# The Effects of Financial Crises on International Trade

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**Abstract**

This paper studies the effects of financial crises on international trade both theoretically and empirically. The major findings are that banking crises had a negative impact on imports but a positive impact on exports in the short term, whereas currency crises decreased both imports and exports in the short term but increased exports in the long term.

## 1 Introduction

The world suffered three major financial crises in the last ten years, namely, the European Monetary System (EMS) crisis of 1992-1993, the Mexican crisis of 1994-1995 (which spread to a number of South American countries) and the Asian crisis of 1997-1998. Economists usually believe these crises were the results of weak economic fundamentals, e.g. declining foreign reserve, increasing foreign debt, capital account and current account deficits, government fiscal deficit and so on.

Obviously, current account deficit, i.e. import minus export, can be a very important factor because other things being equal, it increases foreign debt, decreases foreign reserves and weakens confidence in the exchange rate of the domestic currency. Almost all countries that suffered financial crises had faced rising current account deficits before the crises occurred. So trade deficits are widely regarded as an important factor of financial crises.

International trade links play an important role in the so called "contagious effect", i.e. a crisis in one country causes a new crisis in another country with relatively good fundamentals. Glick and Rose (1999) provide some analysis of the relationship between trade and contagion, while Forbes (2001) goes further to construct some statistics measuring the importance of trade linkages in transmitting crises.

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Since almost all economists agree that international trade is one of the important factors in explaining the financial crises, it seems natural and logical to ask the reverse question: what are the effects of financial crises on international trade? Surprisingly, little research on this subject has been done. Perhaps the reason is that the answer appears to be obvious. Conventional wisdom would predict that a financial crisis, by bringing about a recession in the macroeconomy, would lead to a drop in imports. Exports, however, may rise because of both a decline in domestic demand and devaluation of the domestic currency. A weakening or collapse of the financial system, in particular the banking system, however, might weaken the country's export capability. So the aggregate effects of a financial crisis on the macroeconomy are unclear. This paper tries to clarify the problem both empirically and theoretically.

We divide all the past financial crises into two types: banking crisis and currency crisis. These two different crises, with different attributes, had different effects on international trade. This paper first constructs a model of banking crisis and a model of currency crisis to analyze their respective effects on international trade. Then bilateral trade data, macroeconomic data and geographic data will be used to test the models' theoretical predictions. Overall, the empirical results provide strong support for the theoretical predictions.

This paper contributes to the literature in two ways. First, it presents a theoretical analysis of the impact of financial crises on international trade and the channels of crises transmission through trade. Second, it estimates the effects of banking crises and currency crises on imports and exports. The estimated results can be used to predict the impact of financial crises on trade, thus providing useful information on risk management to policy makers.

The remainder of the paper is organized as follows. Section 2 reviews previous works on the relationship between international trade and financial crisis. Sections 3 and 4 construct theoretical models of banking crisis and currency crisis, respectively, to analyze their effects on trade. Section 5 describes the data and method used to estimate these effects of these crises. Section 6 reports the results of empirical estimation and statistical testing. Section 7 concludes.

## 2 Literature Review: Trade and Financial Crises

Economists pay attention to the role played by trade in financial crises for two reasons. First, trade imbalance is one of the important factors that have been shown to trigger financial crises. Second, financial crises may be transmitted through trade linkages from an affected country to others despite the latter's relatively good fundamentals. In explaining such contagion effects, economists have tried to identify the channels through which contagion was spread. As trade is the most obvious economic linkage between countries, much research has been devoted to this connection. Now importance of trade imbalance in triggering crises is widely accepted, but, there is no agreement on the importance of trade in transmitting financial crises.

Eichengreen and Rose (1999) use a binary-probit model to test whether bilateral trade linkages transmitted crises between industrial countries between 1959 and 1993. They find that the probability of a financial crisis occurring in a country increased significantly if the country had high bilateral trade linkages with countries in crises. They conclude that trade was an important factor. Glick and Rose (1999) conduct a similar analysis with more countries between 1971 and 1997 and obtain a similar result. Forbes (2000) use company's stock market data to study the importance of trade in financial crises transmission and his result also shows that trade played an important role.

Other papers have provided different answers to the problem. For instance, Baig and Goldfajn (1998) think that trade was unimportant in the East Asian Crisis because that the direct bilateral trade volumes between these economies were very small. Masson (1998), analyzing the Mexican crisis and the Asian crisis, obtains similar results.

All the papers that analyze the relationship between trade and financial crises ignore the reverse question: how did financial crises affect international trade? We argue that the effects of financial crises on trade are a precondition for discussing whether trade transmits crises. If financial crises do not affect countries' imports and exports at all, how can financial crises be transmitted through the trade channel? So, before we analyze the importance of trade in transmitting financial crises, we need to clarify the effects of financial crises on international trade. However, little work has

been done on this topic to date. It seems there is a belief that financial crises only affect countries' imports and exports through changes in the exchange rates. Since the effects of exchange rates have already been thoroughly analyzed before, there is no need to study the reverse question. However, this view may not be correct.

A devaluation of a national currency will increase the volume of exports and reduce the volume of imports. Classic international trade theory shows a devaluation improves the trade balance if the Marshall–Lerner condition is satisfied. Since in a financial crisis a country usually experienced a devaluation of its national currency, the same analysis would apply, i.e., the affected countries' imports will decrease but their exports will increase after the crises.

In the real world, there were of two types of financial crises: currency crises and banking crises. In some cases the exchange rates remained stable but the banking systems were in crises. Furthermore, financial crises (including currency crises, banking crises or both) could also affect trade through channels besides the exchange rate. Calvo and Reinhart (1999) point out that financial crises usually caused capital account reversal ("sudden stop") and triggered an economic recession. Mendoza (2001) shows that in an economy with imperfect credit markets these sudden stops may be an equilibrium outcome. The economic recession would reduce not only domestic demand, but also total output and export capability, whereas capital outflow would force the country to increase export. Thus, whether exports increase or decrease after financial crises is unclear without further analysis.

Before we analyze how financial crises affect the crisis countries's imports and exports, let us first define financial crises. Eichengreen and Bordo (2002) provide definitions of currency crises and banking crises:

> "For an episode to qualify as a currency crisis, we must observe a forced change in parity, abandonment of a pegged exchange rate, or an international rescue. For an episode to qualify as a banking crisis, we must observe either bank runs, widespread bank failures and suspension of convertibility of deposits into currency such that the latter circulates at a premium relative to deposits ( a banking panic), or significant banking sector

problems (including but not limited to bank failures) resulting in the erosion of most or all of banking system collateral that are resolved by a fiscally-underwritten bank restructuring."

The above definitions are adopted in this paper. In next two sections, we construct two models to explore the effects of banking crises on the macro-economy and to discuss the effects of currency crises on trade.

## 3 A Model of Banking Crises

This theoretical model is an extension of the classic framework developed by Diamond and Dybvig (1983). The model is an infinite overlapping-generation model of a small open economy. There are three periods for each generation: 0, 1 and 2. Period 2 of generation $t$ overlaps with period 0 of generation on $t+1$.

Consider generation $t$. There are three types of investors: two types of local investors and a single type of foreign investors. The local investors are comprised of $n_p$ "patient investors" and $n_i$ "impatient investors". Each local investor is endowed with $w_l$ units of a local good. The number of foreign investors is $n_f$. Each of them has $w_f$ units of a foreign good.

Both patient and impatient investors are born in period 0. They do not consume any goods in period 0 but do so in period 1 or period 2. Impatient investors only consume in period 1 while patient investors only consume in period 2. Both groups of local investors get utilities from two goods: the local good, which is produced in the economy, and the foreign good, which is imported. A new generation of local investors appear in period 2 of generation $t$ or equivalently period 0 of generation $t+1$.

Local investors do not know their own type before period 1, but each may be impatient or patient with the same probability. Denote the probability that a local investor is impatient by $\lambda$, then $\lambda = \frac{n_i}{n_i+n_p}$. $n_p$, $n_i$ and $n_f$ are fixed and are common knowledge in all periods. We assume foreign investors are patient and only care about the value of their investments.

