0343***	0.0917***	0.0210	0.0235**	0.0301**	0.0291**	0.0328**	0.0369**	0.0434*	0.0733**	0.1362**
	(0.0120)	(0.0113)	(0.0151)	(0.0119)	(0.0127)	(0.0130)	(0.0146)	(0.0175)	(0.0236)	(0.0363)	(0.0568)

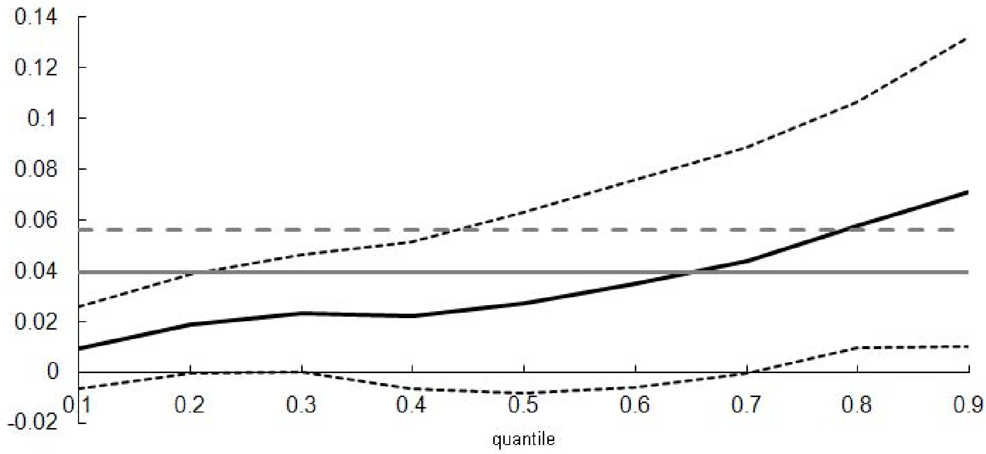
Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

High-income countries



Middle- and low-income countries

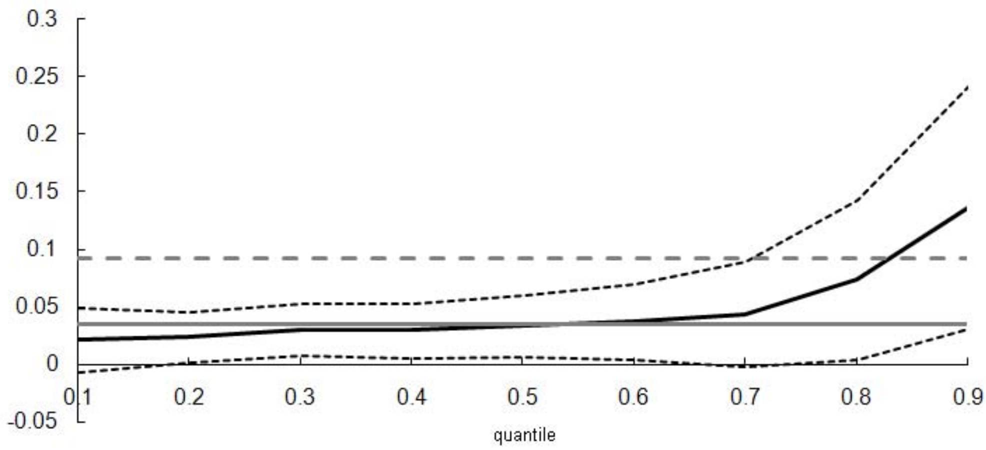


Figure 6: Dynamic panel results of high-income and middle- and low-income countries over 1960–2006

The estimates of $\sum_{j=0}^{3}\text{deficit/money}_{t-j}$ with instruments $\Delta\pi_{it-1}$. The upper is the results of high-income countries. The lower is the results of middle- and low-income countries countries. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

Table 16: Dynamic panel results of OECD countries over 1960–2006

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0136***	0.0336***	0.0667	0.0634	0.0623	0.0640	0.0593	0.0571	0.0631	0.0745	0.0889
	(0.0013)	(0.0018)	(0.5340)	(0.5338)	(0.5340)	(0.5341)	(0.5340)	(0.5340)	(0.5339)	(0.5340)	(0.5345)
inflation_{t-1}	0.5189***	-0.2104***	0.0983	0.3375	0.4828***	0.5311**	0.8181***	1.0395***	0.9909***	0.8751***	0.7365***
	(0.0368)	(0.0626)	(0.2632)	(0.2201)	(0.1618)	(0.2096)	(0.2575)	(0.2117)	(0.1628)	(0.1820)	(0.2154)
deficit/money_t	0.0062	0.0070*	0.0259***	0.0262***	0.0232***	0.0242***	0.0337***	0.0379***	0.0397***	0.0400***	0.0477**
	(0.0046)	(0.0038)	(0.0059)	(0.0045)	(0.0066)	(0.0093)	(0.0106)	(0.0108)	(0.0112)	(0.0140)	(0.0214)
$\text{deficit/money}_{t-1}$	-0.0062	-0.0027	-0.0066	-0.0087	0.0019	0.0016	0.0044	0.0025	-0.0017	0.0028	0.0034
	(0.0048)	(0.0038)	(0.0086)	(0.0085)	(0.0059)	(0.0058)	(0.0079)	(0.0097)	(0.0112)	(0.0115)	(0.0143)
$\text{deficit/money}_{t-2}$	-0.0029	-0.0050	0.0038	0.0083	0.0065	0.0053	0.0050	0.0086	0.0117	0.0123	-0.0029
	(0.0048)	(0.0039)	(0.0072)	(0.0070)	(0.0048)	(0.0051)	(0.0067)	(0.0080)	(0.0086)	(0.0087)	(0.0120)
$\text{deficit/money}_{t-3}$	-0.0023	-0.0064*	-0.0090*	-0.0041	-0.0101	-0.0086	-0.0142*	-0.0125	-0.0085	-0.0173	-0.0046
	(0.0047)	(0.0039)	(0.0051)	(0.0049)	(0.0064)	(0.0061)	(0.0079)	(0.0101)	(0.0127)	(0.0130)	(0.0158)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	-0.0052	-0.0071	0.0142**	0.0217***	0.0215***	0.0224**	0.0288**	0.0365***	0.0412***	0.0378***	0.0436*
	(0.0051)	(0.0045)	(0.0070)	(0.0054)	(0.0069)	(0.0091)	(0.0112)	(0.0136)	(0.0126)	(0.0138)	(0.0241)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 17: Dynamic panel results of non-OECD countries over 1960–2006

