2. Literature Review

2.1 Theoretical Disputes—Nexus between Inflation and Growth

Theoretic debate on relation between inflation and growth has lasted for decades. Some economists consider the nexus to be positive, like Mundell (1963) and Tobin (1965). As inflation increases, people switch money into saving and improve capital accumulation, if wealth can only be held in linear combination of money and saving (or capital).

However, tiding the stagflation over in 1970s, some researchers start to challenge the positive inflation-growth relationship. The viewpoints of these challengers can be divided into two categories, roughly and incompletely. Some of them, such as Stockman (1981), Cooley and Hansen (1989), through a cash-in-advance constraint, argue that money expansion rate, i.e. inflation, in steady state causes decline of capital accumulation or marginal output of capital with the result that inflation impedes the long-term growth. The others, such like Jones and Manuelli (1995) and Haslag (1995), through different dimensions of regulation, discuss the negative inflation-growth linkage. Jones and Manuelli (1995) argue that, under an economy in which tax code provides nominal depreciation allowance, as inflation rate rises, the discounted value of depreciation tax credits decreases, and hence the effective tax on capital income gets higher. Due to lower after-tax real returns, people slow down the rate of capital accumulation; then, output growth is hurt. Haslag (1995) proposes that, to a model in which money and capital are complementary, banks pool all capital providers, i.e. savers, but are asked to hold money to satisfy a requirement of deposit reserve. The author assumes that money offers a strictly lower return capital does. In the calibrated economy, the equilibrium return of deposits is a weighted sum of returns of money and capital. Thus, an inflation rate increase impedes the return of deposit, making the

rate of deposit accumulation slower. Because capital is a fraction of savings, savings decrease implies capital goes down and has negative growth effect, consequently.

Recently, more and more economists regard relation between inflation and growth as nonlinearity. Risk preference and adverse selection are most frequent two concepts used for explanation. Espinosa-Vega and Yip (1999) argue that if people are fairly risk averse, then inflation has negative effect on growth. Oppositely, if people's degree of risk aversion is low enough, the inflation has a positive relationship with growth. Hung (2001) discusses inflation-growth relation in a financial market existing adverse selection and costly state verification. He finds that if the initial inflation rate is low enough, then climbing inflation encourages long-run economic growth. By contrast, if the initial inflation rate is high enough, then increase of inflation would discourage the growth.

2.2 Empirical Evidence—Nexus between Inflation and Growth

Similar to theoretic debates, direction of empirical study also changes for times. Before the two oil shocks, many researchers confirm the relation is either positive or insignificant.[6] After the stagflation in 1970s, however, the non-negative conclusion is challenged by new macroeconomic data; economists find inflation impedes growth thus (Barro, 1995; Kim and Willett, 2000; Apergis 2005). Now, more and more economists are convinced that a low but positive inflation is one better environment for economic growth. If so, that implies all government authorities shall keep inflation under their own threshold as possible. The purpose of this study is to examine the threshold effect of inflation on economic growth, so we only talk about the papers

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[6] According to Johnson (1967), as cited by Bruno and Easterly (1998), there is no conclusive evidence for either positive or negative relation. For instance, IMF, the anti-inflation headquarters, little evidence is provided to confirm negative inflation-growth nexus. Even in Latin America, with higher inflation during the same period, little supportive witness is found.

related to inflation threshold issue in coming paragraphs.

Initially, scholars find out the threshold point(s) by personal judgment, instead of statistical methods. Fischer (1993), the pioneer of this issue, sets 15% and 40% as two check points to examine if high inflation harms growth more than low inflation does. He finds that inflation slumps economic growth through the channel of decreasing investment accumulation and growth rate of productivity. Besides, Bruno and Easterly (1998) defines a crisis as its inflation rate in excess of 40% per year for continuous years to study growth rates before, during, and after high inflation crises. They confirm that economy dramatically drops down during high inflation crises but rapidly revives after crises, even surpasses the level before the crises.[7]

However, the check point method provides little information for policy-making. Thus, later researches urge accurate inflation threshold via various econometric techniques. For systematizing these studies, we divide them, except for arbitrary specification we just mention, into three categories by different approaches to threshold estimation.

