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CAPITAL REQUIREMENTS FOR ECONOMIC GROWTH

by Mason Gaffney

August, 1976

A paper contributed to the Joint Economic Committee Study Series, Economic Growth from 1975-85: Prospects, Problems and Patterns, to be released in 1976.

This paper addresses the problem of how much capital is needed to assure full employment for the present and future labor forces.

← The coefficients of capital, materials and land used per worker and per consumer have risen in our times to very high levels. Are these high coefficients necessary? If so, future growth and employment depend on uncommonly high future capital formation, and appalling future drafts on nature. *These assumptions, indeed, are commonly made and are in in most post debates too* If not, let us learn how to lower the coefficients so the short supplies of capital and materials will go around to match the ~~growing~~ *growing* numbers of workers, and employ the unemployed. Then *jobs and G* we can grow without necessarily using more land, and without being limited by the growth of capital.

and in too short supply for full employment, *suffering from high unemployment rates,* With labor ~~being surplus~~, and capital and land being dear by price, *short,* the needed adjustment is evident: lower the use of capital and per person. But is that possible? There are several alleged obstacles which I will list, and then treat in turn.

1. The obstacle that capital and land coefficients are fixed or predestined to grow for technological and efficiency reasons.
2. The obstacle that labor is overpriced by unions and politics.
3. The obstacle that labor produces capital.
4. The obstacle that more investment outlets are required to prime the flow of spending.
5. The obstacle of inflation associated with high employment.
6. The obstacle of a resource ceiling on throughput.

1. The obstacle that capital and land coefficients are fixed, or predestined to grow, for technological and efficiency reasons.

The possibilities for reducing resource coefficients of work and consumption are far greater than most people have any idea. We know that change is possible, for change is what got us here from there and what man hath wrought, man can unwork. But we need not go backwards. We only need look to realize that the man/land ratio varies over a wide range all around us today.

Just for example, here are some data on farm land use on the east side of the San Joaquin Valley, California. The data refer to neighboring lands, generally of comparable quality and in the same markets. The differences therefore display that factor mix is sensitive to shadings of input prices so slight that they are not equalized by the market--differences internal to families and firms such as result from credit ratings, tax positions, political connections and other institutional biases. For example, an immigrant with many children goes heavier on labor, a speculator with friends in the banks and the Capitol favors lands, while a doctor with income to shelter might invest heavily in depreciable capital.

In the San Joaquin Valley, east side, land is versatile among many competing uses. These range from dryland grazing up to citrus, fresh tomatoes, and berries. Dryland grazing might gross \$15 ^{per acre per year} ~~from the animal unit~~; berries might gross \$1,500 a year, 100 times as much. The specific prices are subject to secular and cyclical and inflationary change, but the basic principle is not: the same land yields a little or a lot, depending on what you do with it. Table 1

is a crop report gathered by the United States Bureau of Reclamation from its Friant-Kern Canal Service Area. Not all the land is versatile among all the options, but a close study of the area has shown that the margins between the uses are ragged (1). Almost every area has several options, and many of them are choices between the highest and the lowest gross. To get high yields, of course, requires more labor per acre.

Labor's share of gross rises with intensity, defined here simply as nonland inputs $\div$ output. For grazing, this is on the order of $\$6/\$15 = 40\%$. Grazing is land-intensive. For berries it is more like $\$1,400/\$1,500 = 93\%$. Berries are labor-intensive. (Grazing and other unirrigated uses are not shown in Table 1, which shows the high variation of yields on irrigated land only.)

Of course the return to land from crops like berries or tomatoes is highly leveraged and volatile, as a short-run gamble, but that is not our concern here. Averaging out the good years and the bad, the return to land from truck crops is very sensitive to wage rates and other costs of hiring like payroll taxes. A slight rise of 7 percent nearly wipes out the rent; a drop of 7 percent nearly doubles it. But the same wage changes would little change the returns to land from grazing. Thus a slight drop of labor costs applies great pressure to shift land to berries and tomatoes and other high-yield, labor-intensive crops, making a very elastic demand for labor.