dependent variable: inflation											
			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0043	0.0245***	0.2281	0.2362	0.2422	0.2457	0.2510	0.2550	0.2616	0.2680	0.2881
	(0.0030)	(0.0028)	(3.2408)	(3.2410)	(3.2407)	(3.2407)	(3.2407)	(3.2406)	(3.2406)	(3.2405)	(3.2403)
inflation_{t-1}	0.7265***	0.1971***	0.1702	0.2792*	0.3065**	0.3411**	0.3279***	0.3449***	0.3778***	0.4543***	0.5580***
	(0.0236)	(0.0400)	(0.1857)	(0.1539)	(0.1384)	(0.1347)	(0.1246)	(0.1165)	(0.1210)	(0.1403)	(0.1660)
deficit/money_t	0.0715***	0.0659***	-0.0022	0.0021	0.0056	0.0087	0.0089	0.0115	0.0126	0.0233**	0.0234
	(0.0046)	(0.0040)	(0.0083)	(0.0056)	(0.0055)	(0.0054)	(0.0062)	(0.0076)	(0.0097)	(0.0107)	(0.0252)
$\text{deficit/money}_{t-1}$	0.0119***	0.0412***	0.0101	0.0102***	0.0082*	0.0067	0.0109***	0.0089	0.0120	0.0197	0.0490***
	(0.0044)	(0.0043)	(0.0070)	(0.0036)	(0.0043)	(0.0042)	(0.0042)	(0.0056)	(0.0073)	(0.0135)	(0.0128)
$\text{deficit/money}_{t-2}$	-0.0408***	-0.0149***	0.0102**	0.0047	0.0068	0.0072*	0.0061	0.0053	0.0078*	0.0148***	0.0169**
	(0.0043)	(0.0041)	(0.0049)	(0.0036)	(0.0042)	(0.0042)	(0.0040)	(0.0040)	(0.0043)	(0.0049)	(0.0075)
$\text{deficit/money}_{t-3}$	0.0050	0.0024	0.0000	0.0076	0.0080*	0.0076	0.0080	0.0130**	0.0157**	0.0170**	0.0255**
	(0.0047)	(0.0040)	(0.0073)	(0.0051)	(0.0046)	(0.0048)	(0.0053)	(0.0059)	(0.0063)	(0.0074)	(0.0104)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	0.0475***	0.0946***	0.0181	0.0246**	0.0286**	0.0302**	0.0339**	0.0386**	0.0480**	0.0748***	0.1148***
	(0.0096)	(0.0089)	(0.0142)	(0.0114)	(0.0126)	(0.0137)	(0.0153)	(0.0176)	(0.0219)	(0.0279)	(0.0358)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