The first is spline function method.[8] Sarel (1996) uses the way and finds the structural break, 8% by estimation, significantly exists between inflation and growth. Then, Ghosh and Phillips (1998) follow similar way to estimate threshold point across countries; the kinked point is 2.5%.[9] Also, Christoffersen and Doyle (2000) estimate the threshold for 22 post-USSR countries through similar approach, and the critical point is found to be 13%. Later, Bolton and Alexander (2001) determines the inflation

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[7] Engelbrecht and Langley (2001) use more countries and longer time span to re-examine Bruno and Easterly's research. What's different, they divide all samples into open and closed countries and add another one inflation crisis criteria 8% from Sarel (1996). They find that inflation is detrimental to economic growth, regardless of 8% or 40% threshold. Besides, after crises, economic growth does not return to the level before crises.

[8] The method assumes the regression has identical error variance within the range of inflation. Then, cut the range into many pieces by tiny points lying between the ceiling and flooring of some range and work out some point which minimizes the sum of squared errors (SSE) of regression, or equivalently maximizes the R^2, that is the threshold point.

[9] Besides, decision-tree technique is used to support importance of inflation to economic growth.

threshold across countries, by the same estimation method, is 3%. Rather than unique threshold point, Burdekin *et al*. (2004) suppose there are multiple turning points in their framework. In their findings, there are two threshold points, 8% and 25%, for the group of industrial countries and two threshold points, 3%, 50%, significant for the group of developing countries.

In addition to spline function estimation, some researchers adopt bootstrapping method, proposed by Hansen (1996, 1999), for inflation threshold estimation and use likelihood ratio test to examine significance of the threshold effect.[10] Khan and Senhadji (2001), for example, find that inflation beyond the threshold value does significant damage to economic growth; the threshold interval for world is 9-10%, industrial countries 1-3%, and developing ones 11-12%.

Finally, there are some papers which use quadratic function to work out inflation threshold. Gylfason and Herbertsson (2001), at the beginning, use an iterative process of estimation to find out a threshold interval 10-20%; then, re-examine the outcome with one threshold-growth quadratic estimator and confirm one threshold around 11%.[11] Besides, Pollin and Zhu (2006) divide all observations into four groups, that is, whole countries, OECD ones, middle-income ones, and low-income ones. As well, the quadratic function, similar to Gylfason and Herbertsson (2001), is employed to figure out inflation threshold for each group; that is, 15-18%, insignificant, 14-16%, and 15-23%, respectively. In their conclusion, below 15-18%, inflation benefits economic growth moderately.

On the other hand, a few scholars apply threshold estimation to case study for specific country. Rather than cross-sectional or pooling data, almost all of them use

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[10] As to spline function method, used by Sarel (1996), t test is used to examine significance of the threshold effect. Still, the purposes of these two techniques are similar, that is, to find a threshold point which minimizes the sum of squared error or maximizes the R^2 of a regression.

[11] To consider a quadratic function of inflation rate (π) and growth rate (g): $g = a + bx - cx^2$, where $x = \pi / (1+\pi)$ and c in the empirical model is (0.036, 0.180), respectively. According to first order condition of optimization, i.e. the extreme value of x equals $b / 2c$, threshold 11% can be figured out.

time series ones for research. Singh and Kalirajan (2003) use yearly data of India from 1971 to 1998 for inflation threshold investigation. Abiding by spline function method, the authors find the inflation threshold is around 5.5% for India.[12] Besides, Sweidan (2004) employs autoregressive conditional heteroskedasticity model (ARCH) covering annual data of Jordan from 1970 to 2000 and, according to spline function technique, estimate the threshold point 2% for the country.

Additionally, Mubarik (2005) creates a time series model with annual data of Pakistan over the period 1973-2000. At the beginning of the empirical process, the author examines the inflation-growth relation of Pakistan by Granger causality test and affirms inflation rate Granger causes economic growth rate. Then, he finds out the threshold of inflation is 9%, following Khan and Senhadji (2001) technique.

In the past, researchers have examined linear inflation-growth nexus in China. In 1990s, Wang (1996) employs 1978-1993 annual data and finds that inflation impedes economic growth rate in the following year. The similar result is also confirmed by other economists (Chen, 2007; Narayan et al., 2009). Instead, some scholars use monthly data to estimate and find that inflation increases economic growth because of Tobin effect (Liu and Xie, 2003; Liu and Zhang, 2004; Chen and Hsu, 2006).