For simplicity, we assume local investors' utility functions to be additive in log, i.e.,

$$u_p(c_{l1}, c_{f1}, c_{l2}, c_{f2}) = \alpha \ln(c_{l2}) + (1-\alpha)\ln(c_{f2})$$

and

$$u_i(c_{l1}, c_{f1}, c_{l2}, c_{f2}) = \alpha \ln(c_{l1}) + (1-\alpha)\ln(c_{f1})$$

where $0 < \alpha < 1$, $c_{l1}, c_{l2}$ are the consumptions of the local good in period 1 and 2, $c_{f1}, c_{f2}$ are the consumption of the foreign good in period 1 and 2, respectively. We assume that the local economy is small and the prices of the local and foreign good are exogenously given. For simplicity, both prices are set equal to 1.

There is a risk free asset which produces $R_0$ units of the local good in period 1 and $R_1$ units of local good in period 2 for each unit of the local good invested in period 0 and period 1, respectively.

There is a representative bank in a perfectly competitive banking sector. The bank has a long term investment project in period 0. The project requires the local goods and the foreign goods as inputs in period 0 and produces some local goods in period 2. The production function is $F(y_L, y_F) = C y_L^{\beta} y_F^{1-\beta}$, where $C$ is constant, and $y_L$ and $y_F$ are the local goods and the foreign goods. Given the production function, the optimal inputs are $y_L = \beta I$ and $y_F = (1-\beta)I$ where $I$ is the total investment of the project. Since the price of the local good is the same as that of the foreign good, each unit of investment in period 0 can get a fixed return $R$ in period 2, where $R = C\beta^{\beta}(1-\beta)^{1-\beta}$. We assume $R > R_0 R_1$, so the project is more profitable than the risk free asset. However, the project is illiquid before maturity, i.e., if the project ends in period 1, it will only produce a fixed return $r < R_0$ for each unit of investment.

The bank provides a contract to all investors in period 0. In this contract, the bank promises that it will repay $R_L$ for each unit of investment to investors in period 2. Investors have the right to withdraw their deposits in period 1 with a fixed rate of return $R_S$. The bank accepts both local and foreign investors' investments and invest them in the risk free asset or the long term project in period 0. We assume the banking sector is perfectly competitive, so the bank's object is to maximize investors' utilities. In period 0, each agent maximizes his/her expected utility: $U(c_{l1}, c_{f1}, c_{l2}, c_{f2}) = \lambda[\alpha \ln(c_{l1}) + (1-\alpha)\ln(c_{f1})] + (1-\lambda)[\alpha \ln(c_{l2}) + (1-\alpha)\ln(c_{f2})]$.

With $n_i+n_p$ local investors and $n_f$ foreign investors depositing their goods in the bank, the bank chooses $R_L$, $R_S$ and the proportion of all deposits invested in the long term project to maximize investors' utilities. We denote the proportion of deposits invested in the long term project by $\delta$.

Since the bank has to maximize the expected utility of two different types of agents at the same time, this problem is a little bit complicated. But we can get the following result.

**Proposition 1** *There is a unique market equilibrium* $R_S^* = R_0$, $R_L^* = R$ *and* $\delta^* = \frac{n_p+n_f}{n_i+n_p+n_f}$.

**Proof** See the Appendix. ■

In period 0, all investors deposit their endowment in the bank, and the bank invests $n_i w_l$ in the risk free asset and $n_p w_l + n_f w_f$ in the long term project. The bank exchanges some foreign goods with local goods to optimize its input combination for the long term project. The optimal inputs of the foreign good are $\beta(n_p w_l + n_f w_f)$. The foreign investor' deposits provide $n_f w_f$ foreign goods. For convenience, we assume $\beta(n_p w_l + n_f w_f) > n_f w_f$, implying some local goods are exported to pay for the import of additional foreign goods.

In period 1, local investors realize their types, and the impatient investors withdraw their deposits. Patient and foreign investors may withdraw all or part of their deposits if they want. The rate of return on deposit withdrawn in period 1 is $R_0$. The bank repays them with the proceed from the sale of the risk free asset. If there is no bank run in period 1, the project ends and produces $R$ units of local goods for each unit of investment in period 2. Investors share the return on their investments.

In period 1, if the proceed does not satisfy the withdrawal requirement, a bank run occurs and the project is liquidated, producing a salvage value $(n_p w_l + n_f w_f)r$. The bank pays back its depositors according to the first-come-first-served rule. Investors who withdraw too late get nothing.

We only consider two extreme cases: good case and bad case.

- Good Case With No Bank Run:

In period 1, the risk free asset produces the return $n_i w_l R_0$. Impatient investors withdraw all

their deposit plus interest equal to $n_i w_l R_0$, while patient and foreign investors do nothing. In this case, the bank satisfies the withdrawal requirement, so bank run does not occur.

In period 2, each unit of long term investment produces $R$. Patient investors and foreign investors share the return according to the amount of their deposits: patient investors get $Rn_p w_l$ and foreign investors get $Rn_f w_f$.

Since the returns are local goods, patient investors and impatient investors have to exchange local goods for foreign goods. According to their utility functions, we can get their demand for local goods and foreign goods:

impatient investors:

$c^i_{l1} = \alpha w_l R_0$

$c^i_{f1} = (1-\alpha) w_l R_0$

patient investors:

$c^p_{l2} = \alpha w_l R$

$c^p_{f2} = (1-\alpha) w_l R$

The foreign investors' deposits give rise to imports and their repatriation of return requires exports. The imports and exports of the economy in the three periods are as follows:

Period 0:

import: $\beta(n_p w_l + n_f w_f)$, the optimal input of the long term project,

export: $\beta(n_p w_l + n_f w_f) - n_f w_f$, the optimal input of the long term project less foreign investment.

Period 1:

import: $n_i c^i_{f1} = n_i(1-\alpha) w_l R_0$,

export: $n_i c^i_{f1} = n_i(1-\alpha) w_l R_0$.

Period 2:

import: $n_p c^p_{f2} = n_p(1-\alpha) w_l R$,

export: $n_p c^p_{f2} + n_f w_f R = n_p(1-\alpha) w_l R + n_f w_f R$.

In an overlapping-generation model, foreign investors invest again in period 0 of generation $t+1$, which overlaps with period 2 of generation $t$. This economy also imports and exports some

goods for consumption and repaying foreign agents in period 0 of the generation $t$, which overlaps with period 2 of the generation $t-1$. Supposing the number of foreign investors is $n'_f$ in generation $t+1$, with each investing $w'_f$. These new foreign investors' investment may offset some capital outflow of previous generation. Taking this into account, we modify the import and export in period 2:

import: $n_p(1-\alpha)w_l R + \beta(n'_p w'_l + n'_f w'_f)$

export: $n_p(1-\alpha)w_l R + n_f w_f R + \beta n'_p w'_l + (\beta-1)n'_f w'_f$.

The import and export in period 0 also need to be modified as follows to account for generation $t-1$. $\beta(n_p w_l + n_f w_f) + Im_{t-1}$ and $\beta(n_p w_l + n_f w_f) - n_f w_f + Ex_{t-1}$, respectively, where $Im_{t-1}$ and $Ex_{t-1}$ are imports and exports from generation $t-1$. As expected, the import and export of period 0 and period 2 are structurally similar when the activities of adjacent generations are aggregated.

- Bad Case With Bank Run:

Suppose for some reasons a bank run occurs in period 1. All investors withdraw all their deposits. The bank becomes insolvent. The long term project is liquidated for a salvage value of $(n_p w_l + n_f w_f)r$. Because $(n_p w_l + n_f w_f)r + n_i w_l R_0 < (n_p w_l + n_f w_f + n_i w_l)R_0$, it is impossible for all investors to get their investment back. For simplicity, we assume that the investors' order of withdrawal is random, implying that local impatient investors, local patient investors and foreign investors get $\frac{n_i w_l[(n_p w_l+n_f w_f)r+n_i w_l R_0]}{(n_p w_l+n_f w_f+n_i w_l)}$, $\frac{n_p w_l[(n_p w_l+n_f w_f)r+n_i w_l R_0]}{(n_p w_l+n_f w_f+n_i w_l)}$ and $\frac{n_f w_f[(n_p w_l+n_f w_f)r+n_i w_l R_0]}{(n_p w_l+n_f w_f+n_i w_l)}$, respectively.

After getting back part of their original deposits, impatient investors consume all they have, patient investors invest them in the risk free asset for consumption in period 2, and foreign investors take their money and leave the economy. Since all they get are local goods, import and export occur again. In period 1, impatient investors acquire some foreign goods to maximize their utilities, and foreign investors sell local goods to get foreign goods before they leave. In period 2 patient investors get return from their risk free investment in period 1 and consume them in this period. They pay for imported foreign goods with local goods, thus giving rise to international trade.

