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Exporting Hyperinflation: The Long Arm of Chiang Kai-shek

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Abstract

As mainland China's inflationary spiral accelerated in 1947-1949 there was a massive outflow of funds to the island of Taiwan. The exporting of China's hyperinflation was facilitated by the fixed, overvalued, exchange rate between the mainland Chinese currency and the Taiwanese currency that was adopted in August 1948. Empirical tests offer support for the importance of the 1948 monetary policy reform and suggest a substantial impact of capital inflows and excess money growth in mainland China on inflationary pressures in Taiwan. We find no independent role for Taiwanese money growth in the inflation process.

JEL codes: E31, E65, F42, N15

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There is a large literature on the international transmission of inflation under fixed exchange rates. In the Bretton Woods era, for example, with the US dollar serving as the reserve currency, the United States was able to export inflation as other member countries absorbed the outflow of funds triggered by excess US money supply growth.¹ By May 1971 the persistent outflow had reached overwhelming proportions, prompting other Bretton Woods members to close their foreign exchange markets and end their support of the fixed exchange rate with the US dollar (Schwartz, 1983). But the inflationary effects of the outflow of funds from the United States pale against the outflow from mainland China to Taiwan during the twilight of Nationalist rule on the mainland over the 1947-1949 period. This outflow reached mammoth proportions in 1948 following the adoption of a fixed rate of exchange between Taiwan's currency and the newly-issued gold yuan on the mainland. The rate of exchange was held fixed through the fall of 1948 in spite of rapidly accelerating money growth on the mainland and this facilitated the transmission of mainland China's hyperinflation to Taiwan as holders of gold yuan took advantage of the increasingly overvalued fixed exchange rate. And, unlike the Bretton Woods members, Taiwan had no immediate option of exiting the fixed exchange rate system imposed from mainland China by the Nationalist government. The Taiwanese experience therefore offers a particularly vivid illustration of the international transmission of inflation – in this case an outright hyperinflation – under fixed exchange rates.

The hyperinflation in mainland China was itself fueled by wartime expenditures that continued after World War II in the face of civil war. The conflict between Nationalist forces under Chiang Kai-shek and Communist forces under Mao Tse-tung continued until 1950. Massive budget deficits and increasing reliance on the printing press are familiar ingredients of

hyperinflation and all are clearly evident in the Nationalist Chinese case (see Table 1). But the inter-relationship between inflation in mainland China and inflation in Taiwan, which was returned to Nationalist control by the Japanese on November 1, 1945, is a unique element not mirrored – as far as we are aware – in any other hyperinflation episode. Taiwan’s resources and the Bank of Taiwan’s printing press were used to help finance the Nationalist war effort. Moreover, the Bank of Taiwan was forced to accept the depreciating Nationalist currency and exchange it for the separate Taiwanese currency at an overvalued rate -- thereby further fueling overall monetary expansion and inflationary pressures on Taiwan. This exporting of hyperinflation to Taiwan leaves the policies of Chiang Kai-shek with the dubious, and quite possibly unique, honor of being responsible not just for one hyperinflation but rather for two.

There is little empirical evidence on how Taiwan’s inflation was affected by events on the mainland. As far as we are aware, the only formal tests on this issue are those of Lin and Wu (1989), who find that mainland inflation (as measured by the inflation rate in Shanghai) Granger-causes Taiwanese inflation over the January 1946-April 1949 period.² In this paper, we seek to re-examine the importance of the mainland Chinese variables to Taiwan’s inflation and also allow for the effects of the capital inflow from mainland China to Taiwan over the 1947 to 1949 period. Finally, we test for a structural break following the monetary reform in mainland China in August 1948 that is thought to have spurred capital inflows and inflationary pressures in Taiwan.³ The acceleration in Taiwanese prices following this reform is evident in Figure 1, which plots Taiwan and mainland China price movements over the 1947-1949 period (based on wholesale price indices from the cities of Taipei and Shanghai). Our empirical work confirms the importance of the August 1948 reform to Taiwan and suggests that Taiwanese inflation rates

are significantly affected by capital inflows and mainland China inflation and money growth rates. Taiwanese money growth is endogenously driven by such external factors and appears to have no independent role in the inflation process.

1. EXTERNAL INFLATION PRESSURES AND MAINLAND CHINA'S CURRENCY REFORM

After the Bank of Taiwan was taken over by the Taiwan Provincial Government in November 1945, the Bank of Taiwan set up a special deposit program to withdraw the old Japanese notes and prohibited the circulation of notes issued after the Japanese surrender. By the beginning of December 1945, the money issued had decreased 20% from the level in October and this deposit program seemed to be effective in reducing the pressure to print money for deficit finance. However, the Bank of Taiwan was now faced by new loan demands from the Chinese Nationalist Government. By May, 1946, the loans debited to the Taiwan Provincial Government equaled 62.8% of the Bank of Taiwan's total loans. On May 22, 1946, the Bank of Taiwan was authorized by the Nationalist Government to issue a new local currency called the "taipi", in an amount of 5.3 billion yuan. There were no reserves for the taipi and the circulation of the taipi was limited to Taiwan. In addition, the issuance of taipi was subject to Nationalist government approval. Makinen and Woodward (1989, p. 91) state that, after this point, "the public finance practices of the Taiwanese government paralleled those on the mainland in that a major source of revenue was derived from the inflation tax." Not only did the Bank of Taiwan face the huge burden of financing the expenses of both new governments (the Taiwanese Provincial and the Nationalist government on the mainland) but also loans to the government were augmented by unsecured loans to state-owned enterprises (Lin and Wu, 1989, pp. 932-933).

The rate of inflation accelerated dramatically during the second half of 1948, reaching 109.9% and 96% in October and November, respectively. This dramatic change was a direct consequence of the August 19, 1948 monetary reform in mainland China that replaced the old

“fapi” currency with the “gold yuan” as the official currency on the mainland. Under this reform, private holdings of gold and silver were prohibited and all specie had to be turned into the central bank in exchange for gold yuan notes. Prices and exchange rates were frozen at the August 19 levels, and extreme penalties were adopted against hoarders and black marketeers. In Shanghai, Chiang Kai-shek's eldest son enforced these restrictive measures using the secret police. Also, on August 23, 1948, the US Ambassador to China, John Leighton Stuart, wrote that "the Central Bank and Central Trust are reported to be releasing stocks of commodities in Shanghai and Canton, particularly cotton yarn, and restricting bank credit" (US Department of State, 1949, p. 877). Ambassador Stuart (op. cit.), foresaw, however, that none of these measures could enjoy more than temporary success given that the government

budgetary deficit, which is what keeps the printing presses rolling out paper, remains with us, and even given maximum economy where economy is possible, the deficit will of necessity remain unmanageable as long as the war goes on.

The government's financial and military positions were both perilous at this time. Losses to the Communists had severely disrupted production and transportation and depleted the government's tax revenue.⁴ Fueled also by rising military spending, the budget deficit rose from 29 thousand billion fapi in 1947 to 425 thousand billion fapi in January-July 1948 (see Table 1). This deficit was financed primarily by money creation, and Table 1 shows a 1029% increase in the money supply between December 1947 and July 1948. The first seven months of 1948 saw a 45-fold increase in the Shanghai wholesale price index and a 50-fold increase in the black market exchange for the US dollar (US Department of State, 1949, p. 399).

