

This paper begins with an absurdly simple observation: in industry, labor and capital—workers and machines—are complements, not substitutes. Our textbooks are surely right that various proportions of land and farm labor can produce the same output. But in industry, where specialization, hence money, hence inflation are important, the proportions are fixed for each kind of machine.

A truck is not more productive with four hands on the steering wheel than with two. A truck driver is not more productive with two trucks than with one. And so it goes with power looms, engine lathes, drill presses, etc. How many workers does it take to man a rolling mill, an oil refinery, a fossil-fuel electric generating plant? Adding workers beyond the required number won't increase the output of such plants.

Confusion, possibly encouraged by the unfortunate example in the textbooks, has obscured the two key points of this paper:

- 1) When a country's demand level fluctuates, workers and machines get more and less scarce together. The effects of the two scarcities on inflation are confounded.
- 2) When, on the other hand, a country's labor force shrinks, causing labor to become more scarce, machines become less scarce.

The first point means that it is hard for central bankers to deduce from the history of demand fluctuations which scarcity is causing inflation. The second point means that when a country's labor force is shrinking, it's critical for its central bankers to know whether inflation is caused by a scarcity of

workers or a scarcity of machines. If the former, it should tighten; if the latter, it should ease.

Cause of Inflation

In a recent paper¹ the author argued that inflation is caused by a shortage of machines: Wage negotiators understand that they don't control the real wage. Instead, when they negotiate a money wage for the next period, they base it on assumptions about what the real wage and the level of money prices will be, using the identity

In the event, if the real wage is different from what negotiators expected when they fixed the money wage, something has to give. That something (transposing the identity) is money prices:

When money prices are different from what wage negotiators expected, so is the inflation rate. But negotiators use last period's inflation rate for the next period's negotiation. So every time the actual real wage is different from what negotiators expected, the inflation rate changes.

The marginal productivity of labor is the labor productivity of the marginal machine. Every time the identity of the marginal machines changes, the real wage changes. For example, when next period's marginal machine is older and less efficient, the real wage falls. If wage negotiators expected a higher real wage, money prices (and the inflation rate) rise.

¹ "A Theory of Inflation", Journal of Investment Management, Vol. 1, No. 1

US Experience in the 1930s

On one hand, it is easy to see mistakes with the benefit of hindsight. On the other, it is important to learn as much from hindsight as we can.

Based on the Consumer Price Index, the US inflation rate was negative from 1926 on. But judging from the rates on bankers' acceptances, the Fed made no adjustment in velocity, hence in its nominal rate. The result was real short interest rates averaging around 5% for four consecutive years. When demand finally collapsed, the CPI fell about 25% between 1929 and 1933 (Dornbusch and Fischer). Needless to say, the Fed completely lost control of the real rate, which was never less than 9% in that period.

Today, no central bank would knowingly steer its economy into negative inflation rates.

Table 1

Year	Acceptances	Inflation	Real rate
1922	3.51%	(0 .59%	4.10%
1923	4.09%	2.88%	1.11%
1924	2.98%	---	2.98%
1925	3.29%	3.43%	(.18%
1926	3.59%	(2.23%	5.82%
1927	3.45%	(1.14%	4.59%
1928	4.09%	(1.16%	5.25%
1929	5.03%	---	5.03%
1930	2.48%	(7.02%	9.50%
1931	1.57%	(10.06%	11.63%
1932	1.28%	(9.79%	1107%
1933	.63%	2.32%	(1.69%
1934	.25%	3.03%	(2.78%
1935	.13%	1.47%	(1.34%
1936	.16%	2.17%	(2.01%
1937	.43%	.71%	(.28%
1938	.44%	(1.41%	1.85%
1939	.44%	(.71%	1.15%
1940	.44%	1.44%	(1.00%

Japan's Problem

Because in industry machines and workers are complements, when a country's work force is shrinking, it will retire its oldest, least efficient plant. As

labor gets scarcer, machines will get less scarce. If whether inflation rises or falls depends on the scarcity of workers, the central bank should tighten. If whether inflation rises or falls depends on the scarcity of machines, it should ease. When their work force is shrinking, it's critical for central bankers to know which inflation theory is right—Professor Phillips' or the author's. Figures 1 and 2 demonstrate that there is little to choose between the forecasting performance of the two models for the US, which wasn't experiencing a shrinking labor force. Figures 3 and 4 suggest a significant difference in performance for Japan, which was.

Japan was the first major country to have a shrinking labor force, its central bankers went with the Phillips curve and expected inflation. Accordingly they raised their overnight rate 400 basis points.

If the central bankers relied on Figure 2 for their policy decisions, we can forgive them for tightening when they should have eased. By the time they could reverse their policy, it was too late. The result was a classic liquidity trap, with negative inflation rates. Even though the central bankers retained control of the nominal overnight rate (which reflects the scarcity of money), they lost control of the real rate.²

Japan's Experience in the 90s

Japan didn't fail to understand the lesson of the US experience with the

² As Merton Miller and Charles Upton pointed out, the opportunity cost of holding money is the (short) nominal interest rate—not the real rate. Thus when a central bank changes the scarcity of money (as reflected, for example, in the appropriate measure of velocity), it changes the nominal rate. Alas, there is no velocity so low that the nominal rate that will be less than zero. So when the inflation is negative, the real rate can't be less than inflation's absolute value.

Depression. To suggest otherwise is unfair to a smart, sophisticated group of central bankers. Indeed, other central bankers would have made the same mistake. And, unless they learn the proper lesson from the Japanese experience, they will make the same mistake when confronted with Japan's circumstance.