On the basis of the patient and impatient investors' demand for local goods and foreign goods, we can derive the import and export in follows.

Period 0:

import: $\beta(n_p w_l + n_f w_f) + Im_{t-1}$,

export: $\beta(n_p w_l + n_f w_f) - n_f w_f + Ex_{t-1}$.

Period 1:

import: $\frac{(1-\alpha)n_i w_l[(n_p w_l+n_f w_f)r+n_i w_l R_0]}{(n_p w_l+n_f w_f+n_i w_l)}$,

export: $\frac{[(1-\alpha)n_i w_l+n_f w_f][(n_p w_l+n_f w_f)r+n_i w_l R_0]}{(n_p w_l+n_f w_f+n_i w_l)}$.

Period 2:

import: $\frac{(1-\alpha)n_p w_l[(n_p w_l+n_f w_f)r+n_i w_l R_0]R_1}{(n_p w_l+n_f w_f+n_i w_l)} + \beta(n'_p w'_l + n''_f w'_f)$.

export: $\frac{(1-\alpha)n_p w_l[(n_p w_l+n_f w_f)r+n_i w_l R_0]R_1}{(n_p w_l+n_f w_f+n_i w_l)} + \beta n'_p w'_l + (\beta-1)n''_f w'_f$.

In deriving the above total import and export in period 2, we have assumed that foreign investors need some time to restore their confidence after a banking crisis, so the number of foreign investors $n''_f$ is less than $n'$, the number of foreign investors without crisis.

The above results show that banking crises affect foreign trade through three channels.

1. Income channel. If a bank run occurs, the bank has to liquidate the long term investment before it matures and all depositors suffer some losses. With a lower income, local investors' demand for foreign goods goes down. Through this channel, both imports and exports decrease during and after banking crises.

2. Foreign capital flow channel. In the absence of bank runs, foreign investors withdraw in period 2, but the withdrawal would be offset by an inflow of new investment fund. However, a bank run causes them to withdraw in period 1 and also reduces new foreign investment in period 2. So banking crises can stimulate exports during crises but reduces them after crises.

3. Input demand channel. As aggregate investment decreases, the input demand for foreign goods also drops. So banking crises have negative effects on long term imports through this channel. On the other hand, as foreign investment decreases, the economy will have to export more local goods to exchange foreign input goods. As a result, banking crises will simulate exports after crises.

## 4 A Model of Currency Crises

In this section we describe a multiple period small open economy. There are an infinitely lived representative consumer, two representative firms and the government. Both the consumer and the government have access to international capital markets.

The consumer is endowed with $y$ units of perishable good in each period. The consumer can sell the good to two representative competitive firms. One firm uses the endowment to produce a non-tradable good, and the other uses the endowment to produce an exportable good. The consumer consumes the non-tradable good and an imported good, but not the exportable good. There are no barriers to trade, so the law of one price holds.

### *4.1 The Representative consumer*

The representative consumer maximizes his/her lifetime utility:

$$U = \sum_{t=1}^{\infty} \beta^t [\alpha \ln c_{Lt} + (1-\alpha) \ln c_{Ft}]$$

where $c_{Lt}$ and $c_{Ft}$ denote the non-tradable good and the imported good respectively, $0 < \beta < 1$ is the discount factor, and $0 < \alpha < 1$.

We denote the real domestic government bond and net foreign assets held by the representative consumer by $b_t$ and $d_t$ respectively. $s_t$ denotes the exchange rate, i.e., units of domestic currency per unit of foreign currency. $p_{yt}$ denotes the price of the endowment, so $\frac{p_{yt}y}{s_t}$ is consumer's income in period $t$, $\tau_t = \frac{\tau p_{yt} y}{s_t}$ denotes the income tax, $0 < \tau < 1$ is the tax rate, $m_t$ represents money balances measured in foreign currency, defined as $m_t = M_t/s_t$, where $M_t$ is nominal local currency holdings. $p_{Lt}$ and $p_{Ft}$ are the prices of the non-tradable and the imported good measured in the local currency, respectively, and $p_{Ft} = p_F^* s_t$, where $p_F^*$ is the constant foreign price of the imported good.

The representative consumer's budget constraint measured in foreign currency is given by:

$b_t + d_t + m_t = \frac{(1-\tau)p_{yt}y}{s_t} + (1+r)(b_{t-1} + d_{t-1}) - \frac{p_{Lt}c_{Lt}}{s_t} - \frac{p_{Ft}c_{Ft}}{s_t} + \frac{m_{t-1}s_{t-1}}{s_t}$

In addition, the consumer faces the cash-in-advance constraint: $\frac{p_{Lt}c_{Lt}}{s_t} + \frac{p_{Ft}c_{Ft}}{s_t} \leq m_t$

We solve the problem with the Lagrangian approach, where the Lagrangian is given by

$L = \sum_{t=1}^{\infty} \beta^t [\alpha \ln c_{Lt} + (1-\alpha) \ln c_{Ft} + \lambda_t (\frac{(1-\tau)p_{yt}y}{s_t} + (1+r)(b_{t-1}+d_{t-1}) - \frac{p_{Lt}c_{Lt}}{s_t} - \frac{p_{Ft}c_{Ft}}{s_t} + \frac{m_{t-1}s_{t-1}}{s_t} - b_t - d_t - m_t) + \mu_t (m_t - \frac{p_{Lt}c_{Lt}}{s_t} - \frac{p_{Ft}c_{Ft}}{s_t})]$

For simplicity, we assume $\beta(1+r) = 1$, where $r$ is the real interest rate. From the first order conditions shown in Appendix, we get $\lambda_t = \beta(1+r)\lambda_{t+1} = \lambda_{t+1}$. So the Lagrange multiplier $\lambda_t$ is constant for all $t$, to be denoted by $\lambda$.

We can get

$$\frac{c_{Lt}p_{Lt}}{s_t} = \frac{\alpha}{\lambda(2 - \beta s_t/s_{t+1})}$$

and

$$\frac{c_{Ft}p_{Ft}}{s_t} = \frac{1-\alpha}{\lambda(2 - \beta s_t/s_{t+1})}$$

Denoting the consumer's total expenditure in period $t$ by $c_t = \frac{c_{Lt}p_{Lt}}{s_t} + \frac{c_{Ft}p_{Ft}}{s_t}$, we get

$$c_t = \frac{1}{\lambda(2 - \beta s_t/s_{t+1})} \tag{1}$$

From cash-in-advance constraint, we obtain $m_t = c_t$.

The household's budget constraint plus the transversality condition $\lim_{t\to\infty} \beta^t(b_t + d_t) = 0$ implies the following intertemporal budget constraint:

$$\sum_{t=1}^{\infty}(1+r)^{1-t}c_t = (b_0+d_0)(1+r) + \sum_{t=1}^{\infty}(1+r)^{1-t}(\frac{m_{t-1}s_{t-1}}{s_t} - m_t + \frac{(1-\tau)p_{yt}y}{s_t})$$

Denoting the consumer's present value of future income plus asset holding at period $t$ by $W_t$, i.e.,

$$W_t = (b_{t-1}+d_{t-1})(1+r) + \frac{m_{t-1}s_{t-1}}{s_t} + \frac{(1-\tau)p_{yt}y}{s_t} + \sum_{k=t+1}^{\infty}(1+r)^{t-k}(\frac{m_{k-1}s_{k-1}}{s_k} - m_k + \frac{(1-\tau)p_{yk}y}{s_k})$$

We get

$$\sum_{t=1}^{\infty}(1+r)^{1-t}c_t = W_1 - m_1 \tag{2}$$

### *4.2 The Representative firms*

There are two representative competitive firms, one producing the non-tradable local good and the other producing the exportable good. Both firms produce under constant returns to scale

technologies, with the consumer's endowments as inputs. For simplicity, we assume $y_{Lt} = i_{Lt}$ and $y_{Tt} = i_{Tt}$, where $y_{Lt}$ and $y_{Tt}$ are the firms' outputs, $i_{Lt}$ and $i_{Tt}$ are the firms' inputs. The price of the exportable good in foreign currency is $p^*_{Tt}$, and under the assumption of a small open economy, $p^*_{Tt}$ is exogenously fixed. The two firms produce different goods with an identical input. In equilibrium, the price of the input must equal the prices of two outputs, i.e. $p_{yt}/s_t = p_{Lt}/s_t = p^*_{T_t}$.