In August 1948, the Minister of Finance announced that the budget deficit "would be reduced from 70 per cent to 30 per cent of government expenditure" (Chang, 1958, p. 80). The

maximum allowable issue of gold yuan notes was set at 2 billion yuan. Although October's budget deficit was reduced to 49% of spending, the reliance on deficit spending quickly increased again, reaching 75% of spending in November and 83% of spending in December (Table 1). It was soon obvious that there were little grounds for confidence in the new monetary standard. While deposits in private banks in Shanghai initially rose after the reform and velocity of circulation of money declined, Chang (1958, p. 274) states that by

the end of October the index of the note issue was four and a half times that of August, price and wage ceilings were in the process of disintegration, and it was abundantly clear that inflation could no longer be contained by the expedient of the currency change ... In November the value of checks cleared in Shanghai rose to more than three times the note issue, and the velocity of circulation of money jumped nearly six times the October figure ... The black-market rate of interest leapt to 120 per cent per month ...

Besides simply unloading unwanted gold yuan notes by purchasing goods and services, mainland Chinese sought to transfer funds to South China en transit to Hong Kong.⁵ But the exchange rate arrangements adopted in August 1948 also gave a special impetus to capital flight to Taiwan. Prior to August 19, the exchange rate system adopted between the fapi and taipei currencies was an adjustable (or managed) exchange rate system. On August 18, 1948, the exchange rate between these two currencies was 1:1635 (one taipei was equal to 1635 fapi). On August 19, 1948, the exchange rate between the gold yuan notes and fapi was set at 1:3,000,000 (one gold yuan note was equal to 3 million fapi). The official exchange rate between the taipei and the gold yuan note thus became 1835:1 (1835 taipei equal to one gold yuan note).

With the official exchange rate between the gold yuan and the taipei held unchanged in spite of the growing loss of confidence in the gold yuan, the attraction of exchanging gold yuan for taipei was obvious. The accelerating net capital inflows into Taiwan after the August 1948

reform are depicted in Figure 2. Perhaps reflecting the fact that the “failure of the monetary reform seemed to be anticipated by the public” (Li and Wu, 1997, p. 7), the net capital inflow between August and October 1948 was equivalent to 95,981 million taipei. This capital inflow was the major force causing the money supply to double over this same period, accounting for 86.8% of the M1 money supply increase in September 1948 and 97.9% of the October increase (Lin and Wu, 1989, pp. 935-36). The Bank of Taiwan stopped accepting deposits in gold yuan notes from the mainland on October 23, 1948 and, on November 1, 1948, the Nationalist government belatedly adjusted the exchange rate between the taipei and the gold yuan. The official rate was re-set at 1:1000 -- that is, one taipei was equal to 1000 gold yuan notes. Also, the exchange rate was now allowed to change more often in response to market forces. The exchange rate adjustment was accompanied by a capital outflow that grew 8.8-fold between October and November 1948 and created the first net capital outflow since the August 1948 reform was enacted. Deflation of -9.5 % was recorded in December 1948, showing how surprisingly sensitive inflation rates were to the Nationalist government’s exchange rate policy.

Taiwan’s respite at the end of 1948 was short lived, however. Capital flight to Taiwan re-accelerated in the face of the Nationalists’ crumbling position on the mainland and the Nationalist government itself began to transfer its remaining resources to Taiwan. In the face of the mounting deficits on the mainland, the 2 billion yuan maximum for the gold yuan notes was formally set aside on November 11, 1948.⁶ Meanwhile the price controls in Shanghai unraveled during the middle of October 1948 in the midst of panic buying when retailers “withheld their goods from sale rather than sell them at official prices, and even the restaurants refused to do business” (Chang, 1958, p. 80). Prices were formally freed on November 1, 1948 under a

Financial Emergency Executive Order. While nearly 3.4 billion gold yuan (equivalent to more than 10,182 thousand billion fapi) were in circulation on November 30, 1948, by the end of April 1949, total note issue had risen to more than 5 thousand billion gold yuan (equivalent to a staggering 15,483,720 thousand billion fapi--see Table 1).⁷ Shanghai wholesale prices rose 59,374 times between September 1948 and April 1949 before rising a further 84 times between April and May 1949 on the eve of the fall of that city to the Communists on May 27, 1949.⁸

Taiwan's November 1948 net capital outflow of -23,277 million taipei reversed to a capital inflow of 214,495 million taipei in December 1948. December's capital inflow amounted to 73.4% of the total increase in currency in that month (Li and Wu, 1997, p. 8). The Taiwanese money supply grew 1.75-fold between November and December 1948. Pressures on the money supply increased when many divisions of the Nationalist army began moving to Taiwan in 1949. The Bank of Taiwan now not only had to support military expenses in mainland China but also needed to make massive loans to support the newly-arriving Nationalist troops. The growth rate of the money supply increased to 41.6% in January 1949, 26.1% in February, 18.8% in March, 42.8% in April, and 118.7% in May. Inflation peaked during this period, reaching 45.3% in January, 56.8% in February, 35.7% in March, 46.5% in April, and 104.8% in May. This still paled in comparison to the depreciation of the gold yuan, however. By late April and early May 1949, the gold yuan's initial official exchange ratio of 4 gold yuan to the US dollar had fallen to the point that open market quotations ranged from 5 million to 10 million gold yuan per US dollar (US Department of State, 1949, p. 401).

2. EMPIRICAL EVIDENCE

The underlying data on the Taiwanese money supply and the Taipei wholesale price index are drawn from Liu (1970). Given that, during this period, currency was apparently “the only means of payment in retail business in Taiwan” (Liu, 1970, p. 24*n*), we attach more significance to the net currency measure of the money supply than to the broader M1 measure.⁹ The data on capital inflows into Taiwan from mainland China are given by Lin and Wu (1989, p. 934). The mainland Chinese money supply and inflation series are based on the currency and Shanghai wholesale price data provided by Quddus, Liu and Butler (1989). None of the series on inflation, money growth and capital inflows is subject to unit roots. The presence of unit roots is rejected at the 99% confidence level when we allow for up to three autoregressive factors in an application of the Augmented Dickey-Fuller test.

Taiwanese inflation and money growth are regressed on their own past values, past values of mainland Chinese money growth and inflation, and the level of capital inflows. This allows us to assess the relative importance of domestic and external monetary conditions to the hyperinflation process in Taiwan. We also examine the determination of the capital inflows themselves and regress the inflows on the *difference* between mainland Chinese and Taiwanese money growth and inflation rates. Increases in these inflation and money growth differentials could be expected to fuel capital outflows from mainland China to Taiwan through increasing the degree of overvaluation of the gold yuan exchange rate. According to the literature on exchange market pressure (see, for example, Girton and Roper, 1977; Burdekin and Burkett, 1990), excess money growth and excess inflation in mainland China vis-à-vis Taiwan should be reflected in some combination of currency depreciation and international reserve losses. If the exchange rate is held constant, loss of international reserves, or capital outflow from mainland China, becomes

the only outlet for the exchange market pressure. A number of Latin American countries experienced this phenomenon in the run-up to the debt crisis of the 1980s, where “the general tendency toward overvaluation fueled massive capital flight ... In country after country, the public speculated against the central bank by acquiring foreign exchange and moving it abroad” (Edwards, 1995, p. 23).