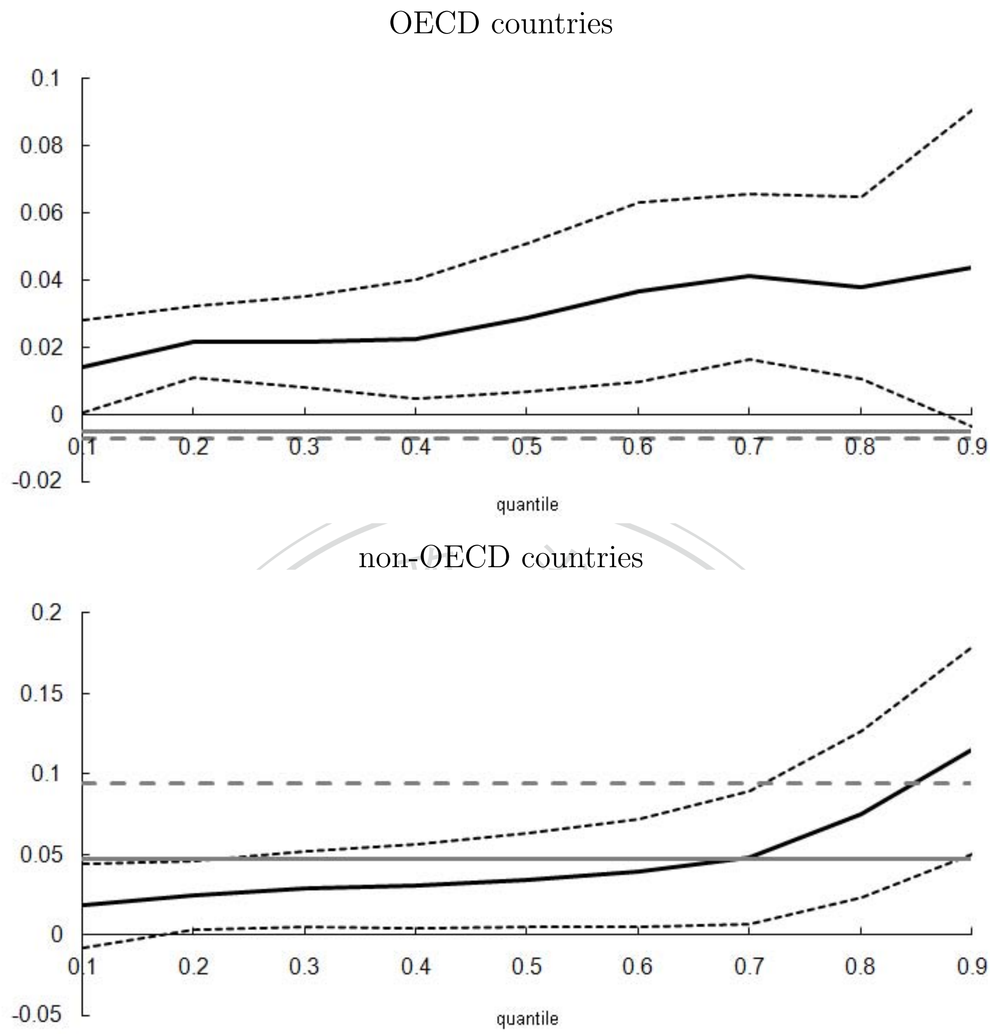


Figure 7: Dynamic panel results of OECD and non-OECD countries over 1960–2006

The estimates of $\sum_{j=0}^{3}\text{deficit/money}_{t-j}$ with instruments $\Delta\pi_{it-1}$. The upper is the results of OECD countries. The lower is the results of non-OECD countries. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

Table 18: Dynamic panel results over 1970–2006

dependent variable: inflation											
			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0044^{**}	0.0244^{***}	0.4878	0.4978	0.5009	0.5036	0.5067	0.5108	0.5146	0.5240	0.5373
	(0.0022)	(0.0024)	(4.2169)	(4.2171)	(4.2173)	(4.2173)	(4.2173)	(4.2174)	(4.2173)	(4.2172)	(4.2174)
inflation$_{t-1}$	0.7225^{***}	0.2693^{***}	0.3303^{*}	0.3403^{**}	0.3597^{***}	0.3717^{***}	0.3799^{***}	0.3920^{***}	0.4400^{***}	0.4448^{***}	0.5488^{***}
	(0.0211)	(0.0378)	(0.1922)	(0.1599)	(0.1375)	(0.1292)	(0.1179)	(0.1226)	(0.1364)	(0.1292)	(0.1439)
deficit/money$_t$	0.0560^{***}	0.0495^{***}	-0.0012	0.0021	0.0065	0.0091^{**}	0.0096^{*}	0.0111	0.0167^{*}	0.0228^{**}	0.0216
	(0.0037)	(0.0032)	(0.0058)	(0.0045)	(0.0041)	(0.0044)	(0.0052)	(0.0068)	(0.0086)	(0.0090)	(0.0161)
deficit/money$_{t-1}$	0.0082^{**}	0.0262^{***}	0.0031	0.0047	0.0040	0.0050^{*}	0.0079^{**}	0.0111^{**}	0.0085	0.0128	0.0457^{***}
	(0.0035)	(0.0033)	(0.0046)	(0.0028)	(0.0025)	(0.0027)	(0.0032)	(0.0045)	(0.0052)	(0.0113)	(0.0160)
deficit/money$_{t-2}$	-0.0292^{***}	-0.0140^{***}	0.0005	0.0031	0.0043	0.0056^{*}	0.0033	0.0018	0.0063	0.0148^{***}	0.0151^{**}
	(0.0034)	(0.0031)	(0.0040)	(0.0028)	(0.0029)	(0.0032)	(0.0031)	(0.0041)	(0.0046)	(0.0043)	(0.0069)
deficit/money$_{t-3}$	0.0103^{***}	0.0087^{***}	0.0015	0.0020	0.0030	0.0026	0.0057	0.0075	0.0125^{**}	0.0130^{*}	0.0248^{**}
	(0.0038)	(0.0032)	(0.0061)	(0.0043)	(0.0034)	(0.0042)	(0.0044)	(0.0052)	(0.0055)	(0.0067)	(0.0096)
$\sum_{j=0}^{3}$deficit/money$_{t-j}$	0.0453^{***}	0.0704^{***}	0.0039	0.0119	0.0178^{*}	0.0222^{**}	0.0266^{**}	0.0315^{**}	0.0440^{**}	0.0634^{***}	0.1072^{***}
	(0.0075)	(0.0067)	(0.0101)	(0.0092)	(0.0092)	(0.0102)	(0.0113)	(0.0144)	(0.0177)	(0.0215)	(0.0280)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 19: Dynamic panel results over 1980–2006