### *4.3 The Government*

The government is assumed to consume $g_t$ units of the non-tradable good, levy a proportional tax $\tau_t$ and borrow at the real interest rate $r$ in period $t$. The government also collect an inflation tax by printing money. The government's budget constraint is given by:

$$f_t - b_t - m_t = \frac{\tau p_{yt} y}{s_t} - \frac{p_{yt} g_t}{s_t} + (1+r)(f_{t-1} - b_{t-1}) - \frac{m_{t-1} s_{t-1}}{s_t}$$

where $f_t$ denotes the government's real net foreign assets. We assume the government's expenditures are constant overtime, i.e., $g_t = g$ for all $t$. With the transversality condition $\lim_{t\to\infty}(1+r)^{-t}(f_t - b_t) = 0$, we denote the present value of the government's future tax revenues plus its assets holdings as

$$GI_t = (f_{t-1} - b_{t-1})(1+r) + \tau \sum_{k=t}^{\infty} \frac{(1+r)^{t-k} p_{yk} y}{s_t} + \sum_{k=t}^{\infty} (1+r)^{t-k} (m_k - \frac{m_{k-1} s_{k-1}}{s_k})$$

So the government's intertemporal budget constraint is given by $\sum_{t=1}^{\infty}(1+r)^{1-t}\frac{p_{yt} g}{s_t} \leq GI_1$.

### *4.4 Competitive Equilibrium*

We calculate the market equilibria under a fixed exchange rate regime and under an expected devaluation.

#### *4.4.1 Fixed Exchange Rate Regime*

In a fixed exchange rate regime, $s_t = s$ for all $t$. Since $c_t = \frac{1}{\lambda(2-\beta)}$ from (1), $c_t$ is constant. In addition, $m_t = c_t$, so $m_t$ is constant for any $t \geq 1$. For simplicity, we assume $m_t = m_0$ for all $t$. As $W_1 = (b_0 + d_0)(1+r) + (1-\tau)\sum_{t=1}^{\infty}(1+r)^{1-t}\frac{p_{yt} y}{s_t} + m_0$, we obtain $c_t = m_t = \frac{r}{1+2r} W_1$ from

(2), and $c_{Lt} = \frac{\alpha c_t}{p_{Lt}/s} = \frac{r}{1+2r}\frac{\alpha W_1}{p_{Lt}/s}$and $c_{Ft} = \frac{r}{1+2r}\frac{(1-\alpha)W_1}{p_{Ft}/s}$. Because $W_t = W_1$ for all $t$, we omit the subscript $t$ for $W_t$ and $m_t$.

In equilibrium, the demand for the non-tradable good equals its supply, so $y_{Lt} = c_{Lt} + g = \frac{r}{1+2r}\frac{\alpha W}{p_{Lt}/s} + g$.

Since the consumer's endowment is perishable, he always sells all endowments to the firms. Then $y = i_{Lt} + i_{Tt}$. Because $y_{Lt} = i_{Lt}$ and $y_{Tt} = i_{Tt}$, it follows that $y_{Tt} = y - c_{Lt} - g = y - \frac{r}{1+2r}\frac{\alpha W}{p_{Lt}/s} - g$. Moreover, $p_{yt} = p_{Lt} = sp_T^*$. So in the fixed exchange rate regime, the prices of the endowment, the non-tradable good and the export good remain unchanged, and the units and values of exports are the same in all periods. We obtain $W = (b_0 + d_0)(1 + r) + \frac{(1-\tau)(1+r)p_T^* y}{r} + m$ and $m = r(b_0 + d_0) + (1 - \tau)p_T^* y$.

Imports are equal to the consumer's demands for the foreign good. So the total value of import in period $t$ is

$$IM = c_{Ft}p_F^* = (1 - \alpha)m \tag{3}$$

Exports are equal to the aggregate output less the consumer and government's demand for non-tradable goods, so the total value of export in period $t$ is

$$EX = p_T^*(y - g - c_{Lt}) = p_T^* y - p_T^* g - \alpha m \tag{4}$$

Is the fixed exchange rate regime sustainable? The answer is yes if the government can balance its budget with taxes, i.e., $\sum_{t=1}^{\infty}(1+r)^{1-t}p_T^* g \leq (f_0 - b_0)(1+r) + \tau\sum_{t=1}^{\infty}(1+r)^{1-t}p_T^* y$. We can prove the present value of the total import equals the present value of the total export plus the consumer's and the government's net foreign assets, $\sum_{t=1}^{\infty}(1+r)^{1-t}IM \leq \sum_{t=1}^{\infty}(1+r)^{1-t}EX + (d_0 + f_0)(1+r)$. So if the government does not face any permanent fiscal deficit and external conditions do not change, the fixed exchange rate regime is sustainable.

#### *4.4.2 Expected Devaluation*

For simplicity, we suppose that the consumer knows the exchange rate will rise from $s$ to $s'$ at time $t_1 + 1$, where $s < s'$, and $s'$ is sustainable. So $s_{k_1} = s$, and $s_{k_2} = s'$ where $k_1 \leq t_1$ and $k_2 \geq t_1 + 1$.

From (1) we obtain $c_{t_1} = \frac{1}{\lambda(2-\beta s/s')}$ and $c_k = \frac{1}{\lambda(2-\beta)}$ for $k \neq t_1$. Obviously, $c_{t_1} < c_k$. Because $m_t = c_t$, we get $m_{t_1} < m_k$

The result is intuitive. If the consumer expects the devaluation at $t_1 + 1$, he will reduce his domestic money holding $m_{t_1}$ to avoid its loss in value, so his consumption $c_{t_1}$ declines, too.

Comparing the results with those under the fixed exchange rate regime, we find the consumer's consumptions are the same at all periods except at $t_1$. Since imports equal the consumer's consumption of the importable good, and exports equal the domestic output minus the consumer's and the government's consumption of the non-tradable good, we obtain at $t_1$, the period just before the devaluation, an increase in exports and a decline in imports. In all other periods, both imports and exports remain unchanged.

### *4.5 Two Sources of Currency Crises*

As mentioned above, if the government does not face any permanent fiscal deficit and the external conditions do not change, the fixed exchange rate regime is sustainable. However, when these conditions are violated, a currency crisis may appear. We assume the crisis is unexpected by the consumer. In this section, we denote all variables before the crisis the same as before, but variables after the crisis are denoted additionally with an apostrophe.

#### *4.5.1 Permanent Fiscal Deficit*

If the government is unable to balance its budget with taxes, i.e., $\sum_{t=1}^{\infty}(1+r)^{1-t}p_T^* g > (f_0 - b_0)(1+r) + \tau\sum_{t=1}^{\infty}(1+r)^{1-t}p_{yt}y/s_t$, what will happen?

Let the present value of the government permanent fiscal deficit be

$$de = \sum_{t=1}^{\infty}(1+r)^{1-t}p_T^* g - (f_0 - b_0)(1+r) + \tau\sum_{t=1}^{\infty}(1+r)^{1-t}p_{yt}y/s_t$$

If the government has not given up the fixed exchange rate by period $t$, then the present value of fiscal deficit will be given by $(1+r)^{t-1}de$. As $t$ increases, the deficit will grow continuously so eventually the government has to give up the fixed exchange rate.

Consider this example. An external shock (such as war, disease) causes the government to lose some reserves and as a result its foreign asset holding decreases from $f_0$ to $f_0 - d$ in period 0, but

for political reasons the government is unable to adjust the tax rate or cut its expenditure. Instead it has to balance its budget by printing money and giving up the exchange rate. We assume that the government does that immediately and the consumer has no time to adjust its money holding. By adjusting the exchange rate once, the government chooses a new sustainable exchange rate $s' > s$. Given new sustainable exchange rate $s'$, the prices of the endowment, the non-tradable and the export good will be fixed, so $p'_y/s' = p'_L/s' = p^*_T$.