The exact lag order of the variables in the inflation, money growth and capital inflow regressions is selected – from a maximum of four lags – according to the Akaike information criterion (AIC). We also allow for the presence of contemporaneous values of the right-hand-side variables. All estimation is performed over monthly data from 1947 through April 1949 (the last month prior to the fall of Shanghai). We test for shifts in the relationships at the time of the August 19, 1948 reform in mainland China and, given evidence that such a shift occurred, re-estimate the equations with the sample truncated at July 1948.

The results for the Taiwanese inflation and money growth are presented in Table 2. Lagged Chinese money growth, and contemporaneous and lagged values of the capital inflows from mainland China are significant in each equation.¹⁰ Lagged Chinese inflation is also significant in the inflation equation. Lagged Taiwanese money growth is selected by the AIC criterion for the money growth equation but is not significant at the 10% level or better. Both equations were initially estimated using two-stage least squares (2SLS) – incorporating an autoregressive term – and then subjected to a battery of specification tests.¹¹ In each case, Q-tests and LM tests for serial correlation, the White test for heteroskedasticity, and Ramsey’s RESET test indicated that the null hypothesis of no specification error could not be rejected. The Jarque-Bera normality test suggested, however, that the residuals from the 2SLS estimates of the

inflation equation were significantly non-normal. Accordingly, the inflation equation was re-estimated using the generalized method of moments (GMM) – which does not require normality – to produce the results reported in the table.¹²

The full sample results are followed by results for the 1947:6-1948:7 sub-sample that excludes the effects of mainland China's August 1948 monetary reform. The Chow breakpoint test for the money growth equation supports the existence of a structural break at August 1948. No such Chow test can be applied under the GMM used for the inflation equation but this equation, too, was re-estimated over the sub-sample and the findings compared to the full-sample results.¹³ The inflation equation reveals the expected positive effects of higher Chinese money growth and rising capital inflows (the positive coefficient on lagged inflows being ten times larger than the negative coefficient on the contemporaneous value). There is, however, a counterintuitive negative sign on lagged Chinese inflation. While lagged Chinese inflation has the expected positive, and significant effect, in the pre-August 1948 sub-sample, these latter results must be qualified by the very short sample period employed. Nevertheless, the inflation equation results do seem to imply a dominant role for the mainland China variables and the inflows from mainland China. Indeed, neither Taiwanese money growth nor lagged Taiwanese inflation was even selected by the AIC criterion when entered alongside these other variables.

The above findings certainly do not mean that Taiwanese money growth was irrelevant to Taiwan's inflation over this period. Rather, these estimation results imply that Taiwan's money supply process may have been endogenously driven by the mainland Chinese variables and capital inflows. The full-sample results for the money growth equation are not inconsistent with this view. Lagged Chinese money growth and capital inflows are the only significant variables in

the equation. The effects of Chinese money growth and capital inflows are positive overall although, in the case of Chinese money growth, a significant negative effect on the first lag partially offsets the larger significant coefficient on the second lag.¹⁴ Unlike the inflation equation, lagged Chinese inflation is not selected by the AIC criterion. Re-estimation over the pre-August 1948 sub-sample shows a stronger positive effect of capital inflows but no significant role for lagged Chinese money growth. For the sub-sample, not only the contemporaneous capital inflow but also the two lags are now statistically significant. Although the first lag (only) has a negative sign, a Wald test confirms an overall positive effect that is significant at better than the 1% level. Finally, the first lag of Taiwanese money growth becomes significant at least at the 11% level over the pre-August 1948 period.

The Table 2 results clearly support an important role for capital inflows in the Taiwanese inflation process. An important motivation behind these capital flows was undoubtedly flight from the political and military risks on the mainland to the relative safety of Taiwan. But these capital inflows were also likely responsive to exchange rate overvaluation associated with any worsening of inflationary pressures in mainland China over and above the levels prevailing in Taiwan. Accordingly, we next examine whether the volume of inflows can be explained by the differential between mainland Chinese and Taiwanese money growth and inflation rates. We would expect any such relationship to be strongest over the post-July 1948 period – during which the rate of exchange between the taipi and the new gold yuan was fixed notwithstanding a tremendous surge of inflationary pressure on the mainland. In Table 3, we examine the effects on capital inflows of money growth and inflation differentials between mainland China and Taiwan over the full sample and over the pre-August 1948 sub-sample. The contemporaneous

inflation differential plus two lagged values are selected by the AIC criterion together with the third lag of the money growth differential. The effect of the inflation differential is actually ambiguous given the mixed significant negative and positive coefficients and a Wald test reveals only an overall 47% significance level. The lagged money growth differential is significant at the 1% level with the expected positive sign, however. The results are undoubtedly compromised by including observations both before and after the August 1948 reform – as reflected perhaps in a Chow breakpoint test statistic of nearly 100! But re-estimation over the pre-August 1948 sub-sample yields a poor fit with no significant coefficients and an insignificant F-statistic for the equation as whole. This may reflect the premise that the important impetus to capital inflows occurred over the later fixed exchange rate period. Alternatively, the weak results may simply reflect the limited degrees of freedom available over the pre-August 1948 sub-sample.

An important qualification to all the above results is the fact that even our “full sample” comprises little more than two year’s worth of data. Nevertheless, the findings do most consistently point to the importance of mainland Chinese monetary variables and capital inflows as determinants of Taiwanese money growth and inflation during the “twilight period” of Nationalist rule on the mainland. The suggested endogeneity of the Taiwanese variables to the mainland Chinese “forcing variables” receives further confirmation if, following Lin and Wu (1989), we apply Granger-causality tests to our set of five variables (allowing for two lags on each).¹⁵ The causality test results are shown in Table 4 and are in line with the inferences drawn from Table 2 above. First, capital inflows Granger-cause both Taiwanese inflation and Taiwanese money growth. Second, Chinese money growth and Chinese inflation also Granger-cause Taiwanese inflation as suggested in Table 2. Third, Taiwanese money growth does *not*

Granger-cause Taiwanese inflation. The only differences from the implications derived from Table 2 are that there is no confirmed causal effect of Chinese money growth on Taiwanese money growth in the Granger tests and that there is a suggested causal effect of Taiwanese inflation on Taiwanese money growth that was not indicated in the prior regression results.

The implication that Taiwanese inflation Granger-causes Taiwanese money growth but that Taiwanese money growth does not Granger-cause Taiwanese inflation matches the conclusions drawn by Makinen and Woodward (1989) and Quddus, Liu and Butler (1989) based on their bivariate causality testing with these two variables.¹⁶ This is also consistent with the potential feedback from inflation to future rates of money growth in high inflation episodes emphasized by Sargent and Wallace (1973). Surprisingly Lin and Wu (1989) reach opposite conclusions even though their approach is seemingly more similar to ours than to Makinen and Woodward (1989) and Quddus, Liu and Butler (1989) -- neither of whom control for the role played by the mainland Chinese variables in their causality testing. Lin and Wu's other finding that Chinese inflation Granger-causes Taiwanese inflation remains in line with our results.