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0069**	0.0266***	1.1670	1.1790	1.1823	1.1828	1.1861	1.1892	1.1922	1.1977	1.2079
	(0.0033)	(0.0031)	(85.9528)	(85.9526)	(85.9527)	(85.9527)	(85.9527)	(85.9527)	(85.9525)	(85.9526)	(85.9526)
inflation$_{t-1}$	0.6952***	0.1312***	0.1822	0.1853	0.2029	0.2421*	0.2238*	0.2187*	0.2445*	0.2975**	0.4931***
	(0.0249)	(0.0441)	(0.1660)	(0.1442)	(0.1378)	(0.1323)	(0.1327)	(0.1320)	(0.1358)	(0.1518)	(0.1888)
deficit/money$_t$	0.0726***	0.0665***	-0.0035	-0.0020	-0.0023	0.0013	0.0043	0.0025	0.0002	0.0040	0.0105
	(0.0052)	(0.0044)	(0.0060)	(0.0043)	(0.0034)	(0.0034)	(0.0034)	(0.0042)	(0.0063)	(0.0089)	(0.0233)
deficit/money$_{t-1}$	0.0129***	0.0457***	0.0009	0.0026	0.0048*	0.0053*	0.0059**	0.0060	0.0102*	0.0175	0.0495***
	(0.0049)	(0.0048)	(0.0044)	(0.0034)	(0.0029)	(0.0028)	(0.0030)	(0.0040)	(0.0056)	(0.0111)	(0.0178)
deficit/money$_{t-2}$	-0.0472***	-0.0169***	-0.0028	0.0016	0.0026	0.0000	-0.0010	0.0025	0.0083**	0.0103**	0.0123
	(0.0048)	(0.0046)	(0.0045)	(0.0029)	(0.0024)	(0.0027)	(0.0036)	(0.0037)	(0.0036)	(0.0049)	(0.0082)
deficit/money$_{t-3}$	0.0032	0.0004	0.0041**	0.0029	0.0047	0.0073*	0.0089**	0.0110***	0.0104**	0.0130**	0.0238**
	(0.0051)	(0.0043)	(0.0063)	(0.0046)	(0.0041)	(0.0041)	(0.0041)	(0.0036)	(0.0051)	(0.0073)	(0.0138)
$\sum_{j=0}^{3}$deficit/money$_{t-j}$	0.0414***	0.0958***	-0.0014	0.0051	0.0098	0.0140	0.0182*	0.0219**	0.0291**	0.0448*	0.0961**
	(0.0111)	(0.0102)	(0.0119)	(0.0092)	(0.0087)	(0.0087)	(0.0097)	(0.0107)	(0.0144)	(0.0237)	(0.0409)

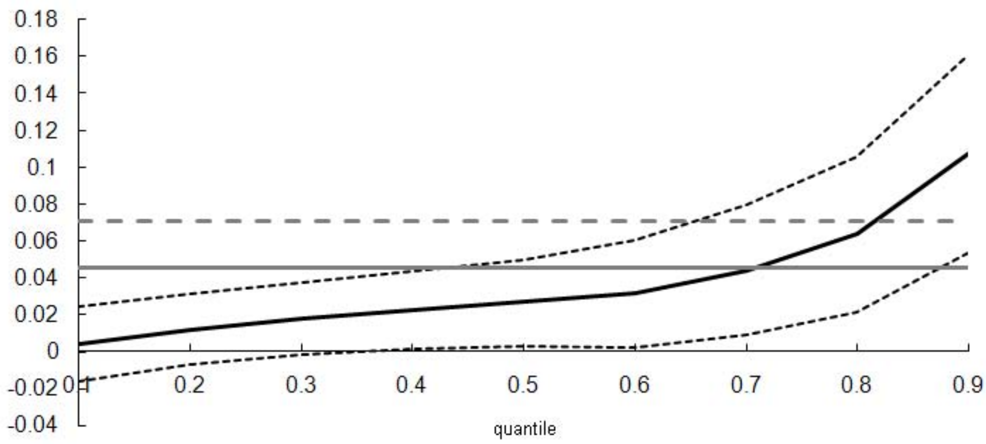
Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

1970–2006



1980–2006

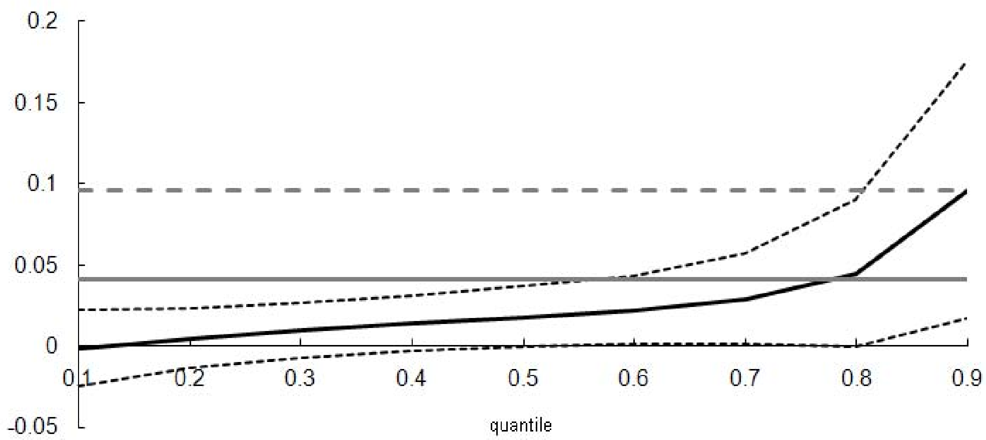


Figure 8: Dynamic panel results over 1970–2006 and 1980–2006

The estimates of $\sum_{j=0}^{3}$deficit/money$_{t-j}$ with instruments $\Delta\pi_{it-1}$. The upper is the results over 1970–2006. The lower is the results over 1980–2006. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