Beside, for China case study, Kong (2007) establishes a time series model with yearly data covering the period 1952-2004 to investigate if the effect of financial development on growth structurally changes under different degree of inflation. The research makes use of bootstrapping method and gets two structural breaks, i.e. 3.9% and 6.5%. What's interesting, it finds financial development significantly promotes growth as inflation beyond the two threshold points but has little effect on growth as

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[12] However, at the end of this paper, the data cannot pass tests of structural change of time series, i.e. cumulative sum (CUSUM) as well as cumulative sum of squares (CUSUMSQ). Therefore, the authors disclaim nonlinear inflation-growth relation existing in India; that means inflation is detrimental to economic growth whenever.

inflation below the two points, which is dissimilar to other's finding of the inflation threshold effect.[13]

In the literature of inflation threshold on growth, there are two features we get. On the one hand, as to cross-country study, there is no universal agreement about what the inflation threshold is.[14] Such implies no country knows what threshold result of various papers is fit for her. On the other hand, as a result of small sample size, single-country study probably tends to misestimate the coefficients of key explanatory variables, which causes too weak applicability to policy making. Therefore, this paper tries to "sift the wheat from the chaff" with a panel data approach in a single-country case, which enlarges observations for regression and ensure policy application in the issue of inflation threshold on growth.

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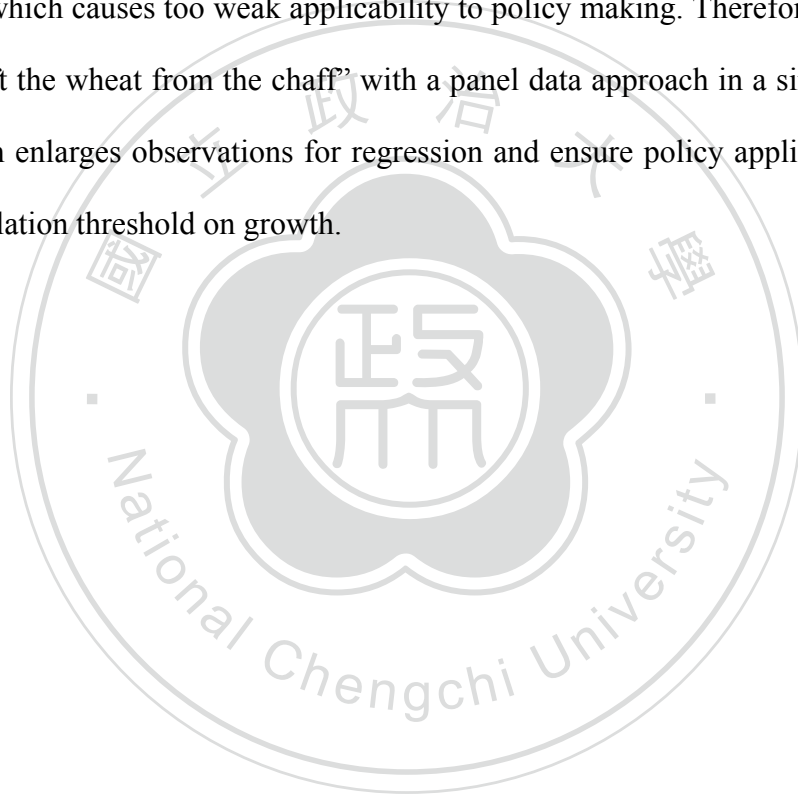
[13] However, in Kong's conclusion, he states that "basically, there exists inverse relationship between inflation and economic growth."

[14] For example, Sarel (1996) point out the threshold point of 87 countries during 1970-1990 was 8%; Ghosh and Phillips (1998) find the point of 145 countries during 1960-1996 was 2.5%; Christoffersen and Doyle (2000) indicate the point of 22 post-USSR countries during 1990-1997 was 13%; Khan and Senhadji (2001) find the threshold interval of industrial countries of 140 countries during 1960-1998 was 1-3%, the interval of developing countries within the same sample and time span was 11-12%.