Estimation of impulse response functions confirms that the suggested causal effects of the Chinese variables on Taiwanese inflation and the effects of capital inflows are economically significant in terms of their magnitudes. Figures 3 and 4 show that one standard deviation shocks to Chinese money growth and Chinese inflation produce an up to 10% shift in Taiwanese inflation across the different lag orders. Figures 5 and 6 suggest similar-size shifts in Taiwanese money growth and Taiwanese inflation following a one standard deviation shock to the level of capital inflows. Each figure shows the impulse response with one-standard error bands that are calculated using the Monte Carlo method with 100 repetitions. These results are for an ordering

with capital inflows first followed by Chinese money growth and Chinese inflation and then Taiwanese money growth and Taiwanese inflation. But a similar pattern emerges if we experiment with other orderings of the variables. The effects of Taiwanese inflation on Taiwanese money growth were less clear in the impulse response analysis, however. While a significant impact was evident with some variable orderings the magnitude was always smaller, as well as less consistent, than the impulse responses to Chinese money growth, Chinese inflation and capital inflows.

3. CONCLUDING COMMENTS

The importance of mainland China's inflationary process to Taiwan's own hyperinflation has received surprisingly little recognition in the academic literature. Yet this episode seems to be a textbook case of the exporting of inflation from the fading Nationalist regime on the mainland to their new power base on Taiwan. This process was facilitated by the fixed, and overvalued, rate of exchange for the new gold yuan against the Taiwanese taipi that was adopted in August 1948. The inflationary spiral in Taiwan continued into 1950, when it was finally stopped with the help of a deposit program designed to draw currency out of circulation and with the arrival of US aid (see, for example, the discussion and references in Burdekin and Whited, 2001). Meanwhile, the last Nationalist forces outside Taiwan were evacuated from the Choushan Islands on May 17, 1950.

FOOTNOTES

3. The inflationary consequences were, however, mitigated by central banks' ability to sterilize the effects of the international reserve flows on the money stock (Laney and Willett, 1982).
4. Meanwhile, Lin and Wu (1989), Makinen and Woodward (1989), and Quddus, Liu and Butler (1989) all test causality between money growth and inflation in Taiwan but Lin and Wu's conclusions are opposite to the other two studies.
3. Regarding the importance of this reform to the inflation process on the mainland, Quddus, Liu and Butler (1989) find that truncating the sample period at August 1948 eliminates the bi-directional feedback between inflation and money growth in mainland China that applies if the sample is extended into 1949 (see also Tang and Hu, 1983). Meanwhile, our own prior univariate analysis of inflation and the growth rates of nominal and real money balances in Taiwan over the 1945-1953 period (Burdekin and Whited, 2001) suggests that the August 1948 reform coincides with the beginnings of an extended period of instability in Taiwanese currency and inflation processes that continues into 1949 and 1950.
4. The area of circulation of the fapi also was reduced as local Communist currency was issued in its stead. Hsia (1953, pp. 73-74) details ten different currencies circulating in the Communist-controlled areas in January 1948.
5. The total capital flight from China to Hong Kong between 1947 and 1949 has been estimated at around HK\$500 million (Chang, 1958, p. 320).

6. Chang (1958, p. 80) incorrectly puts this maximum at 200 million. Note that the 374 thousand billion fapi in circulation in July 1948 were already equivalent to 125 million gold yuan. US Department of State (1949, p. 200) confirms the 2 billion limit and refers to the 200 million figure as being the value of the gold, silver and foreign exchange that was available to back the currency.
7. On July 3, 1949, the director of the People's Bank of China at Shanghai stated that the total issue of gold yuan notes reached 60,000 billion on May 25, 1949 (equivalent to 180,000 quadrillion fapi, or 11.6 times larger than Table 1's April 1949 figure given by the Nationalist central bank).
8. There was a subsequent ten-fold increase in Shanghai wholesale prices after the Communist takeover before stabilization was finally achieved in March 1950 (see Burdekin and Wang, 1999). While Nationalist forces remained on the field in mainland China until 1950, Chou (1963, p. 27) states that after the fall of Shanghai "the gold yuan notes were rejected by the public." Attempts to replace the gold yuan notes with a new "silver yuan" standard on July 1, 1949 were an utter failure. Reportedly, the budget deficit in the second half of 1949 totaled 88% of expenditures--a deficit that "had to be met with gold, silver, and foreign exchange since bank notes no longer enjoyed the people's acceptance" (Chang, 1958, p. 169).
9. As with Makinen and Woodward (1989), Quddus, Liu and Butler (1989) and Burdekin and Whited (2001), our currency series does not include the emergency money that was issued in 1948 and 1949. As the reported emergency money is only 2% of other currency

in June 1949 and less than 1% in December 1948 (Chen, 1955, p. 87), it is unlikely that excluding this emergency money has any major effect on the results.

10. Besides capital inflows, the addition of contemporaneous values of the other variables was always rejected on the basis of an F-test.
11. Additional lagged values of the variables included in the equations were used to form the instruments in the 2SLS estimation. In the inflation equation the instrument were lags two through four of Chinese inflation, Chinese money growth and capital inflows. In the money growth equation the instruments were lags three through five of Taiwanese money growth, Chinese money growth and capital inflows.
12. While it is far from ideal to apply GMM to such a small sample as this, the results for the 1947:6-1949:4 period actually seem to be quite robust to the estimation procedure employed. The application of 2SLS, for example, has no effect on the signs and significance levels of the coefficients reported in Table 2. The results for the 1947:6-1948:7 sub-sample are not as consistent, however, and the right-hand-side variables there are generally not statistically significant under 2SLS estimation – the only exception being that the lagged capital inflow remains significant at approximately the 7% level.
13. Simply adding a dummy variable defined as one for the post-July 1948 period and zero otherwise did not capture the source of the instability and, when such a dummy was added to either the inflation, money growth, or capital inflow equation, it was always insignificant. This suggests that any instability is reflected more in the slope coefficients but, at the same time, there were insufficient degrees of freedom to add further dummies. We also could not sensibly estimate over the post-1948 period alone and, as it is, the pre-

August 1948 estimates cannot be considered anything more than suggestive given that they use barely more than a year's worth of data.

14. Application of a Wald test showed the *overall* positive effect to be significant only at approximately the 13% level. There are also partially offsetting effects for the capital inflows variable but neither of the negative coefficients on the lagged terms is significant at even the 20% level. Re-estimating the equation over the full-sample with the statistically insignificant lagged Taiwanese money growth and lagged capital inflow deleted actually improves the overall goodness of fit and, for comparison, the results are:

$$\begin{aligned} \text{Taiwanese money growth} = & 13.812^{***} - 0.096^{**} \text{ Chinese Money Growth } (-1) \\ & + 0.135^{**} \text{ Chinese Money Growth } (-2) + 0.422^{***} \text{ Capital Inflow} \end{aligned}$$

$$\text{Adjusted } R^2 = 0.88; \text{ F-Statistic} = 49.71^{***}; \text{ Chow Breakpoint Test} = 2.4^*$$

15. Our procedure differs from that of Lin and Wu (1989), however, in that they did not allow for the role of capital inflows and hence considered only a four-variable system.
16. Makinen and Woodward (1989) find that this pattern is not maintained if the sample is extended from 1949 to 1953 – in which case their results indicate no causality in either direction. An important caveat, however, is that all such causality test results, including our own, remain vulnerable to the numerous potential shifts in the underlying inflation and money growth processes over the 1948-1950 period in Taiwan (Burdekin and Whited, 2001).