Table 20: Dynamic panel results over 1990–2006

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0117***	0.0286***	0.2669	0.2703	0.2773	0.2828	0.2851	0.2895	0.2937	0.3008	0.3076
	(0.0035)	(0.0030)	(0.4808)	(0.4807)	(0.4807)	(0.4807)	(0.4807)	(0.4807)	(0.4808)	(0.4807)	(0.4806)
inflation$_{t-1}$	0.4818***	0.0107	0.3955	0.4719	0.3639	0.2833	0.2656	0.1869	0.1432	0.1118	0.2473
	(0.0381)	(0.0421)	(0.3536)	(0.3114)	(0.2930)	(0.2678)	(0.2419)	(0.2140)	(0.1720)	(0.1706)	(0.2082)
deficit/money$_t$	0.0008	-0.0004	-0.0092*	-0.0107**	-0.0073**	-0.0084***	-0.0072**	-0.0066*	-0.0032	-0.0048	-0.0031
	(0.0066)	(0.0055)	(0.0051)	(0.0042)	(0.0035)	(0.0032)	(0.0030)	(0.0035)	(0.0039)	(0.0061)	(0.0109)
deficit/money$_{t-1}$	0.0194***	0.0195***	-0.0050	-0.0048	-0.0038	-0.0012	-0.0010	-0.0018	-0.0032	-0.0018	0.0037
	(0.0057)	(0.0047)	(0.0052)	(0.0040)	(0.0033)	(0.0027)	(0.0026)	(0.0025)	(0.0032)	(0.0049)	(0.0079)
deficit/money$_{t-2}$	0.0092*	0.0138***	-0.0058	-0.0011	-0.0013	-0.0007	-0.0021	-0.0009	-0.0001	0.0020	0.0080
	(0.0054)	(0.0044)	(0.0052)	(0.0034)	(0.0029)	(0.0028)	(0.0030)	(0.0032)	(0.0035)	(0.0054)	(0.0099)
deficit/money$_{t-3}$	-0.0042	0.0001	-0.0034	-0.0032	-0.0015	-0.0016	-0.0002	0.0022	0.0027	0.0030	0.0104
	(0.0049)	(0.0041)	(0.0064)	(0.0041)	(0.0030)	(0.0029)	(0.0035)	(0.0042)	(0.0052)	(0.0072)	(0.0074)
$\sum_{j=0}^{3}$deficit/money$_{t-j}$	0.0253**	0.0330***	-0.0234**	-0.0198**	-0.0139**	-0.0118*	-0.0106*	-0.0071	-0.0037	-0.0016	0.0190
	(0.0126)	(0.0103)	(0.0107)	(0.0084)	(0.0070)	(0.0064)	(0.0062)	(0.0068)	(0.0071)	(0.0087)	(0.0124)

Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

Table 21: Dynamic panel results over 1990–2000

dependent variable: inflation			quantile[a]								
	D-GMM L[b]	D-GMM D[c]	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
intercept	0.0663**	0.0977***	0.3619	0.3794	0.3990	0.3992	0.3988	0.3987	0.4136	0.4138	0.4362
	(0.0267)	(0.0260)	(1.3529)	(1.3526)	(1.3527)	(1.3526)	(1.3527)	(1.3528)	(1.3528)	(1.3529)	(1.3525)
inflation_{t-1}	0.7361***	-0.4563**	1.1383	0.9232	0.6773	0.7150	0.7567	0.7863	0.5383	0.5962	0.5617
	(0.0500)	(0.1832)	(1.5171)	(1.1562)	(0.9095)	(0.7730)	(0.7261)	(0.6910)	(0.6725)	(0.6799)	(0.7880)
deficit/money_t	0.0267	-0.0210	-0.0147	-0.0117	-0.0140*	-0.0096	-0.0082	-0.0072	-0.0073	-0.0043	-0.0097
	(0.0241)	(0.0233)	(0.0108)	(0.0085)	(0.0080)	(0.0070)	(0.0067)	(0.0073)	(0.0090)	(0.0133)	(0.0310)
$\text{deficit/money}_{t-1}$	0.0310	0.0288	-0.0206*	-0.0205*	0.0054	0.0085	0.0113**	0.0127**	0.0117	0.0202	0.0518*
	(0.0216)	(0.0204)	(0.0114)	(0.0115)	(0.0076)	(0.0057)	(0.0053)	(0.0056)	(0.0071)	(0.0123)	(0.0287)
$\text{deficit/money}_{t-2}$	-0.1141***	-0.0466**	-0.0052	0.0061	-0.0004	-0.0005	-0.0039	-0.0021	0.0016	-0.0052	0.0041
	(0.0212)	(0.0199)	(0.0113)	(0.0083)	(0.0060)	(0.0053)	(0.0058)	(0.0068)	(0.0078)	(0.0117)	(0.0230)
$\text{deficit/money}_{t-3}$	0.0017	-0.0186	0.0194*	0.0091	0.0031	-0.0007	-0.0003	-0.0039	-0.0037	-0.0032	-0.0269
	(0.0121)	(0.0115)	(0.0116)	(0.0113)	(0.0098)	(0.0097)	(0.0101)	(0.0103)	(0.0109)	(0.0143)	(0.0244)
central bank independence	-0.1009**	-0.0334	0.0025	0.0025	-0.0037	-0.0047	-0.0057	-0.0062	-0.0079	-0.0071	-0.0251
	(0.0513)	(0.0490)	(0.0154)	(0.0071)	(0.0061)	(0.0060)	(0.0060)	(0.0061)	(0.0067)	(0.0089)	(0.0247)
$\sum_{j=0}^{3}\text{deficit/money}_{t-j}$	-0.0547	-0.0574*	-0.0210	-0.0169	-0.0059	-0.0023	-0.0010	-0.0006	0.0023	0.0075	0.0193
	(0.0355)	(0.0332)	(0.0157)	(0.0176)	(0.0176)	(0.0173)	(0.0172)	(0.0175)	(0.0181)	(0.0187)	(0.0239)

