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Is Financial Friction Irrelevant to the Great Depression?

– Simple modification of the Carlstrom-Fuerst model –

Keiichiro Kobayashi

Abstract

It is argued that existing theory implies that financial frictions appear as investment wedges. Since data show that the output declines in the Great Depression were mainly due to the productivity declines, it is also argued that financial frictions may not be the primary cause of the depression. By slightly modifying the model of Carlstrom and Fuerst (1997), I show that financial frictions may show up as declines in productivity. This result may restore the relevance of financial frictions to the Great Depression and other depression episodes, such as Japan's "lost decade."

Keywords: Agency costs, net worth, business cycle accounting, the Great Depression.

JEL Classifications: D82, E32, N12, O47.

1 Introduction

Recent studies on the Great Depression (Chari, Kehoe, and McGrattan [2004], Cole and Ohanian [2000]) cast doubt on the story that financial frictions associated with stock market crashes, deflation, and bank failures were the main cause of the severity of the output declines in the Great Depression.

In this brief paper, I theoretically examine whether the financial friction story proposed by Bernanke and Gertler (1989) (hereafter denoted as BG) and further elaborated by Carlstrom and Fuerst (1997) (hereafter denoted as CF) can account for the Great Depression in the United States and the decade-long stagnation in Japan in the 1990s.

Chari, Kehoe, and McGrattan make two points against the financial friction story. First, they show that the financial friction in CF must show up as investment friction in their business cycle accounting, and that the data on the Great Depression indicate that there was a negligible investment wedge. Thus, they conclude that CF cannot account for the Great Depression. Second, they show that the declines in total factor productivity (TFP) were the primary contributor to output falls in the 1929–33 period. This result indicates that any theoretical model that attempts to account for the Great Depression must show the TFP declines, while BG and CF do not imply changes in productivity.

Cole and Ohanian compare the deflation of the 1921–22 depression with that of the 1929–31 period, and dismiss the debt deflation story (which is formalized by BG and CF) as an explanation for the relative severity of the Great Depression since deflation during the two depressions were comparable.¹ Their result indicates that a theory of the Great Depression needs to explain why the Great Depression was more severe than the 1921–22 depression. They also suggest that the TFP decline in the Great Depression is the key factor.

The financial friction story is exposed to the similar criticism when applied to the

¹Cole and Ohanian also cast doubt on the story that the sticky wages and deflation working together caused the shrinkage of output (Bordo, Erceg, and Evans [2000]), since the changes in wages were also comparable during the two depressions. Therefore, their results imply that monetary shock might have played very small role in the Great Depression.

decade-long recession of the 1990s in Japan. Hayashi and Prescott (2002) show that the main contributor to the recession was also the TFP slowdown and that the investment frictions were not significant. Therefore, BG and CF seem incapable of explaining Japan's recession.

In what follows, I show, by reinterpreting a slightly modified model of CF, that a mathematically identical friction to that in CF (or BG) can satisfy the above requirements for a theory of the Great Depression. In the next section, I construct a simple model in which CF-type friction shows up as a TFP decline in a growth model.

2 Model

Let us consider a growth model in which the representative household solves the problem

$$(PH) \quad \max_{c_t, k_{t+1}, l_t} \sum_{t=0}^{\infty} \beta^t u(c_t, 1 - l_t)$$

subject to

$$c_t + k_{t+1} - (1 - \delta)k_t = w_t l_t + r_t k_t, \quad (1)$$

where β is the discount factor, δ the depreciation rate, $u(c, 1 - l)$ is a utility function that is concave and increasing in c and $1 - l$, c_t the consumption, l_t the labor supply, k_t the capital stock, w_t the wage rate, and r_t the rental rate of capital.

Note that there is no distinction between consumer goods and capital goods in this model. Consumer goods are the only final output.