REFERENCES

- Burdekin, Richard C. K., and Paul Burkett. "A Re-Examination of the Monetary Model of Exchange Market Pressure: Canada, 1963-1988." *Review of Economics and Statistics* 72 (November 1990), 677-681.
- Burdekin, Richard C. K., and Fang Wang. "A Novel End to China's Big Inflation in 1950." *Economics of Planning* 32 (1999), 211-229.
- Burdekin, Richard C. K., and Hsin-hui I. H. Whited. "Multiple Regime Shifts and Multiple Ends of the Taiwanese Hyperinflation, 1945-1953." *Southern Economic Journal* 68 (July 2001), in press.
- Chang, Kia-NGau. *The Inflationary Spiral: The Experience in China, 1939-1950*. Cambridge, Mass.: Technology Press of Massachusetts Institute of Technology, 1958.
- Chen, Rong-Fu. *Finance and Foreign Trade of Taiwan, 1895-1955*. Taipei, Taiwan: San Sheng Bookstore, 1955 (in Chinese).
- Chou, Shun-Hsin. *The Chinese Inflation: 1937-1949*. New York: Columbia University Press, 1963.
- Edwards, Sebastian. *Crisis and Reform in Latin America: From Despair to Hope*. New York: Oxford University Press, 1995.
- Girton, Lance, and Don Roper. "A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience." *American Economic Review* 67 (September 1977), 537-548.
- Hsia, Ronald. *Price Control in Communist China*. New York: Institute of Pacific Relations, 1953.

- Laney, Leroy O. and Thomas D. Willett. "The International Liquidity Explosion and Worldwide Inflation: The Evidence from Sterilization Coefficient Estimates." *Journal of International Money and Finance* 1 (August 1982), 141-52.
- Li, Yitang, and Tsong-Min Wu. "U.S. Aid and the End of Taiwan's Big Inflation." Mimeo, National Tsing Hua University, Hsin Chu, Taiwan, October 13, 1997.
- Lin, Kenneth S., and Tsong-Min Wu. "Taiwan's Big Inflation: 1946-1949." In *The Second Conference on Modern Chinese Economic History (III)*, pp. 917-49. Taipei, Taiwan: The Institute of Economics, Academia Sinica, January 5-7, 1989.
- Liu, Fu-Chi. *Studies in Monetary Development of Taiwan*. Taipei, Taiwan: Academia Sinica, October 1970.
- Makinen, Gail E., and G. Thomas Woodward. "The Taiwanese Hyperinflation and Stabilization of 1945-1952." *Journal of Money Credit, and Banking* 21 (February 1989), 90-105.
- Quddus, Munir, Jin-Tan Liu, and John S. Butler. "Money, Prices, and Causality: The Chinese Hyperinflation, 1946-1949, Reexamined." *Journal of Macroeconomics* 11 (Summer 1989), 447-53.
- Sargent, Thomas J., and Neil Wallace. "Rational Expectations and the Dynamics of Hyperinflation." *International Economic Review* 14 (June 1973), 328-50.
- Schwartz, Anna J. "The Postwar Institutional Evolution of the International Monetary System." In Michael R. Darby, James R. Lothian and Arthur E. Gandolfi, Anna J. Schwartz, and Alan C. Stockman, *The International Transmission of Inflation*, pp. 14-45. Chicago: University of Chicago Press, 1983.

Tang, De-Piao, and Teh-Wei Hu. "Money, Prices, and Causality: The Chinese Hyperinflation, 1946-1949." *Journal of Macroeconomics* 5 (Fall 1983), 503-10.

US Department of State. *United States Relations with China, With Special Reference to the Period 1944-1949*. Washington, DC: Department of State Publication 3573, Far Eastern Series 30, August 1949.

Wu, Kang. *Historical Material Relating to the Inflation in Old China*. Shanghai: Shanghai People's Press, 1958 (in Chinese).

TABLE 1: Nationalist Government Finances, 1936-1949

	Expenditure	Revenue	Budget Deficit	Note Issue Outstanding
1936-37	1,894	1,972	-78	1,410
1937-38	2,091	815	1,276	1,730
1939	2,797	740	2,057	4,290
1940	5,288	1,325	3,963	7,870
1941	10,003	1,310	8,693	15,100
1942	24,511	5,630	18,881	34,400
1943	58,816	20,403	38,413	75,400
1944	171,689	38,503	133,186	189,500
1945	2,348,085	1,241,389	1,106,696	1,031,900
1946	7,574,790	2,876,988	4,697,802	3,726,100
1947	43,393,895	14,064,383	29,329,512	33,188,500
Jan-July 1948	655,471,087	220,905,475	434,565,612	374,762,200
Aug 1948	--	--	—	890,400,000
Sept 1948	1,030,242,000	326,562,000	703,680,000	3,606,000,000
Oct 1948	848,499,000	435,270,000	413,229,000	5,550,000,000
Nov 1948	2,024,832,000	517,230,000	1,507,602,000	10,182,000,000
Dec 1948	7,948,827,000	1,340,241,000	6,608,586,000	24,960,000,000
Jan 1949	--	--	—	62,466,000,000
Feb 1949	--	--	—	178,932,000,000
Mar 1949	--	--	—	588,207,000,000
Apr 1949	--	--	—	15,483,720,000,000

Notes: All numbers are given in millions of fapi

Data from August 1948 on have been converted by applying the official 3 million to 1 exchange rate between fapi and the gold yuan

Note issues outstanding are end of period values.

Source: Chang (1958, pp. 16, 40, 51, 71, 84, 124, 168), Wu (1958, p. 122) and authors' calculations.

TABLE 2: Regression Results for Taiwanese Inflation and Taiwanese Money Growth

Right-hand-side variables	Taiwanese Inflation		Taiwanese Money Growth	
	1947:6-1949:4	1947:6-1948:7	1947:6-1949:4	1947:6-1948:7
Constant	2.765 (1.34)	4.506*** (3.11)	3.733 (0.56)	-11.640 (-1.74)
Taiwanese Money Growth (-1)			0.230 (0.89)	0.608# (1.89)
Taiwanese Money Growth (-2)			0.456 (1.41)	-0.054 (-0.51)
Chinese Inflation (-1)	-0.043*** (-11.20)	0.087*** (9.15)		
Chinese Money Growth (-1)	0.310*** (18.09)	0.126** (3.13)	-0.147** (-2.78)	0.326 (1.56)
Chinese Money Growth (-2)			0.205*** (2.95)	0.478 (1.47)
Capital Inflow	-0.067*** (-13.19)	0.411*** (6.26)	0.420*** (6.82)	1.550** (2.98)
Capital Inflow (-1)	0.730*** (13.33)	2.410*** (26.98)	-0.138 (-0.95)	-2.050*** (-5.14)
Capital Inflow (-2)			-0.213 (-1.27)	4.830*** (7.97)
Estimation Method	GMM	GMM	2SLS	2SLS
Adjusted R ²	—	—	0.87	0.82
F-Statistic	—	—	21.81***	9.51***
J-Statistic	0.175	0.262	—	—
Chow Breakpoint Test	—	—	4.83**	—

Notes:

The numbers in parentheses after the independent variables denote the lag order (if any),

***, **, * and # denote significance at the 1%, 5%, 10% and 11% levels, respectively,

t-statistics are listed in parentheses below each coefficient,

GMM denotes Generalized Method of Moments and 2SLS denotes Two-Stage Least Squares,

J-Statistic is a goodness of fit diagnostic for GMM regressions for which R²s and F-Statistics cannot be computed (the lower the value of the J-Statistic the better the fit), and

the Chow Breakpoint Test is for a hypothesized structural break at the time of the monetary reform in August 1948.