The consumer's money holdings after the currency crisis are $m'$. The present value of the consumer's future endowment income plus assets $W' = (b_{t-1}+d_{t-1})(1+r)+\frac{(1-\tau)(1+r)p^*_T y}{r}+m\frac{s}{s'} < W$, and the present value of the government's future taxes revenues plus its assets holdings is $(f_{t-1} - b_{t-1})(1 + r) + \frac{\tau(1+r)p^*_T y}{r} + (m' - m\frac{s}{s'})$. Since the new fixed exchange rate regime is sustainable, by definition, $(f_{t-1}-b_{t-1})(1+r)+\frac{\tau(1+r)p^*_T y}{r}+(m'-m\frac{s}{s'}) = d+\frac{(1+r)p^*_T g}{r}$. Because the old exchange rate regime was sustainable without $d$, $\frac{(1+r)p^*_T g}{r} = (f_{t-1} - b_{t-1})(1 + r) + \frac{\tau(1+r)p^*_T y}{r}$. Upon comparison, we obtain $d = m' - m\frac{s}{s'}$.

Using $m' = \frac{rW'}{1+2r} = \frac{rW}{1+2r} - \frac{r}{1+2r}\frac{s'-s}{s'}m = m(1 - \frac{r}{1+2r}\frac{s'-s}{s})$ and substituting $d + m\frac{s}{s'}$ for $m'$ , we obtain $s' = \frac{sm(1+r)}{m(1+r)-d(1+2r)}$ and $W' = W - \frac{1+2r}{1+r}d$. Using these expressions we can derive the effects on trade.

Since $c'_L = \frac{r}{1+2r}\frac{\alpha W'}{p'_L/s'}$ and $c'_F = \frac{r}{1+2r}\frac{(1-\alpha)W'}{p^*_F}$, the consumer's consumptions of non-tradable good and imports decrease in the new equilibrium after the crisis. More specifically, the value of imports decreases from $\frac{(1-\alpha)Wr}{1+2r}$ to $\frac{(1-\alpha)W'r}{1+2r}$, and the value of exports increases from $(p^*_T y - p^*_T g - \frac{\alpha W r}{1+2r})$ to $(p^*_T y - g - \frac{\alpha W' r}{1+2r})$. In other words, the value of imports $IM' = IM - \frac{r(1-\alpha)}{1+r}d$, and the value of exports $EX' = EX + \frac{r(1-\alpha)}{1+r}d$. Since $p^*_T$ does not change, the value of imports will fall but that of exports will rise after the crisis.

We believe that the currency crises in Brazil, Mexico and Argentina are close to this case. These governments failed to control their fiscal deficits and financed their deficits by printing money, leading eventually to the abandonment of their fixed exchange rates. After the crises, imports fell whereas exports rose.

*4.5.2 External Demand Shocks*

In this subsection, we analyze how sometimes a country with relatively good fundamentals may also fall victim to a crisis following the crises in other countries with weak fundamentals, i.e., the dynamics of "contagious crises".

Before the external price shock occurs, the exchange rate of a local economy is stable and its government's budget is balanced. For convenience, we suppose $(f_{t-1} - b_{t-1})(1+r) + \frac{\tau(1+r)p_T^* y}{r} = \frac{1+r}{r} p_T^* g$. However, a currency crisis occurs in the economy's trading partner because of a permanent fiscal deficit. So the demand for the domestic economy's exportable good declines. As a result, the prices (measured in foreign currency) of the exportable good and the non-tradable good fall to $p_T^{*\prime}$. If the government does not adjust the exchange rate, the price (measured in local currency) of the non-tradable good will decline from $p_T^* s$ to $p_T^{*\prime} s$.

In reality, the price deflation is a painful process because cutting price is very difficult. For instance, cutting the government officials' salary may be particularly challenging. During the price deflation, firms usually suffer losses and unemployment rises. To minimize the social costs, the government may choose to give up the fixed exchange rate regime. For simplicity, we assume that the government sets the new fixed exchange rate $s' = \frac{p_T^* s}{p_T^{*\prime}}$, implying that the local currency price of the non-tradable good is the same as before.

Does the government face a permanent fiscal deficit after a devaluation? The following proposition answers this question.

**Proposition 2** *If* $(f_{t-1} - b_{t-1}) \geq -\frac{p_T^*(b_{t-1}+d_{t-1})r}{(1+2r)}$*, there is no fiscal deficit after the devaluation. If* $(f_{t-1} - b_{t-1}) \leq -\frac{p_T^*(b_{t-1}+d_{t-1})r}{(1+2r)}$*, the government faces fiscal deficit* $d = \frac{(p_T^* - p_T^{*\prime})(f_{t-1} - b_{t-1})(1+r)}{p_T^*} + \frac{(1+r)(p_T^* - p_T^{*\prime})(b_{t-1}+d_{t-1})r}{(1+2r)}$.

**Proof** See the Appendix. ■

If the government faces some fiscal deficit after the devaluation, it will have to devaluate the local currency further in the future. The result will be the same as the case of the permanent fiscal deficit. For simplicity, we only consider the case $(f_{t-1} - b_{t-1}) \geq -\frac{p_T^*(b_{t-1}+d_{t-1})r}{(1+2r)}$, i.e., the new fixed exchange rate regime is sustainable.

We believe that was the case of Thailand, Malaysia, Taiwan, Singapore and Hong Kong. These economies faced competition in their export market from China, especially after the devaluation of Yen in 1996. The Thai government had to give up its fixed exchange rate in July, 1997 triggering the Asian financial crisis. Its neighbors discovered their costs structures were too high to support their currencies, so they had to give up the fixed exchange rates despite their relatively good fundamentals. Even through Hong Kong's currency board was maintained, it paid a high price in the form of price deflation and fiscal deficit.

If the government gives up the fixed exchange rate regime in period $t$, the exchange rate rises to $s' = \frac{sp_T^*}{p_T^{*\prime}}$. The results are similar to those obtained in a permanent fiscal deficit. After the devaluation, the present value of the consumer's future income plus assets $W' = (b_{t-1} + d_{t-1})(1 + r) + \frac{(1-\tau)(1+r)p_T^{*\prime}y}{r} + \frac{ms}{s'}$, the real money demand $m' = \frac{r(b_{t-1}+d_{t-1})(1+r+rP_T^{*\prime}/P_T^*)}{1+2r} + (1-\tau)p_T^{*\prime}y$. So we can obtain the value of imports and exports as follows

$$IM' = (1-\alpha)(1-\tau)p_T^{*\prime}y + (1-\alpha)\frac{r(b_{t-1}+d_{t-1})(1+r+r\frac{P_T^{*\prime}}{P_T^*})}{1+2r} \tag{5}$$

$$EX' = (1-\alpha+\alpha\tau)p_T^{*\prime}y - p_T^{*\prime}g - \frac{\alpha r(b_{t-1}+d_{t-1})(1+r+r\frac{P_T^{*\prime}}{P_T^*})}{1+2r} \tag{6}$$

Comparing these results with those before the shock, we find there are two channels that affect exports and imports.

1. Income channel. As the price of the exportable good declines, the consumer's income falls. So both imports and exports decline. The effects are captured by the first term of RHS of (5) and of (6).

2. Wealth channel. The consumer loses some wealth during the depreciation, so he has to cut back his consumption. So imports decline and exports rise after the currency crisis. The second term of RHS of (5) and the third term of RHS of (6) capture this channel.

#### *4.5.3 Unexpected Devaluations*

The consumer loses $\frac{m(s'-s)}{s'}$ wealth during a devaluation. If the devaluation is expected, the consumer will decrease $m$, but if the consumer does not expect the devaluation, he/she will not decrease $m$, thus incurring more losses. Since $c_k = \frac{1}{\lambda(2-\beta)}$ for $k \neq t_1$, consumption will return to

the level before the devaluation at $t_1$ if the devaluation is expected. If the government's expenditure for non-tradable good remains unchanged, both imports and exports will return to the original level. However, if the devaluation is unexpected, the consumer suffers some unexpected loss, so his/her consumption declines. As a result, imports decline further and exports are higher.

#### *4.5.4 Effects of Currency Crises on Imports and Exports*

Let us recapitulate the effects of currency crises on trade. Whether a currency crisis is caused by a permanent fiscal deficit or an external shock, imports always decrease in the long term, but the reasons are different. If the crisis is caused by a permanent fiscal deficit, the consumer's wealth goes down because of inflationary finance. If a crisis is caused by an external shock, the consumer's income declines because of the lower price of the exportable good. In both types of currency crises, the consumer always loses some wealth, so he/she has to reduce the consumption of the imported good.