At each date t , consumer goods are produced from intermediate goods, which are produced by competitive firms using labor l_t and capital k_t . The production process is as follows: At the beginning of t , a household is divided into a capitalist (husband) and a laborer (wife). The capitalist lends his capital k_t to a firm and receives $r'_t k_t$ units of intermediate goods as rent. (He is also repaid the depreciated capital $(1 - \delta)k_t$ from the firm.) The laborer sells her labor l_t to a firm and receives $w'_t l_t$ units of intermediate goods as a wage. I assume that the production technology for the intermediate goods is Cobb-Douglas:

$$m_t = F(k_t, l_t) \equiv A k_t^\alpha l_t^{1-\alpha}. \quad (2)$$

Competition among firms implies $r'_t k_t = \alpha F(k_t, l_t)$ and $w'_t l_t = (1 - \alpha)F(k_t, l_t)$, where α is a number close to 0.3.

I assume that if one unit of the intermediate goods is stored until the time of consumption, i.e., the end of date t , it changes to one unit of consumer goods. I assume, however, that the capitalists have access to “retail” technology that can stochastically transform one unit of intermediate goods to ω units of consumer goods, where $0 \leq \omega \leq \infty$, $E\omega = z$, and $z > 1$. The random variable ω is i.i.d. across capitalists and time t , while its p.d.f. is $\phi(\omega)$ and its c.d.f. is $\Phi(\omega)$.

Receiving $r'_t k_t$ units of intermediate goods, the capitalist (husband) establishes a retail firm and undertakes a retail project before he goes back home. I assume that the retail firm entails the same agency problem as CF: The realization of ω is private information to the retailer; the retailer chooses i_t , the amount of intermediate goods invested in his retail project, where $i_t - n_t$ is borrowed from a financial intermediary and $n_t \equiv \alpha F(k_t, l_t)$ is his net worth² at date t . I assume that one financial intermediary is established at each date t and that all laborers deposit their wage with this intermediary. The intermediary lends the intermediate goods deposited by laborers to the retailers. The intermediary can monitor the realized output ωi_t by paying μi_t units of consumer goods. The same anonymity assumption as CF applies to the retailers: Thus, they are allowed only to establish within-period deterministic contracts that are made before the realization of ω and pay off after their realization. Assuming that the retailers are risk-neutral³, it is easily shown by the same reasoning as CF that the optimal contract is a risky debt in which the retailer pays $R_t(i_t - n_t)$ of consumer goods if ω is greater than a certain cutoff value $\bar{\omega}$ and ωi_t otherwise, where $R_t(i_t - n_t) = \bar{\omega} i_t$. The intermediary monitors the retailer if and only if $\omega < \bar{\omega}$. The expected income of the retailer is

$$\int_{\bar{\omega}}^{\infty} \omega i_t \phi(\omega) d\omega - [1 - \Phi(\bar{\omega})] R_t(i_t - n_t) = i_t \left\{ \int_{\bar{\omega}}^{\infty} \omega \phi(\omega) d\omega - [1 - \Phi(\bar{\omega})] \bar{\omega} \right\} \equiv i_t f(\bar{\omega}),$$

²I assume that the depreciated capital $(1 - \delta)k_t$ cannot be included in the retailer’s net worth. It may be thought that the intermediate firms return the depreciated capitals to wives, not husbands.

³This convention is justified by the assumption that households have fair insurance for variable income. See “Insurance” subsection below.

and the expected income of the financial intermediary is

$$\int_0^{\bar{\omega}} \omega i_t \phi(\omega) d\omega - \Phi(\bar{\omega}) \mu i_t + [1 - \Phi(\bar{\omega})] R_t (i_t - n_t) = i_t \left\{ \int_0^{\bar{\omega}} \omega \phi(\omega) d\omega - \Phi(\bar{\omega}) \mu + [1 - \Phi(\bar{\omega})] \bar{\omega} \right\} \equiv i_t g(\bar{\omega}).$$