TABLE 3: Regression Results for Capital Inflows into Taiwan from Mainland China

Right-hand-side variables	Capital Inflows	
	1947:8-1949:4	1947:7-1948:7
Constant	-5.010* (-1.78)	0.275 (0.23)
Inflation Differential	0.151*** (4.49)	-0.027 (-0.91)
Inflation Differential (-1)	-0.090** (-2.89)	0.023 (0.33)
Inflation Differential (-2)	-0.114*** (-7.51)	-0.058 (-1.46)
Money Growth Differential (-3)	0.506*** (3.94)	0.026 (0.25)
Estimation Method	2SLS	2SLS
Adjusted R ²	0.92	0.22
F-Statistic	26.94***	1.76
Chow Breakpoint Test	92.99***	—

Notes:
 Inflation Differential is the difference between the inflation rate for mainland China and the Taiwanese inflation rate, and
 Money Growth Differential is the difference between the money growth rate in mainland China and the Taiwanese money
 growth rate.
 (See also the explanatory Notes to Table 2.)

TABLE 4: Granger-Causality Tests on the Five Variable System

Causal Relationship Tested	Chi-Squared Statistic
Taiwanese Money Growth ® Taiwanese Inflation	2.83 [0.2432]
Chinese Money Growth ® Taiwanese Inflation	34.42*** [0.0000]
Chinese Inflation ® Taiwanese Inflation	7.83** [0.0199]
Capital Inflow ® Taiwanese Inflation	25.38*** [0.0000]
Taiwanese Inflation ® Taiwanese Money Growth	12.05*** [0.0024]
Chinese Money Growth ® Taiwanese Money Growth	4.17 [0.1244]
Chinese Inflation ® Taiwanese Money Growth	4.46 [0.1075]
Capital Inflow ® Taiwanese Money Growth	13.49*** [0.0011]

Notes:

***, ** and * denote significance at the 1%, 5% and 10% levels, respectively, the figures in brackets are the exact significance levels (P-values), and two autoregressive terms have been included in each regression to correct for serial correlation.