The scope for this kind of change is manifest in the fact that most of California's prodigious farm output comes from a fraction of her good farm land, that which is used intensively. For example, of the several million

Table 1. Crop Production, Friant-Kern Canal Service

Crop	Acres	Value Per Acre \$
Barley	15,696	51.09
Corn	10,490	96.68
Rice	907	167.66
Sorghums	17,279	74.77
Wheat	3,176	87.85
Alfalfa Hay	63,460	144.11
Irrigated pasture	17,388	77.66
Beans, dry and edible	4,293	107.14
Cotton, lint (upland)	108,928	352.80
Asparagus	1,383	418.70
Beans (processing)	27	900.00
Beans (fresh market)	75	975.33
Corn, sweet (fresh market)	254	205.91
Lettuce	423	336.51
Cantaloupes, etc.	507	547.02
Onions, dry	686	495.70
Potatoes, early	12,711	366.04
Tomatoes (fresh market)	1,343	881.16
Alfalfa	1,279	151.79
Berries (all kinds)	80	1,215.60
Oranges and tangerines	24,952	915.51
Grapes, table	43,795	545.24
Olives	7,172	327.45
Peaches	6,371	644.38
Prunes and plums	3,288	674.00
Walnuts	1,374	338.14

Source: Sacramento Office, U.S. Bureau of Reclamation, 1958. Minor crops omitted. Data refer to irrigated land only.

acres of irrigable land in California, there are only about 21,000 acres in plums, 36,000 in freestones, and 65,000 in navels (2). Most California farm land is used at lower intensities, using little labor to yield barley, alfalfa, forage pasture, hay, sorghum, safflower, rice or cotton.

In irrigated farming water is an indirect land input, since a water right is the right to the water yield of a vast watershed. One might then think the truck crops really use a lot of land in the form of irrigation water. But in fact the high-grossing crops such as tomatoes, citrus, peaches and berries are modest users of water. Pasture, alfalfa, and rice are the heavy drinkers, and they yield only \$50-\$200 per acre, not one-tenth of the high yielders.

The high-grossing crops use more labor per acre not just in the fields, but in the packing houses, the railroads, the stores and the kitchens. A \$1500 berry crop will use more labor at every step to the consumer than a \$15 weight gain on a calf, do it sooner, and much more often. Thus a higher use of labor in the field, ^{raising yields,} increases demand for labor beyond the field.[‡] Reciprocally, lower costs between consumer and farmer, raising field prices by say 7 percent, would (in our example) double land returns from berries and increase demand for labor on the farm.

For another and briefer example in Iowa, a more uniform state, Shrader and Landgren have calculated that if all farmers followed the standards already practiced by the most advanced farmers, Iowa alone could supply the nation's output of feed grain (3).

Now that's agriculture, where people often suppose that yields are hard to raise and depend only on genetic miracles,

‡ Field labor may also be used to substitute for offsite labor, as when field labor reduces needs for buying machinery or pesticides, herbicides, chemical fertilizers, water etc., with constant yields. The point here is that higher yields are the raw material for further labor in packing, sorting, storing, moving, distributing, exchanging, retailing,

fertilizers and green revolutions. Turning to other human activities, we find even greater dispersion of resource coefficients. Table 2 shows value added per kilowatt-hour (or equivalent energy) in various industries. The numbers speak for themselves.

Table 2. *The production multiplier of energy, measured by*
~~Energy Efficiency in~~ Dollars of Value-Added per
 Kilowatt-hour (VA/KWH)^{1,2}, for Selected Industrial
 Groups

Industry Group	VA/KWH	Industry Group	VA/KWH
Cookies & crackers	.91	Blast furnaces &	
Book printing	.50	steel mills	.033
Millwork plants	.36	Primary Copper	.020
Wood furniture	.28	Paving Mixtures	.018
Fluid milk	.13	Paper mills	.016
Frozen fruits, vegetables	.12	Pulp mills	.015
Yarn mills	.12	Petroleum refining	.012
Sawmills	.083	Beet sugar	.010
Wool weaving mills	.048	Brick	.008
Aluminum rolling & drawing	.048	Primary aluminum	.007
		Cement, hydraulic	.006
		Lime	.004

1. KWH equivalents are used where relevant.
2. Source: ~~Dr. John Wilson, citing~~ U.S. Census of Manufacturers, 1967, ^{added in} (personal letter from Dr. John Wilson to Dwayne Chapman, Jan. 16, 1974).. *Invented by writer.*

It only requires a little imagination to see what these facts imply about possible factor substitution. We can change the consumption mix, using less of the resource and capital-intensive things, and modifying all products. In addition we can modify the processes we use to produce any given thing. Among other evidence, years of research at Resources for the Future, Inc., has demonstrated the high elasticity of factor substitution when the process and the product are both treated as variables.[†] But most of us need only review our own consumption history to have all the evidence we need of how we can and do modify resource demands in response to relative input costs and to income and wealth. Some housing is land-intensive --- Beverley Hills makes a good example. Some is capital-intensive, like a new high-rise. Most old housing becomes labor-intensive as costs of operation and upkeep rise to eat up most of the cash flow or service flow. So even in the production of something as universal and basic as shelter there are no fixed resource coefficients but a wide range of choices.