The financial intermediary can be plausibly assumed to be risk-neutral, and it can lend the intermediate goods to the retailers or store them at the gross rate of return of 1. I assume that the total amount invested in retail projects is less than the total assets of the financial intermediary (This is justified by assuming equation [7]). Thus, the optimal contract maximizes the retailers' expected income subject to the constraint that the intermediary's gross return on the investment of $i_t - n_t$ is at least 1: The optimal contract is determined by

$$(PF) \quad \max_{i_t, \bar{\omega}} i_t f(\bar{\omega})$$

subject to

$$i_t g(\bar{\omega}) \geq i_t - n_t.$$

The solution $\bar{\omega}$ is characterized by

$$1 = z - \Phi(\bar{\omega}) \mu + \phi(\bar{\omega}) \mu \frac{f(\bar{\omega})}{f'(\bar{\omega})}. \quad (3)$$

I assume for parameters that

$$z - \mu < 1 < z, \quad (4)$$

and for the distribution that $\phi(\omega)$ is continuous and

$$\phi(0) = \lim_{\omega \rightarrow \infty} \phi(\omega) = 0. \quad (5)$$

These assumptions ensure that there exists a solution to (3).⁴ Given that $\bar{\omega}$ is determined by (3), the value of i_t is determined by

$$i_t = \frac{n_t}{1 - g(\bar{\omega})}. \quad (6)$$

⁴Uniqueness of the solution to (PF) is not guaranteed in general. But unless the distribution of ω is very unusual, the value of $\bar{\omega}$ that maximizes $i_t f(\bar{\omega})$ must be determined uniquely, since the number of the solutions to (3) is finite.

Note that $i_t > n_t$ so that retailers necessarily borrow from the intermediary. I assume for the distribution and the parameters that

$$\frac{g(\bar{\omega})}{1-g(\bar{\omega})} < \frac{1-\alpha}{\alpha}, \quad (7)$$

where $\bar{\omega}$ is the solution to (PF). This assumption guarantees that not all assets in the intermediary are invested in retail projects. A positive amount of the intermediary's assets is stored at a zero rate of return.

The retailer's income is a random variable: $I(\omega) = \min\{(\omega - \bar{\omega})i_t, 0\}$. It is zero if he defaults, and its expected value is $i_t f(\bar{\omega}) = \frac{z - \Phi(\bar{\omega})\mu - g(\bar{\omega})}{1-g(\bar{\omega})} n_t$, since $f(\bar{\omega}) + g(\bar{\omega}) = z - \Phi(\bar{\omega})\mu$. Since $f'(\bar{\omega}) = -[1 - \Phi(\bar{\omega})] < 0$, equation (3) implies that the expected rate of return for a retailer is positive: $i_t f(\bar{\omega}) > n_t$.

Insurance After the payoff of retail projects, husbands (retailers) go back home with $I(\omega)$. I assume for simplicity that households can verify their $I(\omega)$ and they form fair insurance beforehand over their random income. The existence of fair insurance can be consistent with the optimal contract if we assume that the financial intermediary cannot identify the household that a retailer belongs to. Fuerst (1995) posits the same kind of anonymity assumption. Under this anonymity assumption, a retailer's ω cannot be inferred by observing insurance payments among households. Fair insurance among households guarantees plausibility of the assumption that a retailer is risk-neutral and solves (PF).

Total income of a household is summarized as follows. Since the gross rate of return on deposits with the financial intermediary is 1, the labor income, which is deposited in the intermediary within date t , becomes $w_t l_t = w'_t l_t = (1 - \alpha)F(k_t, l_t)$. The rent of capital, which is equalized among households by fair insurance, is $r_t k_t = \frac{z - \Phi(\bar{\omega})\mu - g(\bar{\omega})}{1-g(\bar{\omega})} n_t$, where $n_t = r'_t k_t = \alpha F(k_t, l_t)$. Given these incomes, the household solves (PH). The equilibrium without exogenous shocks is characterized by (1) and