The behavior of exports depends on the cause of the currency crisis. If the crisis is caused by a permanent fiscal deficit, demand for the non-tradable good declines and exports increase. However, if the crisis is caused by an external shock, the result is unclear. Exports may increase as the consumer's demand for the non-tradable good declines, but since the price of the exportable good declines, the values of exports may go either way.

If an unexpected currency crisis happens in period $t$, then both firms and consumer would be caught off guard. A firm producing the same quantity of exportable good and setting the same price (measured in local currency) as before the crisis will see the value of its exports during period t decline from that in the previous because $s_{t-1} < s_t$. If the consumer does not expect the crisis, he/she will choose the same cash holdings $M_t$ as before, leading to a bigger loss in wealth and a bigger decline in imports.

## 5 Crises, Estimation Model and Data

Having analyzed the effects of banking crises and currency crises on foreign trade in theoretical models, let us use real world data to test our theoretical predictions.

Although the two theoretical models analyze the effects of financial crises on aggregate exports and imports, we use bilateral trade data to test the predictions in order to isolate external effects that vary across countries. For example, if a country and its main trading partner fall into financial crises at the same time, the country's exports and imports are affected by both internal and external shocks. However, we are unable to include the external shock as explanatory variable if we use the aggregate data. The use of bilateral trade data allows us to include the crisis dummies of both importing and exporting countries separately. Thus we can avoid biases caused by inappropriate use of dummies in analyzing aggregate trade data.

Eichengreen and Bordo (2002) provide a list of financial crises found in the major economies (Table 1). We use the same list in the following analysis because the included countries are sufficiently representative.

We analyze how financial crises affected foreign trade in three consecutive years. We regard the effects on trade during the crisis year as "short-term" and the two years after crises as "longer-term". We do not consider lags in excess of two years because the major crises were less than three years apart. For example, the EMS crisis, the Mexican crisis and the Asian crisis.

Once the crises are identified, we can estimate the effects of these crises on trade with the following estimation model, which is an extension of the well known gravity equation of bilateral trade.

$$\begin{aligned}\log(export_{t,i,e}) = {} & \alpha_1 b_{i,t} + \alpha_2 b_{i,t-1} + \alpha_3 b_{i,t-2} + \alpha_4 b_{e,t} + \alpha_5 b_{e,t-1} + \alpha_6 b_{e,t-2} \\ & + \beta_1 c_{i,t} + \beta_2 c_{i,t-1} + \beta_3 c_{i,t-2} + \beta_4 c_{e,t} + \beta_5 c_{e,t-1} + \beta_6 c_{e,t-2} \\ & + \lambda \cdot \log(export_{t-1,i,e}) + \theta_1 X_{t,i,e} + \theta_2 Y_{t-1,i,e} + \theta_3 Y_{t-2,i,e} + C + \gamma \cdot n + \varepsilon_{n,i,e}\end{aligned}$$

where $export_{t,i,e}$ is export from country e to country i at time t. We assume that there is continuity in bilateral trade, so the lag of the dependent variable $\log(export_{t-1,i,e})$ is included as an explanatory variable. The reason is that our interest is not in the long term effect of the determinants of trade but the relative changes in imports and exports during and after financial

crises. So we have to allow for the continuity of these long term determinants.

The variables $b_{i,t}$ and $c_{i,t}$ are dummy variables for banking crises and currency crises at time t respectively.

$b_{i,t} = 0$ if country i does not fall into a banking crisis at time t;

1 otherwise.

$c_{i,t} = 0$ if country i does not fall into a currency crisis at time t;

1 otherwise.

This model includes both import and export countries' banking crises and currency crises dummies ($b_{i,t}$ , $c_{i,t}$, $b_{e,t}$ , $c_{e,t}$), so we can analyze the effects of crises on both imports and exports together. Since financial crises may have different short-term effects and longer-term effects, this model also includes the first period and second period lag of these crisis dummies $b_{i,t-1}, b_{e,t-1}, b_{i,t-2}, b_{e,t-2}, c_{i,t-1}, c_{e,t-1}, c_{i,t-1}$ and $c_{e,t-2}$.

$X_{t,i,e}$ is a set of macroeconomic variables that affect trade between country i and e at time t. Based on the gravity equation framework, $X$ is taken to include the following variables: *igdp*, the log value of GDP of the importing country; *egdp*, the log value of GDP of the exporting country; *ipop*, the log value of the population of importing country; *epop*, the log value of the population of exporting country; *dis*, the log value of the distance between importing and exporting countries; *comland*, a common land border dummy equal to 1 if the trading countries have a common land border and 0 otherwise; *nland*, the number of trading countries being landlocked (i.e., 0, 1 or 2); *nisland*, the number of trading countries being islands countries (i.e., 0, 1, or 2); *idev*, the rate of devaluation of importing country's currency relative to US$; *edev*, the rate of devaluation of exporting country's currency relative to US$.

Since a currency devaluation has both short-term and long-term effects, $Y_{t-1,i,e}$ and $Y_{t-2,i,e}$ include the first and second lag of the devaluation variables $lagidev$, $lagedev$, $lag2idev$ and $lag2edev$ as explanatory variables.

The data used in the equation come from many different sources. Bilateral import value is from World Trade Database. GDP, population and exchange rate (used to calculate the devaluation rate) data are taken from the International Financial Statistics. Distances, common language, the

number of the landlocked countries and the number of the island countries are taken from Frankel and Rose (2002)'s database. Financial crises dummies are taken from Eichengreen and Bordo (2002). All data are between 1978 to 1999.

## 6 Estimation Results and Statistical Tests

The estimation results are reported in Table 2. Because the model includes GDP and devaluation as independent variables, the effects of the crisis dummies capture the effects of crises through channels other than economic recession or currency devaluation.

First, we analyze the effects of banking crises on imports. The coefficient for $b_{i,t}$ is negative but insignificant, meaning that the impact of banking crises on imports during the crisis year was unclear. After the crisis year, the impact was more visible because the coefficient for $b_{i,t-1}$ is negative and significant at 0.01% level, and that for $b_{i,t-2}$ is negative at 10% level. These results are consistent with our bank run model's predictions. As we have pointed out, in the short term, banking crises reduce imports through the income channel, and in the longer term, they decrease imports through the input channel. The effects via the income channel are already captured by GDP, so the coefficient of $b_{i,t}$ is as expected insignificant. After a banking crisis, there is less foreign capital inflow, so the input demand for foreign goods drops. The coefficients of $b_{i,t-1}$ and $b_{i,t-2}$ fit the predictions.

Second, we consider the effects of banking crises on exports. Our model predicts that in the short term foreign capital outflow will stimulate exports whereas in the longer term the effects are unclear. The latter's ambiguity is explained as follows: the lower level of foreign debt requires less exports (foreign capital flow channel), but less foreign capital inflow will force the economy to export more to pay for the input demand for foreign goods (input demand channel). The coefficient for $b_{e,t}$ is positive and significant at 0.03% level, that for $b_{e,t-1}$ is insignificant and that for $b_{e,t-2}$ is negative and significant at 0.07%. These results show the short term effect ($b_{e,t}$) is positive and the longer term effect ($b_{e,t-2}$) is negative. Perhaps the coefficient for $b_{e,t-1}$ is insignificant because that the short term and the longer term effects cancel each other. The negative short term effect is

consistent with the theory, and our finding of a negative longer term effect shows that the impact of reduced capital inflow dominated the positive impact through input demand.

Next, we check the effects of currency crises on imports. The model of currency crises predicts that imports always decline in both the short term and the longer term. All the coefficients for $c_{i,t}$, $c_{i,t-1}$ and $c_{i,t-2}$ are negative, consistent with the predictions, but that for $c_{i,t-2}$ is insignificant, failing to provide strong support to our model's longer term prediction.

Finally, we find that in the short term, the impact of currency crisis on exports was negative, i.e., the coefficient for $c_{e,t}$ is negative and significant at 2% level. In the longer term, the impact was positive, i.e., the coefficient for $c_{e,t-2}$ is positive and significant at 0.01% level. These results are consistent with the model's predictions: except for the income channel (already captured by GDP), the short term effect of currency crises on exports is negative and the long term effect is positive. The insignificance of the coefficient for $c_{e,t-1}$ can again be explained by the cancellation of opposite long term and short term effects.