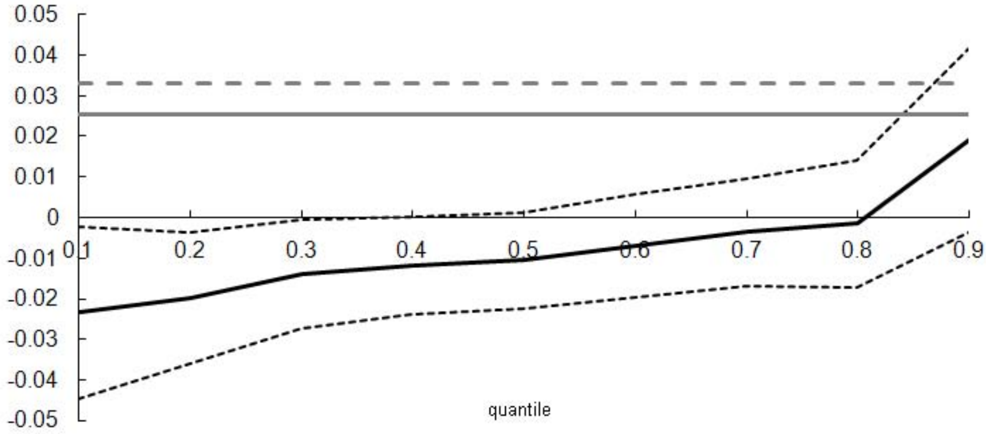
Standard errors in parenthesis. ***, ** and * indicate the significant level of 1%, 5% and 10% repectively.

[a] Dynamic panel quantile regression of Lin (2010) with instruments $\Delta\pi_{it-1}$.

[b] Dynamic GMM of Arellano and Bond (1991) with instruments π_{it-2} and Δx_{it-j}, where $j = 0, \ldots, 3$.

[c] Dynamic GMM of Arellano and Bond (1991) with instruments $\Delta\pi_{it-2}$ and Δx_{it-j}, where $j = 0, \ldots, 3$.

1990–2006



1990–2000

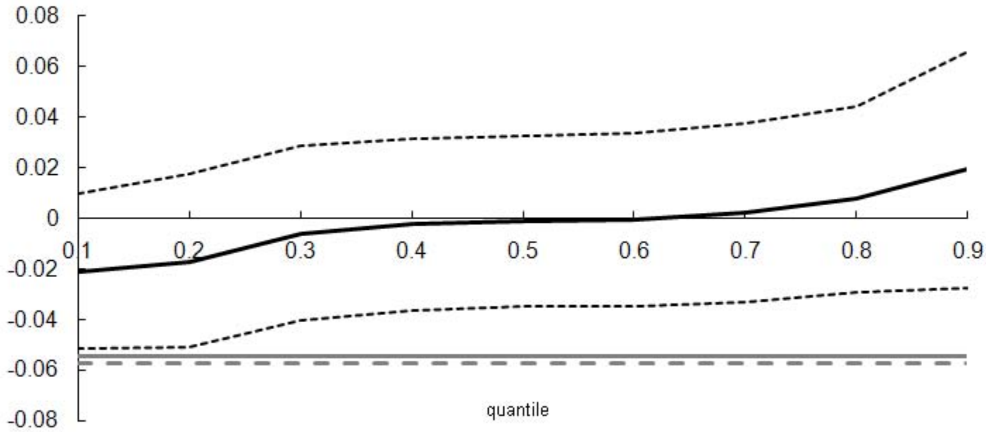


Figure 9: Dynamic panel results over 1990–2006 and 1990–2000

The estimates of $\sum_{j=0}^{3}$deficit/money$_{t-j}$ with instruments $\Delta\pi_{it-1}$. The upper is the results over 1990–2006. The lower is the results of controlling central bank independence over 1990–2000. The black solid line: the coefficients of quantile regression. The black dotted line: the 95% confidence interval of quantile regression. The grey solid line: the coefficient of D-GMM L. The grey dotted line: the coefficient of D-GMM D.