Figure 1
Price Indices for Taiwan and Mainland China, January 1947 - April 1949

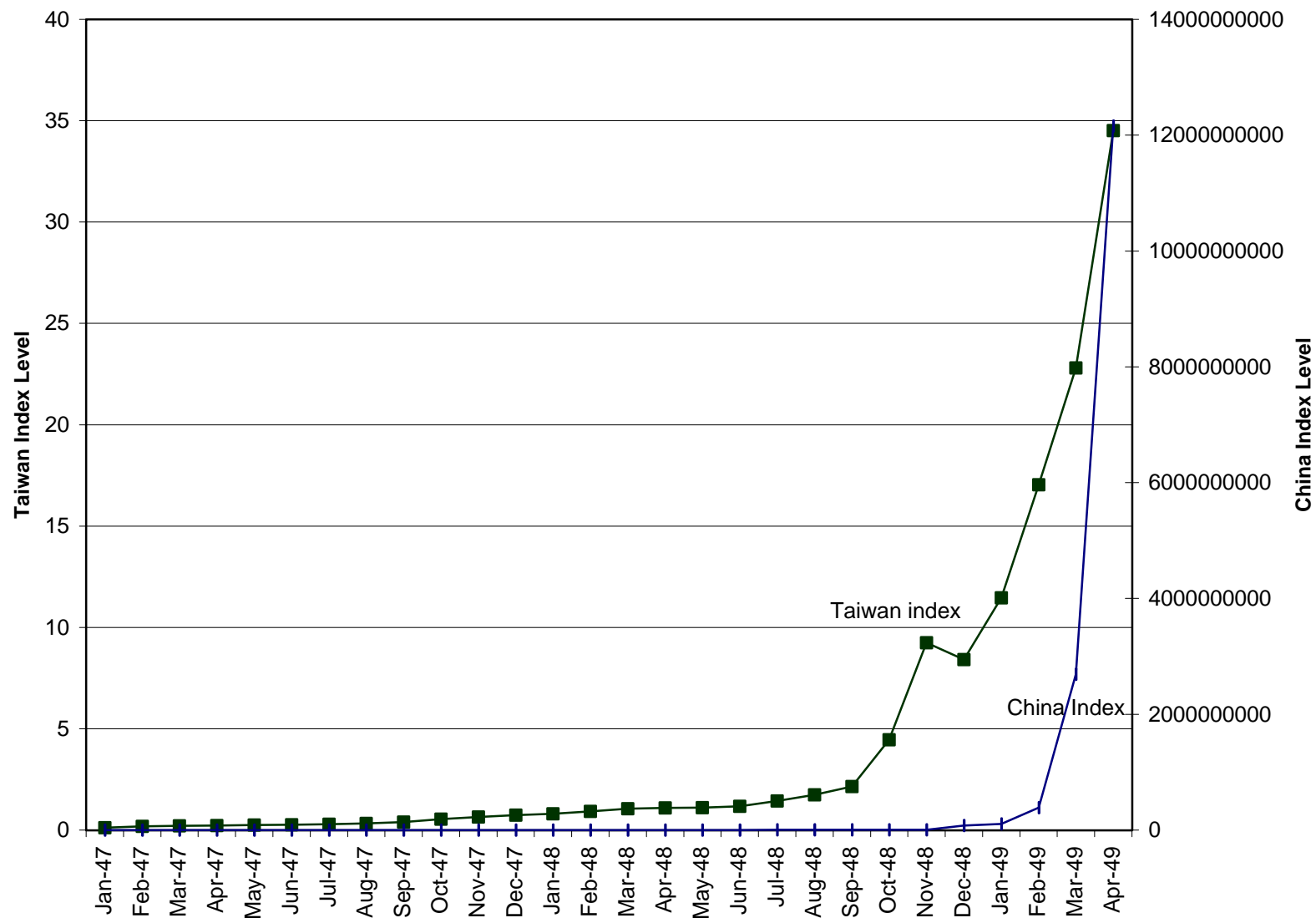


Figure 2
Net Capital Inflow into Taiwan, January 1947 - April 1949

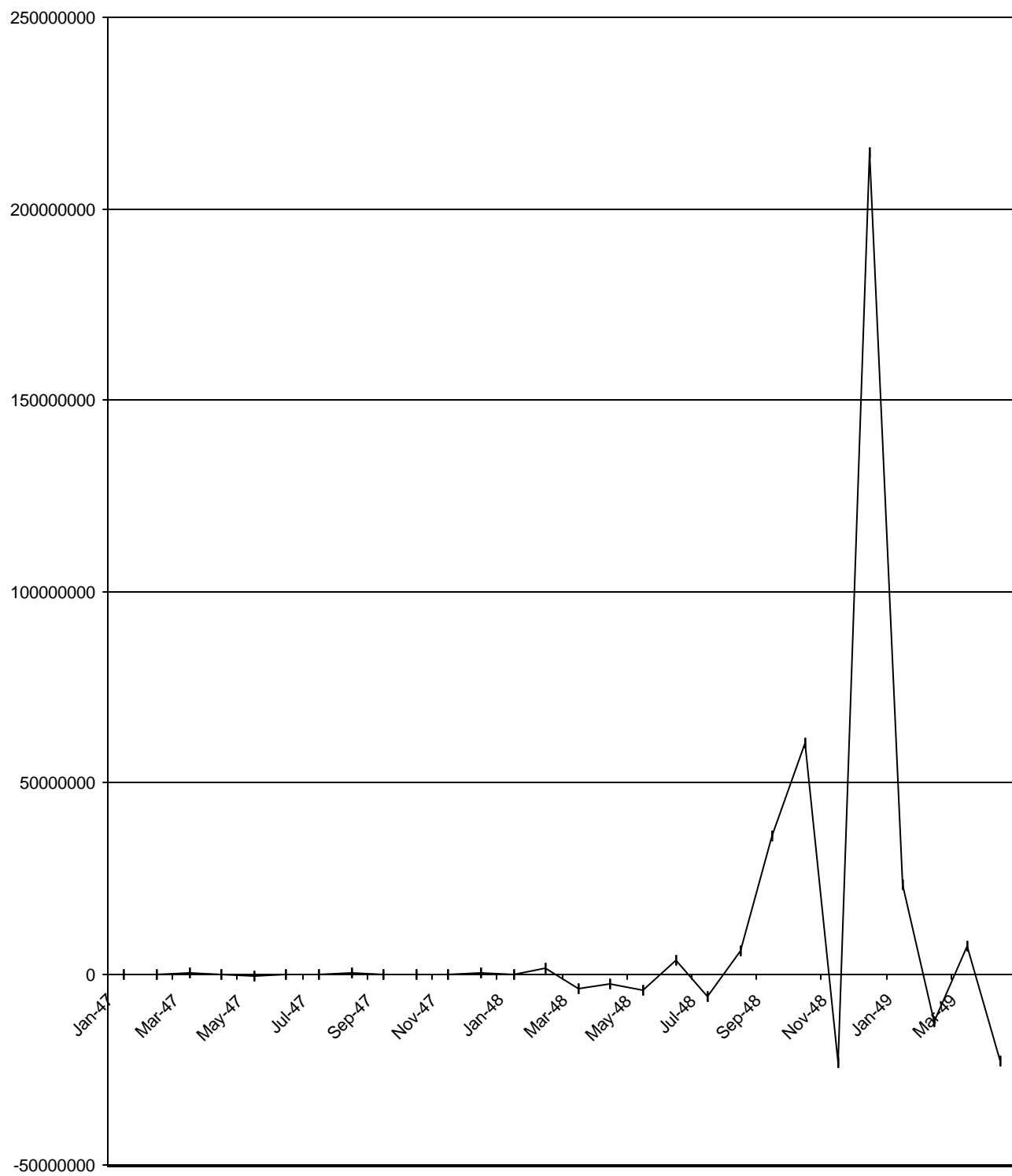


Figure 3
Impulse Response of Taiwanese Inflation to a One Standard Deviation Shock to
Chinese Money Growth

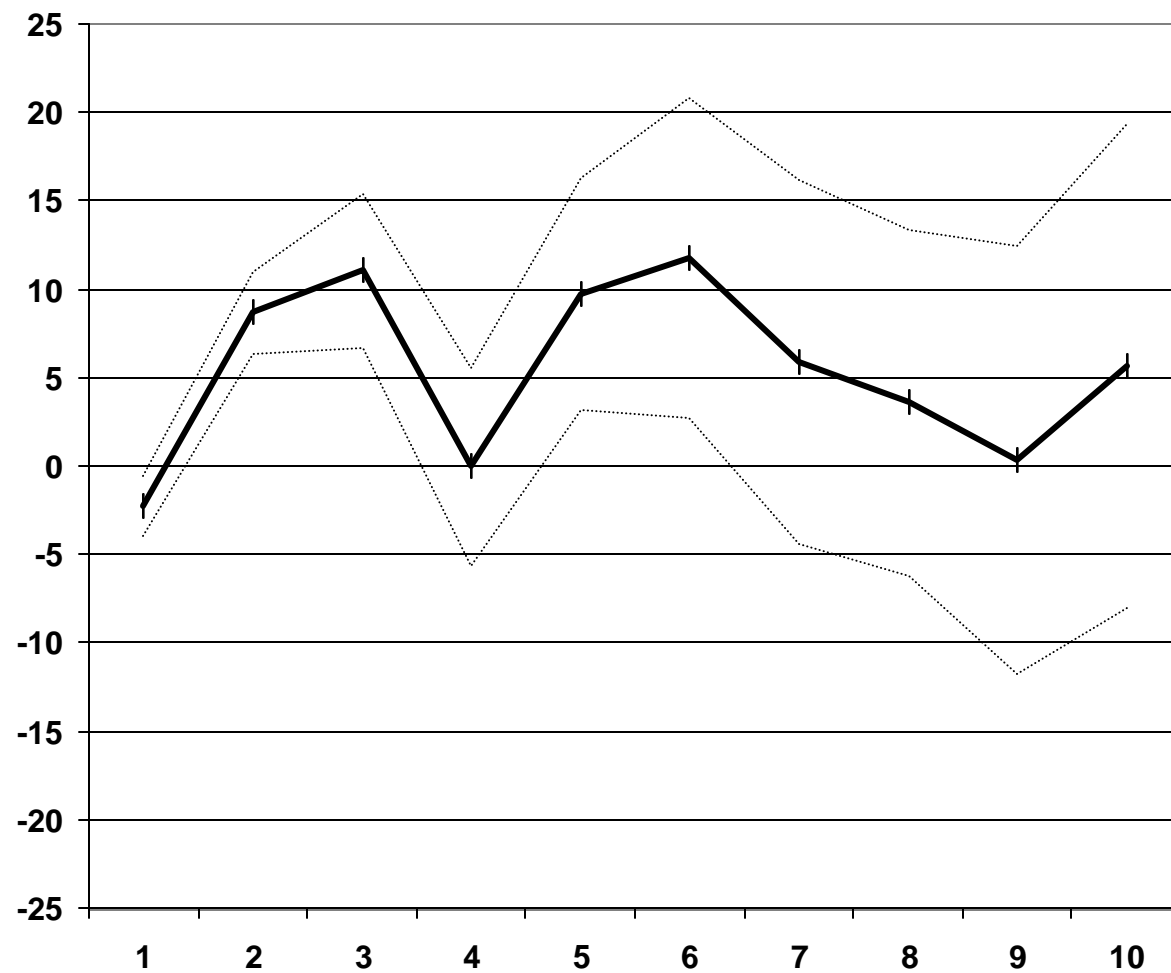


Figure 4
Impulse Response of Taiwanese Inflation to a One Standard Deviation Shock to
Chinese Inflation