How large are the effects on trade? Since we express the variables in logarithmic terms, we can compute the size of the effects from the regression results. In the case of banking crises, a country's imports on average would decline by about 6.5% in the first year after crisis, and would decline further by 2.5% in the subsequent year; exports would increase by about 5.5% during the crisis year and would decrease by 5.5% in the second year after crisis. In the case of currency crises, the country's imports would drop by about 6.5% during the crisis year and by a further 6.5% in the subsequent year, whereas exports would drop by about 2.5% during the crisis year but recover about 4.5% in the second year after crisis.

To test the robustness of the results, we modify the regression model in four different ways. (1) exclude all currency crises dummies; (2) exclude all banking crises dummies; (3) exclude the variables of devaluation; (4) exclude the common land border dummy, the number of landlocked countries and the number of island countries, which are not related to financial crises directly.

The results are reported in Table 3.1 and 3.2. Most results are stable except for some coefficients of banking crises dummies. For example, the coefficient of $b_{i,t}$ has become significant in (1) and (3). We believe this result can be explained by the simultaneous appearance of "twin crises",

i.e., banking crises and currency crises occur at the same time. In (1) and (3) we exclude the currency crises dummies and the devaluation variables, so the coefficient of $b_{i,t}$ absorbs the effects of currency crises and devaluations.

## 7 Conclusions and Predictions for Further Research

We have analyzed how financial crises affect international trade, an important question ignored by the literature. We developed a bank run model to explore the impact of banking crises on imports and exports. The theoretical results predict that imports will decrease during and after a banking crisis, whereas export will rise during but fall after the crisis. We developed a small open economy model to analyze how currency crises caused by different external shocks affect imports and exports. The analysis predicts imports and exports will fall during crises but the effect after the crisis depends on the source of external shocks. Real world data are then used to test these predictions. By estimating a model of bilateral trade between 50 countries over a period of 20 years, the empirical results generally have provided good support to the theories.

This paper has analyzed theoretically the direct effects of financial crises on the value of trade. For simplicity, we assume the price elasticity of demand for the exportable good to be infinite, so the value and the volume of trade are directly proportional. However, the infinite price elasticity assumption does not hold in reality. In the future, we may consider relaxing the assumption and analyzing the impacts of financial crises on the volume of trade. In addition, the impact of financial crises on different tradable goods may be different. It would be interesting to explore whether the relationships between trade and financial crisis varied significantly across different products. For instance, products that enjoyed a comparative advantage versus those that suffered a comparative disadvantage.

# Appendix

**Proof of Proposition 1**

First, we consider the case of $n_f = 0$, i.e., there are no foreign investors. The bank's problem (BP) is following.

$Max_{R_S,R_L,\delta,b,c_{l1},c_{f1},c_{l2},c_{f2}} U(c_{l1}, c_{f1}, c_{l2}, c_{f2})$

s.t.

$c_{l1} + c_{f1} \leq w_l R_S$

$c_{l2} + c_{f2} \leq w_l R_L$

$\lambda(n_i + n_p) w_l R_S \leq (1-\delta)(n_i + n_p) w_l R_0 + br$

$(1-\lambda) n w_l R_L \leq [\delta(n_i + n_p) w_l - b] R$

$b \geq 0$

where $b$ is the amount investment liquidated in period 1.

We solve BP using the Lagrangian approach and obtain the following solutions.

$R_S^* = R_0$

$R_L^* = R$

$b^* = 0$

$c_{l1}^* = \alpha w_l R_0$

$c_{f1}^* = (1-\alpha) w_l R_0$

$c_{l2}^* = \alpha w_l R$

$c_{f2}^* = (1-\alpha) w_l R$

$\delta^* = \lambda = \frac{n_p}{n_i + n_p}$

$U(c_{l1}^*, c_{f1}^*, c_{l2}^*, c_{f2}^*) = \alpha \ln \alpha + (1-\alpha) \ln(1-\alpha) + \lambda \ln w_l R_0 + (1-\lambda) \ln w_l R$

Next, we consider the case of $n_f > 0$. In this case, if the bank chooses $R_L^* < R$, then other banks can choose $R_S = 0$ and $R_L \in (R_L^*, R)$ and attract all foreign investors. Since other banks will enjoy positive profits, $R_L^* < R$ cannot be a market equilibrium.

If the bank chooses $R_L^* > R$, the local investors must suffer some net loss because the return of the long term project is $R$. So the local investors' utility must be less than $\alpha \ln \alpha + (1-\alpha) \ln(1-\alpha) + \lambda \ln w_l R_0 + (1-\lambda) \ln w_l R$, the highest expected utility they can get without foreign investors. If other banks choose $R_S = R$ and $R_L = R - \epsilon$, then all local investors will deposit in the other banks but foreign investors will not because they only care about the return in period 2. In this case, the bank catering to foreign investors alone by choosing $R_L^* > R$ will suffer a net loss while the other banks will enjoy positive profits. So $R_L^* < R$ cannot be a market equilibrium. Thus, it

follows that $R_L^* = R$ for all $n_f$.

Now we know the bank will invest the foreign investors' deposits in the long term project and repay the return to them in period 2. So the foreign investors do not affect the local investors' utilities. The local investors' highest utilities must the same as the case of $n_f = 0$. ■

**First order conditions of representative consumer's problem:**

$$\frac{\partial L}{\partial c_{Lt}} = 0 : \frac{\alpha}{c_{Lt}} - \frac{(\lambda_t + \mu_t)p_{Lt}}{s_t} = 0$$

$$\frac{\partial L}{\partial c_{Ft}} = 0 : \frac{1-\alpha}{c_{Ft}} - \frac{(\lambda_t + \mu_t)p_{Ft}}{s_t} = 0$$

$$\frac{\partial L}{\partial b_t} = 0 : -\lambda_t + \beta(1+r)\lambda_{t+1} = 0$$

$$\frac{\partial L}{\partial d_t} = 0 : -\lambda_t + \beta(1+r)\lambda_{t+1} = 0$$

$$\frac{\partial L}{\partial m_t} = 0 : -\lambda_t + \mu_t + \beta\lambda_{t+1}\frac{s_t}{s_{t+1}} = 0$$

**Proof of Proposition 2**

After the devaluation, the present value of the consumer's future endowment income plus assets declines to $W' = (b_{t-1} + d_{t-1})(1+r) + \frac{(1-\tau)(1+r)p_T^{*\prime}y}{r} + \frac{ms}{s'} < W$. So the real money demand $m' = \frac{r}{1+2r}W' < m$. The government gets some inflation tax, so the present value of its future taxes revenues plus its assets holdings is

$$GI_t = (f_{t-1} - b_{t-1})(1+r) + \frac{\tau(1+r)p_T^{*\prime}y}{r} + \frac{(1+r)(p_T^* - p_T^{*\prime})(b_{t-1} + d_{t-1})r}{(1+2r)}$$

, and the present value of government expenditure is $\frac{1+r}{r}p_T^{*\prime}g$.

Before the external demand shock occurs, the government's budget is balanced, i.e., $(f_{t-1} - b_{t-1})(1+r) + \frac{\tau(1+r)p_T^*y}{r} = \frac{1+r}{r}p_T^*g$. So if $\frac{1+r}{r}p_T^{*\prime}g = \frac{p_T^{*\prime}}{p_T^*}[(f_{t-1} - b_{t-1})(1+r) + \frac{\tau(1+r)p_T^*y}{r}] \leq (f_{t-1} - b_{t-1})(1+r) + \frac{\tau(1+r)p_T^{*\prime}y}{r} + \frac{(1+r)(p_T^* - p_T^{*\prime})(b_{t-1}+d_{t-1})r}{(1+2r)}$, i.e., $(f_{t-1} - b_{t-1}) + \frac{p_T^*(b_{t-1}+d_{t-1})r}{(1+2r)} \geq 0$, there is no fiscal deficit; otherwise, the government faces fiscal deficit $d = \frac{(p_T^* - p_T^{*\prime})(f_{t-1} - b_{t-1})(1+r)}{p_T^*} + \frac{(1+r)(p_T^* - p_T^{*\prime})(b_{t-1}+d_{t-1})r}{(1+2r)}$. ■