$$\frac{u_l(t)}{u_c(t)} = (1 - \alpha) A k_t^\alpha l_t^{1-\alpha}, \quad (8)$$

$$\frac{u_c(t)}{\beta u_c(t+1)} = 1 - \delta + \frac{z - \Phi(\bar{\omega})\mu - g(\bar{\omega})}{1-g(\bar{\omega})} \alpha A k_{t+1}^{\alpha-1} l_{t+1}^{1-\alpha}, \quad (9)$$

where $u_c(t) = u_1(c_t, 1 - l_t)$ and $u_l(t) = u_2(c_t, 1 - l_t)$.

The final output of consumer goods at t is $y_t = \frac{z - \Phi(\bar{\omega})\mu}{1 - g(\bar{\omega})}n_t + (m_t - \frac{1}{1 - g(\bar{\omega})}n_t) = A(s_t)k_t^\alpha l_t^{1 - \alpha}$, where $s_t = \frac{n_t}{F(k_t, l_t)} = \frac{r_t' k_t}{F(k_t, l_t)}$ is the capital share of the intermediate goods sector, and

$$A(s_t) = \left\{ 1 + \frac{z - \Phi(\bar{\omega})\mu - 1}{1 - g(\bar{\omega})}s_t \right\} A. \quad (10)$$

If there is no disturbances to retailers' wealth, the share s_t equals α . This equation implies that in this economy, an econometrician who conducts growth accounting will observe $A(s_t)$ as the aggregate productivity, which is a function of the share of the retailers' net worth. If the economy is hit by a monetary shock that redistributes wealth, productivity will change through a change in s_t . If the economy is hit by a banking shock that changes the monitoring technology (Bernanke [1983]), productivity will also change through a change in μ .

The redistribution of wealth (due to a monetary shock) from retailers to laborers may also change the investment wedge and labor wedge if we conduct business cycle accounting (Chari, Kehoe, and McGrattan [2004]). This is solely because I assumed for simplicity that only capitalists have access to retail technology. If I change this assumption so that both capitalists and laborers become retailers with probability η , and that households have fair insurance over this risk, the wealth redistribution from retailers to non-retailers will not cause changes in the investment wedge or labor wedge.

3 Concluding remarks

In this paper, I incorporate an almost identical friction as that of CF to a standard growth model such that friction shows up as a decline in productivity.

The key is the assumption that friction exists in consumer goods or the retail sector, not in production of capital goods as assumed in CF or BG. This assumption seems plausible, since small shops may be subject to severer borrowing constraints and agency problems, while large, established companies that produce investment goods are not so severely credit-constrained as small retailers.

The model implies that the financial frictions in CF may be consistent with the findings that TFP declined during the Great Depression and that there was little investment friction. CF type friction can also account for the difference between the 1921–22 depression and the Great Depression if we interpret the stock market collapse in the 1929–33 period as a large wealth-redistribution shock. Since the stock market was rather stable or rose slightly in the 1921–22 period, the wealth redistribution associated with stock market collapse may have been much severer during the Great Depression than during the 1921–22 depression (see Figure for the stock prices in the 1920–33 period). This difference may explain the TFP declines in the Great Depression.

The result of this paper may also bridge the gap between practitioners' view that financial problems were at the center of Japan's lost decade, and macroeconomic data that indicate the TFP slowdown was the primary problem. This paper implies that the problems in Japan's financial sector may have appeared as a slowdown in TFP.

The productivity declines are the important fact in the depression episodes in the United States and in Japan, which should be explained by economic theory. But to search for a theory that shows productivity declines is not to dismiss the relevance of financial friction. Although we may be able to develop a completely new theory in which financial problems cause the TFP declines (see for example Kobayashi [2004]), this paper demonstrates that a slight modification of existing theory can reconcile financial friction with productivity declines.