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Appendices

A List of countries

1960–2006	1970–2006	1980–2006	1990–2006
Argentina	Argentina	Argentina	Argentina
Australia	Australia	Australia	Australia
Austria	Austria	Austria	
Bahamas	Bahamas	Bahamas	Bahamas
Bahrain	Bahrain	Bahrain	Bahrain
Barbados	Barbados	Barbados	Barbados
Belgium	Belgium	Belgium	Belgium
		Belize	Belize
	Bhutan	Bhutan	Bhutan
Bolivia	Bolivia	Bolivia	Bolivia
		Botswana	Botswana
		Brazil	
		Bulgaria	Bulgaria
Burkina Faso	Burkina Faso	Burkina Faso	Burkina Faso
Burundi	Burundi	Burundi	Burundi
			Cambodia
Canada	Canada	Canada	Canada
Chad	Chad	Chad	Chad
Chile	Chile	Chile	Chile
China	China	China	China
Colombia	Colombia	Colombia	Colombia
		Congo, Rep. of	Congo, Rep. of
Costa Rica	Costa Rica	Costa Rica	Costa Rica
Cyprus	Cyprus	Cyprus	Cyprus
			Czech Rep.
Denmark	Denmark	Denmark	Denmark
Dominican Rep.	Dominican Rep.	Dominican Rep.	Dominican Rep.
Ecuador	Ecuador	Ecuador	Ecuador
Egypt	Egypt	Egypt	Egypt
El Salvador	El Salvador	El Salvador	El Salvador
Ethiopia	Ethiopia	Ethiopia	Ethiopia
Fiji	Fiji	Fiji	Fiji
Finland	Finland	Finland	Finland

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1960–2006	1970–2006	1980–2006	1990–2006
France	France	France	
Germany	Germany	Germany	Germany
Ghana	Ghana	Ghana	Ghana
Greece	Greece	Greece	Greece
Guatemala	Guatemala	Guatemala	Guatemala
Guyana	Guyana	Guyana	
Haiti	Haiti	Haiti	Haiti
Honduras	Honduras	Honduras	Honduras
Hungary	Hungary	Hungary	Hungary
Iceland	Iceland	Iceland	Iceland
India	India	India	India
Indonesia	Indonesia	Indonesia	Indonesia
Iran	Iran	Iran	Iran
Ireland	Ireland	Ireland	Ireland
Israel	Israel	Israel	Israel
Italy	Italy	Italy	Italy
Japan	Japan	Japan	
Jordan	Jordan	Jordan	Jordan
Kenya	Kenya	Kenya	Kenya
Korea	Korea	Korea	
			Lebanon
	Lesotho	Lesotho	Lesotho
		Madagascar	Madagascar
Malawi	Malawi		
Malaysia	Malaysia	Malaysia	Malaysia
Maldives	Maldives	Maldives	Maldives
Mali	Mali	Mali	Mali
Malta	Malta	Malta	Malta
Mauritius	Mauritius	Mauritius	Mauritius
Mexico	Mexico	Mexico	Mexico
Morocco	Morocco	Morocco	Morocco
Myanmar	Myanmar	Myanmar	Myanmar
Nepal	Nepal	Nepal	Nepal
Netherlands	Netherlands	Netherlands	Netherlands
New Zealand	New Zealand	New Zealand	New Zealand
Nicaragua	Nicaragua	Nicaragua	Nicaragua
Nigeria	Nigeria	Nigeria	Nigeria
Norway	Norway	Norway	Norway
Oman	Oman	Oman	Oman

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1960–2006	1970–2006	1980–2006	1990–2006
Pakistan	Pakistan	Pakistan	Pakistan
Panama	Panama	Panama	Panama
Papua New Guinea	Papua New Guinea	Papua New Guinea	Papua New Guinea
Paraguay	Paraguay	Paraguay	Paraguay
Peru	Peru	Peru	Peru
Philippines	Philippines	Philippines	Philippines
		Poland	Poland
Portugal	Portugal	Portugal	Portugal
Romania	Romania	Romania	Romania
Rwanda	Rwanda	Rwanda	Rwanda
Seychelles	Seychelles	Seychelles	Seychelles
Sierra Leone	Sierra Leone	Sierra Leone	Sierra Leone
Singapore	Singapore	Singapore	Singapore
	Solomon Islands	Solomon Islands	Solomon Islands
South Africa	South Africa	South Africa	South Africa
Spain	Spain	Spain	Spain
Sri Lanka	Sri Lanka	Sri Lanka	Sri Lanka
	St. Vincent & the Gren.	St. Vincent & the Gren.	St. Vincent & the Gren.
Swaziland	Swaziland	Swaziland	Swaziland
Sweden	Sweden	Sweden	
Switzerland	Switzerland	Switzerland	Switzerland
Syria	Syria	Syria	Syria
Tanzania	Tanzania	Tanzania	Tanzania
Thailand	Thailand	Thailand	Thailand
	Togo	Togo	
Trinidad & Tobago	Trinidad & Tobago		
Tunisia	Tunisia	Tunisia	Tunisia
Turkey	Turkey	Turkey	Turkey
Uganda	Uganda	Uganda	Uganda
United Kingdom	United Kingdom	United Kingdom	United Kingdom
United States	United States	United States	United States
Uruguay	Uruguay	Uruguay	Uruguay
Venezuela	Venezuela	Venezuela	Venezuela
			Viet Nam
			Yemen
Zambia	Zambia	Zambia	Zambia