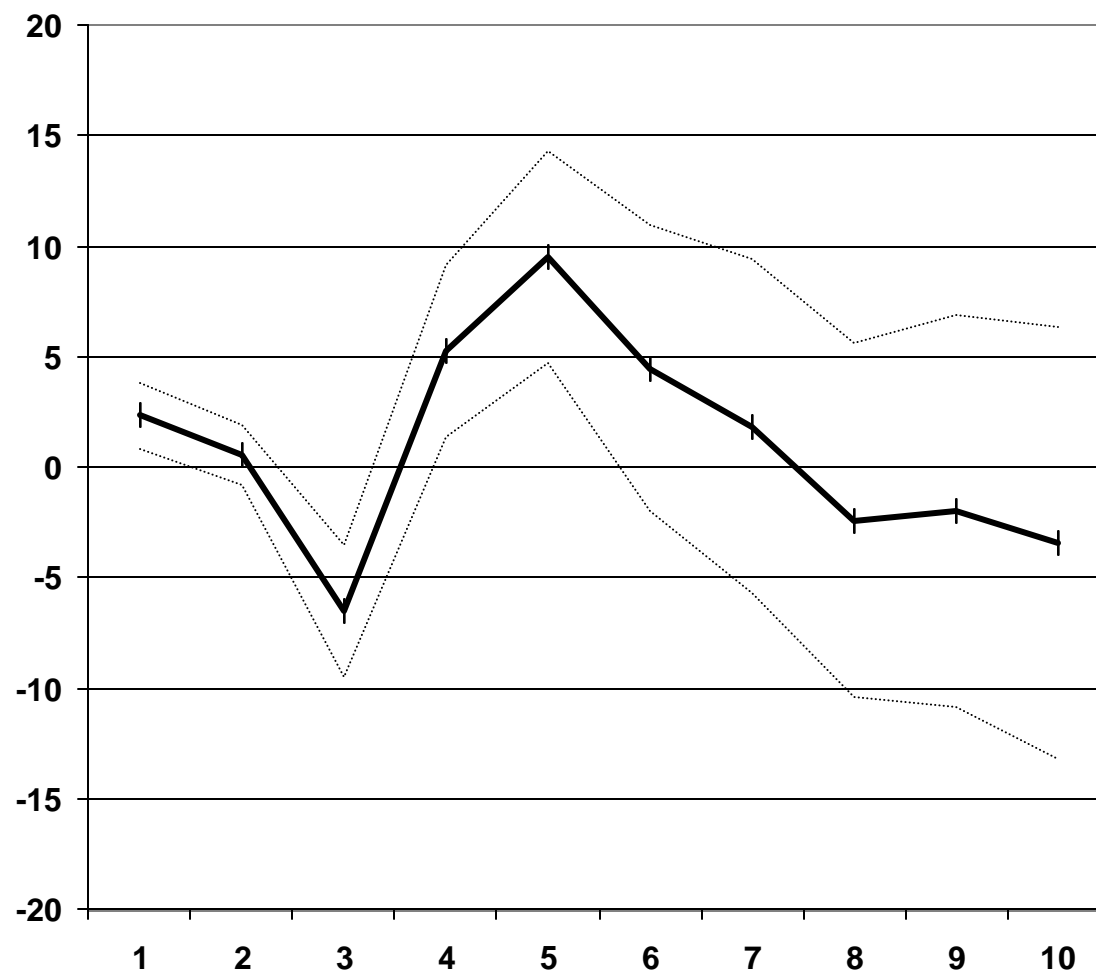


Figure 5
Impulse Response of Taiwanese Inflation to a One Standard Deviation Shock to
Capital Inflows

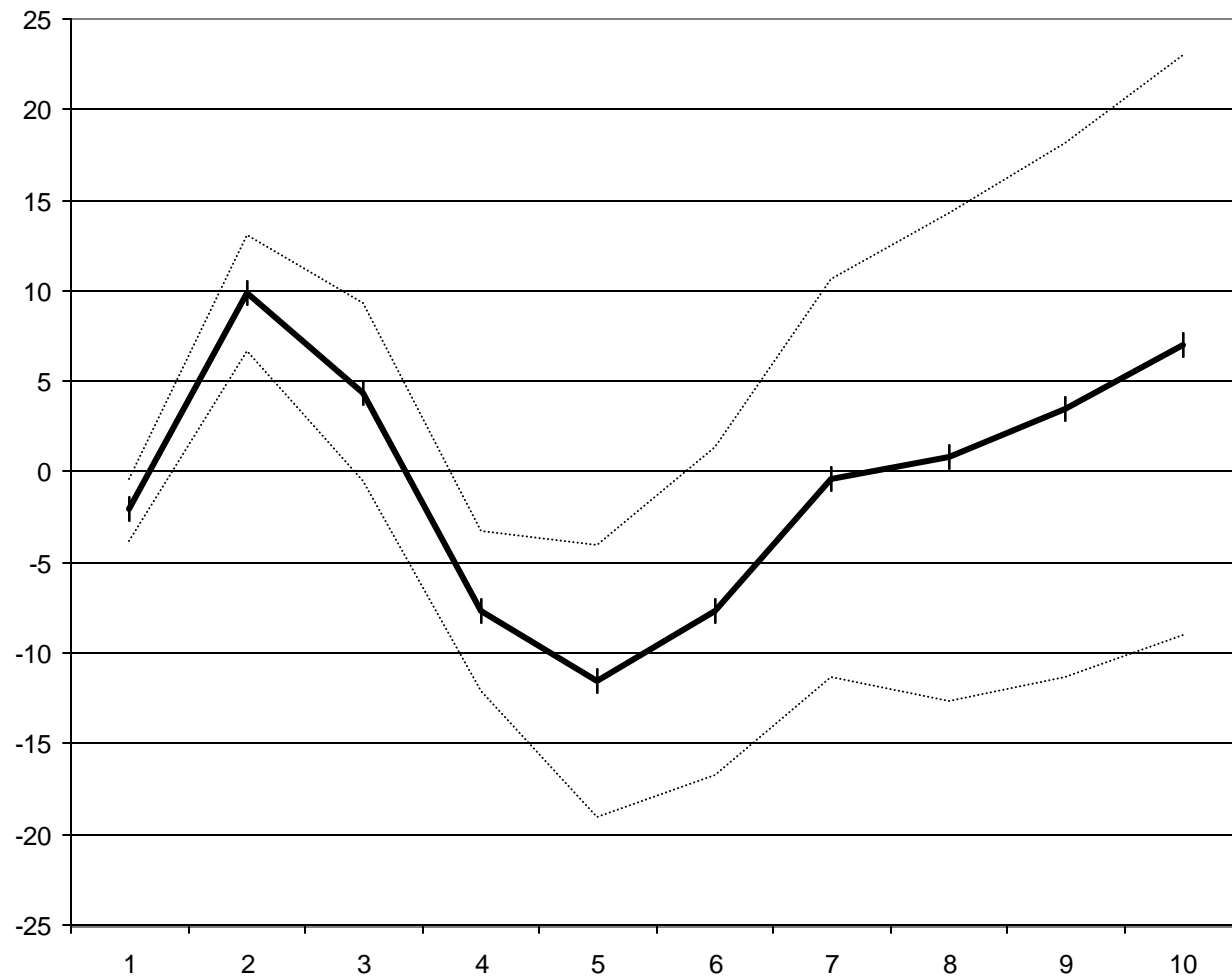


Figure 6
Impulse Response of Taiwanese Money Growth to a One Standard Deviation Shock to Capital Inflows