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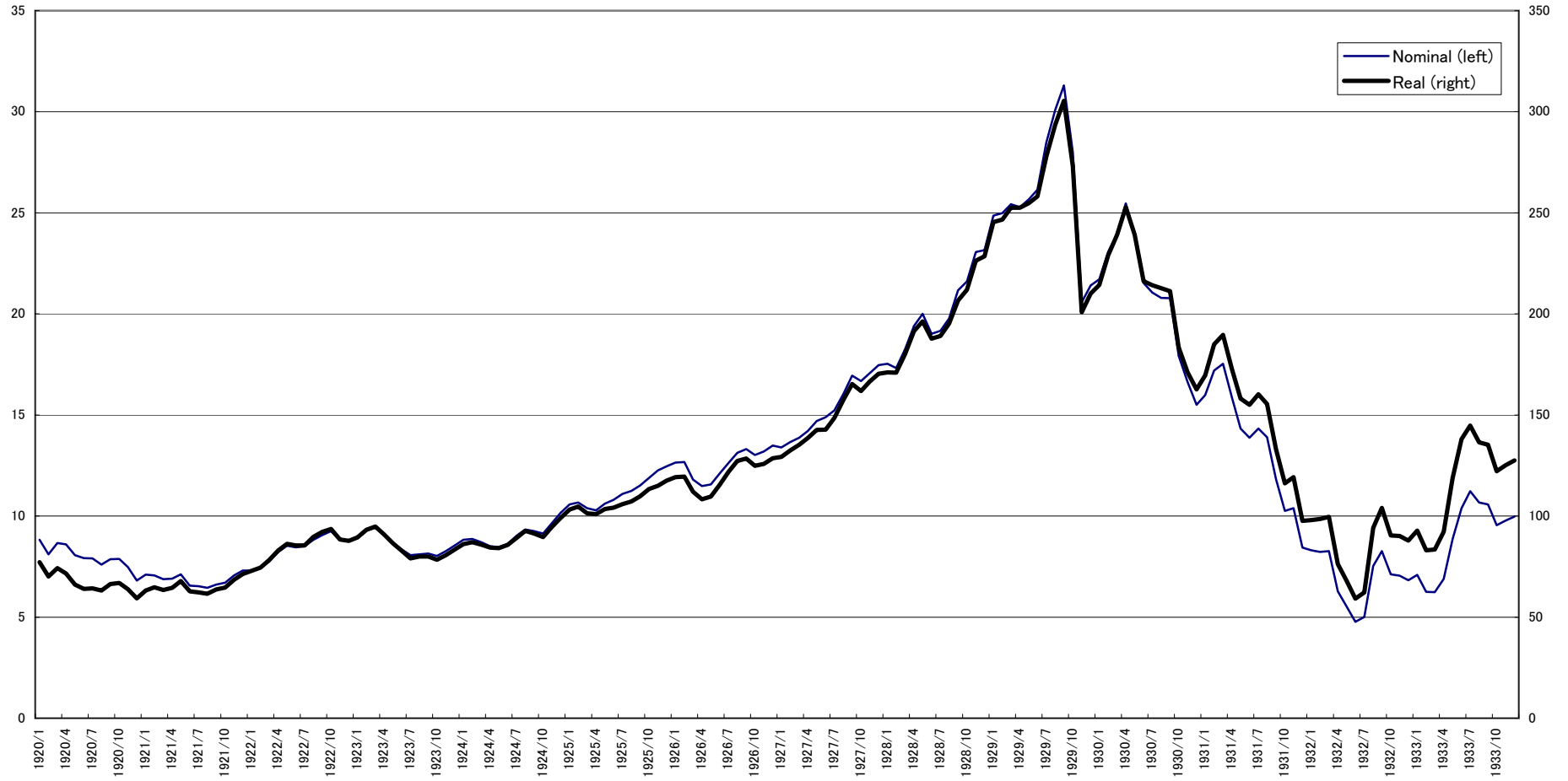
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