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**Table 1 Country List**

| | | | |
|---|---|---|---|
| Argentina | Egypt | Japan | Singapore |
| Australia | Finland | Korea Rp | South Africa |
| Austria | France | Malaysia | Spain |
| Bangladesh | Germany | Mexico | Sri Lanka |
| Belgium-Lux | Greece | Netherlands | Sweden |
| Brazil | Hong Kong | New Zealand | Switzerland |
| Canada | Iceland | Nigeria | Thailand |
| Chile | India | Norway | Turkey |
| China | Indonesia | Pakistan | UK |
| Colombia | Ireland | Paraguay | Uruguay |
| Costa Rica | Israel | Peru | USA |
| Denmark | Italy | Philippines | Venezuela |
| Ecuador | Jamaica | Portugal | Zimbabwe |

| **Table 2 Estimation results of total bilateral trade** | | | |
|---|---|---|---|
| | Parameter Estimated | Standard Error | Pr>\|t\| |
| $export_{t-1,i,e}$ | 0.86747 | 0.00221 | <.0001 |
| $igdp$ | 0.11827 | 0.00355 | <.0001 |
| $egdp$ | 0.14574 | 0.00386 | <.0001 |
| $ipop$ | -0.00514 | 0.00285 | 0.0719 |
| $epop$ | -0.02429 | 0.00290 | <.0001 |
| $idev$ | -0.15051 | 0.01142 | <.0001 |
| $edev$ | -0.04800 | 0.01137 | 0.3765 |
| $lagidev$ | -0.02739 | 0.01317 | 0.0376 |
| $lagedev$ | 0.06595 | 0.01316 | <.0001 |
| $lag2idev$ | 0.13567 | 0.01149 | <.0001 |
| $lag2edev$ | -0.03497 | 0.01143 | 0.0022 |
| $b_{i,t}$ | -0.01378 | 0.01507 | 0.3604 |
| $b_{e,t}$ | 0.05461 | 0.01508 | 0.0003 |
| $b_{i,t-1}$ | -0.06642 | 0.01553 | <.0001 |
| $b_{e,t-1}$ | -0.02174 | 0.01561 | 0.1636 |
| $b_{i,t-2}$ | -0.02665 | 0.01599 | 0.0957 |
| $b_{e,t-2}$ | -0.05447 | 0.01606 | 0.0007 |
| $c_{i,t}$ | -0.06887 | 0.01080 | <.0001 |
| $c_{e,t}$ | -0.02689 | 0.01084 | 0.0131 |
| $c_{i,t-1}$ | -0.06816 | 0.01084 | <.0001 |
| $c_{e,t-1}$ | 0.00670 | 0.01087 | 0.5377 |
| $c_{i,t-2}$ | -0.01158 | 0.01075 | 0.2814 |
| $c_{e,t-2}$ | 0.04437 | 0.01080 | <.0001 |
| $dis$ | -0.12205 | 0.00512 | <.0001 |
| $comland$ | 0.09153 | 0.02055 | <.0001 |
| $nland$ | -0.04683 | 0.00974 | <.0001 |
| $nisland$ | 0.04145 | 0.00643 | <.0001 |
| $year$ | -0.00225 | 0.00070203 | 0.0013 |
| $Observations$ | 43938 | | |
| $R^2$ | 0.9395 | | |

| **Table 3.1 Robustness Test I** | | |
|---|---|---|
| | (1) | (2) |
| $export_{t-1,i,e}$ | 0.86741 (0.00221)*** | 0.86748 (0.00221)*** |
| *igdp* | 0.12247 (0.00352)*** | 0.11815 (0.00355)*** |
| *egdp* | 0.14493 (0.00384)*** | 0.14546 (0.00386)*** |
| *ipop* | -0.00888 (0.00282)*** | -0.00542 (0.00285)* |
| *epop* | -0.02344 (0.00286)*** | -0.02386 (0.00290)*** |
| *idev* | -0.16239 (0.01099)*** | -0.14935 (0.01139)*** |
| *edev* | -0.05270 (0.01094)*** | -0.04474 (0.01133)*** |
| *lagidev* | -0.03787 (0.01244)*** | -0.03217 (0.01311)** |
| *lagedev* | 0.06798 (0.01243)*** | 0.06677 (0.01308)*** |
| *lag2idev* | 0.13903 (0.01105)*** | 0.13471 (0.01145)*** |
| *lag2edev* | -0.02824 (0.01100)** | -0.03906 (0.01139)*** |
| $b_{i,t}$ | -0.02788 (0.01493)* | |
| $b_{e,t}$ | 0.04742 (0.01494)*** | |
| $b_{i,t-1}$ | -0.08588 (0.01535)*** | |
| $b_{e,t-1}$ | -0.02897 (0.01543)* | |
| $b_{i,t-2}$ | -0.04535 (0.01587)*** | |
| $b_{e,t-2}$ | -0.05552 (0.01593)*** | |
| $c_{i,t}$ | | -0.07768 (0.01058)*** |
| $c_{e,t}$ | | -0.02671 (0.01062)** |
| $c_{i,t-1}$ | | -0.07328 (0.01077)*** |
| $c_{e,t-1}$ | | 0.00349 (0.01079) |
| $c_{i,t-2}$ | | -0.01004 (0.01073) |
| $c_{e,t-2}$ | | 0.04121 (0.01077)*** |
| *dis* | -0.12227 (0.00512)*** | -0.12281 (0.00511)*** |
| *comland* | 0.09358 (0.02057)*** | 0.08978 (0.02056)*** |
| *nland* | -0.04744 (0.00975)*** | -0.04541 (0.00973)*** |
| *nisland* | 0.04096 (0.00643)*** | 0.04234 (0.00643)*** |
| *year* | -0.00223 (0.00070)*** | -0.00212 (0.00070)*** |
| *Observations* | 43938 | 43938 |
| $R^2$ | 0.9394 | 0.9394 |

***, ** and * indicate significance at 1, 5 and 10 percent levels respectively.

| Table 3.2 Robustness Test II | | |
|---|---|---|
| | (3) | (4) |
| $export_{t-1,i,e}$ | 0.86727 (0.00221)*** | 0.87008 (0.00220)*** |
| $igdp$ | 0.12034 (0.00356)*** | 0.11498 (0.00353)*** |
| $egdp$ | 0.14648 (0.00384)*** | 0.14161 (0.00383)*** |
| $ipop$ | -0.00661 (0.00285)** | -0.00407 (0.00283) |
| $epop$ | -0.02463 (0.00289)*** | -0.02235 (0.00287)*** |
| $idev$ | | -0.15099 (0.01142)*** |
| $edev$ | | -0.04856 (0.01136)*** |
| $lagidev$ | | -0.02757 (0.01318)** |
| $lagedev$ | | 0.06507 (0.01317)*** |
| $lag2idev$ | | 0.13615 (0.01148)*** |
| $lag2edev$ | | -0.03484 (0.01143)*** |
| $b_{i,t}$ | -0.02838 (0.01506)* | -0.01184 (0.01508) |
| $b_{e,t}$ | 0.05274 (0.01507)*** | 0.05696 (0.01510)*** |
| $b_{i,t-1}$ | -0.06502 (0.01548)*** | -0.06539 (0.01554)*** |
| $b_{e,t-1}$ | -0.01475 (0.01555) | -0.02034 (0.01562) |
| $b_{i,t-2}$ | -0.01252 (0.01597) | -0.02604 (0.01601) |
| $b_{e,t-2}$ | -0.06026 (0.01603)*** | -0.05326 (0.01607)*** |
| $c_{i,t}$ | -0.09973 (0.01045)*** | -0.06873 (0.01081)*** |
| $c_{e,t}$ | -0.03897 (0.01050)*** | -0.02735 (0.01085)** |
| $c_{i,t-1}$ | -0.08117 (0.01041)*** | -0.06874 (0.01085)*** |
| $c_{e,t-1}$ | 0.02228 (0.01043)** | 0.00533 (0.01088) |
| $c_{i,t-2}$ | 0.00887 (0.01043)*** | -0.01174 (0.01076) |
| $c_{e,t-2}$ | 0.03744 (0.01047)*** | 0.04411 (0.01081)*** |
| $dis$ | -0.12477 (0.00512)*** | -0.12464 (0.00471)*** |
| $comland$ | 0.08136 (0.02046)*** | |
| $nland$ | -0.04542 (0.00974)*** | |
| $nisland$ | 0.04485 (0.00638)*** | |
| $year$ | -0.00144 (0.00070)*** | -0.00204 (0.00070)*** |
| $Observations$ | 43938 | 43938 |
| $R^2$ | 0.9391 | 0.9394 |

***, ** and * indicate significance at 1, 5 and 10 percent levels respectively.