B Data sources and descriptions

Variable	Description	Source
Deficit	central government deficit	IFS line 80
Money	narrow money stock, M1	IFS line 34; Mitchell (2007a–c)
Exchange rate	nominal exchange rate	PWT 6.3 XRAT; IFS line 00
GDP	current GDP	IFS line 99; WDI; UN National Accounts Statistics
Oil price (in dollars)	average crude price of petroleum	IFS line 76
Oil price (in local currency)	Oil price in dollars multiplied by Exchange rate	(calculated by myself)
Inflation	annual change in the CPI index	IFS line 64; Desai et al. (2003); Mitchell (2007a–c)
Deficit/Money	Deficit over Money	(calculated by myself)
Deficit/GDP	Deficit over GDP	(calculated by myself); Desai et al. (2003)
Money growth	annual change in Money	IFS line 34; (calculated by myself)
Growth rate of real GDP per capita	annual change in real GDP per capita	PWT 6.3 grgdpch; WDI
Oil price inflation	annual change in Oil price in local currency	(calculated by myself)
Openness	average of import- and export-to-GDP ratio	PWT 6.3 openc; WDI
Exchange rate regime	0–6, the smaller the index the more fixed the exchange rate	Reinhart and Rogoff (2004)
Central bank independence	0–1, the smaller the index the less independent the central bank	Polillo and Guillén (2005)

C List of country groups (1960–2006)

high-income	middle- and low-income		OECD	non-OECD	
Australia	Argentina	Pakistan	Australia	Argentina	Mexico
Austria	Bolivia	Panama	Austria	Bahamas	Morocco
Bahamas	Burkina Faso	Papua New Guinea	Belgium	Bahrain	Myanmar
Bahrain	Burundi	Paraguay	Canada	Barbados	Nepal
Barbados	Chad	Peru	Denmark	Bolivia	Nicaragua
Belgium	Chile	Philippines	Finland	Burkina Faso	Nigeria
Canada	China	Romania	France	Burundi	Oman
Cyprus	Colombia	Rwanda	Germany	Chad	Pakistan
Denmark	Costa Rica	Seychelles	Greece	Chile	Panama
Finland	Dominican Rep.	Sierra Leone	Hungary	China	Papua New Guinea
France	Ecuador	South Africa	Iceland	Colombia	Paraguay
Germany	Egypt	Sri Lanka	Ireland	Costa Rica	Peru
Greece	El Salvador	Swaziland	Italy	Cyprus	Philippines
Hungary	Ethiopia	Syria	Japan	Dominican Rep.	Romania
Iceland	Fiji	Tanzania	Korea	Ecuador	Rwanda
Ireland	Ghana	Thailand	Netherlands	Egypt	Seychelles
Israel	Guatemala	Trinidad	New Zealand	El Salvador	Sierra Leone
Italy	Guyana	& Tobago	Norway	Ethiopia	Singapore
Japan	Haiti	Tunisia	Portugal	Fiji	South Africa
Korea	Honduras	Turkey	Spain	Ghana	Sri Lanka
Malta	India	Uganda	Sweden	Guatemala	Swaziland
Netherlands	Indonesia	Uruguay	Switzerland	Guyana	Syria
New Zealand	Iran	Venezuela	United Kingdom	Haiti	Tanzania
Norway	Jordan	Zambia	United States	Honduras	Thailand
Oman	Kenya			India	Trinidad
Portugal	Malawi			Indonesia	& Tobago
Singapore	Malaysia			Iran	Tunisia
Spain	Maldives			Israel	Turkey
Sweden	Mali			Jordan	Uganda
Switzerland	Mauritius			Kenya	Uruguay
United Kingdom	Mexico			Malawi	Venezuela
United States	Morocco			Malaysia	Zambia
	Myanmar			Maldives	
	Nepal			Mali	
	Nicaragua			Malta	
	Nigeria			Mauritius	

D List of countries with data of exchange rate regime (1960–2006)

Argentina	Finland	Kuwait	Romania
Australia	France	Malawi	Singapore
Austria	Germany	Malaysia	South Africa
Bahamas	Ghana	Mali	Spain
Barbados	Greece	Malta	SriLanka
Belgium	Guatemala	Mauritius	Swaziland
Bolivia	Guyana	Mexico	Sweden
Burkina Faso	Haiti	Morocco	Switzerland
Burundi	Honduras	Myanmar	Syria
Canada	Hungary	Nepal	Tanzania
Chad	Iceland	Nerlands	Thailand
Chile	India	New Zealand	Tunisia
China	Indonesia	Nicaragua	Turkey
Colombia	Iran	Nigeria	Uganda
Costa Rica	Ireland	Norway	United Kingdom
Cyprus	Israel	Pakistan	United States
Denmark	Italy	Panama	Uruguay
Dominican Rep.	Japan	Paraguay	Venezuela
Ecuador	Jordan	Peru	Zambia
Egypt	Kenya	Philippines	
El Salvador	Korea	Portugal	

E List of countries with data of central bank independence (1990–2000)

Argentina	Ethiopia	Korea	Portugal
Australia	Finland	Malaysia	Romania
Austria	France	Malta	Singapore
Bahamas	Germany	Mexico	South Africa
Barbados	Ghana	Morocco	Spain
Belgium	Greece	Nepal	Switzerland
Bolivia	Honduras	Netherlands	Tanzania
Brazil	Hungary	New Zealand	Turkey
Canada	Iceland	Nicaragua	United Kingdom
Chile	India	Nigeria	United States
China	Indonesia	Norway	Uruguay
Colombia	Ireland	Pakistan	Venezuela
Costa Rica	Israel	Panama	
Denmark	Italy	Peru	
Egypt	Kenya	Philippines	