Table 2

Year				Δ GDP	Δ^2 GDP	workforce
1990	3.1	7.24	4.14	5.3		
1991	3.2	7.46	4.26	3.0	(2.3	65,050
1992	1.7	4.58	2.88	.9	(2.1	65,780
1993	1.3	3.06	1.76	.5	(4.	66,150
1994	.7	2.20	1.50	1.0	.6	66,450
1995	(.1	1.21	1.31	1.6	.6	66,660
1996	.1	.47	.46	3.3	1.7	67,110
1997	1.7	.48	(1.22	1.9	(1.4	67,870
1998	.7	.37	.33	(1.1	(3.0	67,930
1999	(.3	.06	.36	.8	1.9	67,790
2000	(.7	.11	.81	1.5	.7	67,660
2001	(.7	.06	.76	.1	(1.4	67,520
2002						
2003						
2004						

In the event, the workforce did indeed shrink, just as Japan's central bankers expected. But as it shrank, machines became more plentiful. As the least efficient machines were retired, the labor productivity of the marginal machine, hence the real wage, rose. With the money wage fixed by negotiation, money prices fell. Between 1990 and 2001, Japan's CPI inflation rate fell almost 400 basis points.

Shrinking Work Forces in Europe

The Japanese experience suggests that, when your labor force is shrinking, you cannot rely on the Phillips curve. But central bankers wouldn't be human if they weren't reluctant to abandon an old friend. The problem today is European fertility rates, which are now far below the 2.1 rate necessary to maintain the current size of their populations. When the first of the smaller cohorts grow up and reach the workforce, it too will begin to shrink. As the first table shows, work forces in the major countries have already leveled off. Will European central bankers repeat Japan's mistake?³

Table 3 - Fertility Rates (2000-2005)

France	1.9
Germany	1.3
Italy	1.3
Spain	1.3

Table 4 - Recent Work Force Trends

(in millions)

³ Labor and capital aren't substitutes in Europe either: agriculture has become a trivial part of these countries' GDP (2004?):

France	2.8%
Germany	1.1%
Italy	2.3%
Spain	3.6%

Country	1999	2000	2001	2002	2003	2004
France		26.2	26.4	26.7	27.3	27.5
Germany	39.9	39.7	40.0	40.0	40.2	
Italy	23.4	23.7	23.9	24.1	24.2	
Spain	16.4	16.8	17.8	18.3	18.8	
TOTAL		106.4	108.1	109.1	110.5	

A workforce begins to shrink when there are fewer young people entering than old people leaving. Some young people will enter after graduate school, some after college, some after high school and some after dropping out. Perhaps a reasonable age to focus on is high-school graduation—the cohort aged 15 to 19.

Looking at the cohort groupings for the major European countries, we see that

- 1) the drop in fertility rates has affected the people already in the workforce only slightly.
- 2) the drop is probably noticeable in the 15 or 16 year olds, and substantial in the younger cohorts.
- 3) The timing seems to be different for different countries:

Table 5

Country	Age 10-14 (in thousands)	Age 15-19 (in thousands)	Age 20-24 (in thousands)	Age 55-59 (in thousands)
France	3680	3826	3908	4152
Germany	4242	4810	4741	4702
Italy	2763	2797	3066	3773
Spain	1934	2085	2580	2336
TOTAL	12,619	13,518	14,295	14,963

But there is still time. Demographer David Foot estimates that for Canada the first year of the lower fertility rate was 1990. The babies born in 1990 won't begin to reach Canadian labor force until 2008. Is Europe's timetable similar?

Liquidity traps are aptly named, because they are hard to get out of. Central bankers can learn from Japan's experience, but how fast? Speed is more important for Europe than it was for Japan. Japan extricated itself by devaluing the yen against its important trading partners. But the major European countries won't be able to devalue against each other. And neither Japan nor the US can afford to oblige the Europeans by increasing the value of its currency—Japan because its inflation rate is already too low, and the US because its trade deficit is already too high.

Escaping From a Liquidity Trap

Historians are in wide agreement that World War II was instrumental in restoring prosperity. "At the end of the Depression decade...one in seven

workers remained unemployed. By war's end, unemployment was negligible." (p. 857) Civilians will of course resist the idea of using war to solve another stubborn, widespread demand failure. Leaders of democratic countries understand the problem. West Pointer General Brehon B. Somervell, who rose in World War II to become one of our highest ranking officers, acknowledged the problem with civilians: "only in a small percentage of instances do they have enough hate." (p. 655).

The White House also recognized the problem. On the eve of the 1940 presidential election, it used a radio address to the nation to promise: "Your boys are not going to be sent into any foreign war." (p. 463).

Conclusion

For some readers the author's distinction between "substitutes" and "complements" may seem academic. But the distinction isn't academic for central bankers.

If labor and capital are substitutes, than a scarcity of labor will also be a scarcity of capital. If a country's work force is shrinking, its plant is also getting scarcer. But if they are complements, then a scarcity of one results in a surplus of the other. In particular, a shrinking work force results in a surplus of machines. Should it ease or tighten? The central bank needs to know which scarcity causes inflation.

Skeptical readers may question whether the author is capable of an objective comparison of the two inflation theories. But the Japanese experience raises questions about the Phillips curve. And the situation in

Europe suggests that we need to resolve those questions now.

Anyone who takes the author's argument seriously will do his bit to bring it to the attention of the appropriate central bankers. Still there is a significant chance that, despite our concerted efforts, we will fail—especially when one considers that some central bankers probably think labor and capital are substitutes. In an effort to conclude this paper on a constructive note, the author offers the following list, recently published by the London Economist, of the world's most successful munitions manufacturers.

Quotes from Freedom from Fear (American People in Depression and War) by David M. Kennedy, Oxford Press (1999).