Another important variable is size of firm. E. F. Schumacher has struck a responsive chord with "Small is Beautiful," *Schumacher's theme is that smaller firms are more labor-intensive.* ~~relating size of enterprise to high resource~~

~~coefficients.~~ Although size is only one factor involved, the data bear him out. The use of labor *per unit of property tends to decline with increasing size of firm. For example,* ~~on property tends~~ *over a whole economy, to be regressive.* The U. S. Census

of Agriculture ranks farms by gross sales. "Class I" farms, those grossing \$25,000 or more per year, had 22%

application of labor to property on this pattern may be styled "regressive", a term I will use. of the land in farms but only 7 percent of the labor in 1950. *The*

Turning to "industrial" corporations, the regressive use of labor on property may be inferred from data in Fortune magazine's yearly report on the largest 500. I tested the thesis by ranking them by "net worth", ~~or invested capital,~~

Allen V. Kneese and Blain Bowser, Managing Water Quality (Baltimore: Johns Hopkins Press, 1968).
Allen V. Kneese, Robert U. Ayres, and Ralph C. D'Arge, Economics and the Environment (Baltimore: Johns Hopkins Press, 1970.)

Table 3. Profits Per Employee, Large and Small Industrial Firms, Ranked by Net Worth (4)

Group	Net Worth (\$000,000)	Profit After Taxes (\$000,000)	Employees (000)	Profits/ Employee (\$)
Top 10	40,090.	5,470.	1,662.	3,291.
All 500	133,660.	14,839.	9,966.	1,489.
Lowest 10	116.	8.826	29.687	297.

Source: Calculated from data in ^{The} ~~Fortune~~ ^{Directory} ~~Magazine~~, (New York: August, 1964).

and calculating profits (after taxes) per employee. Table 3 shows the broad results. The choice of profits/employee to test the case premises that profits in general are the realized earnings of and some index to the ^{owned} ~~real~~ assets of a firm. In fact, if the larger firms use their property less intensively (as this and other evidence suggest) then their realized profits as an index understate the assets of larger firms compared to smaller ones.

It seems likely from this that smaller business characteristically ^{combines property with} ~~performs operations in a more labor-intensive way~~ than big business. As we modify consumption mixes and products and processes we can also modify firm sizes. For increasing labor-intensity, small is beautiful indeed.

But how about productivity and efficiency? Is not maximum output per worker the goal of economic organization and the index of success? No, it is not. Many economists have for decades now seriously misled themselves and others by speaking loosely of "productivity" as output per worker, even though their own elementary theory textbooks taught

then by its
of products
processes, (and
or both.)

Capital stock, surplus and retained earnings. Fortune uses "net worth" and "invested capital" interchangeably. Their data on gross worth are labelled "assets".

better. Defining efficiency as output per worker is a perverse concept with a built-in bias against employment. Only recently with new studies of energy-efficiency and more sophisticated ones of "total factor productivity" ^{is} ~~are~~ most ^{economic discourse (in my observation)} people beginning to escape this single-minded preoccupation with economizing on labor, ~~at any cost.~~

Substituting capital and land excessively for labor raises "efficiency" only by wasting capital and land and unemployed labor, and only seems efficient in unrealistic models where land and capital are underpriced and unemployment is ignored. High labor-efficiency then means low land-efficiency and low capital-efficiency, either directly or at one remove in the form of low energy-efficiency, low water-efficiency, low feed-grain efficiency, etc. Capital is not free--saving is a sacrifice, too. Land is not free to a nation--past and present military outlays attest to that. And unemployment is not to be confused with voluntary leisure. The time and talent of the unhappy idle is wasted and worse, used to make trouble for others.

Misled by the goal of labor "productivity" we have exalted ^{employed} high output per man as a symbol and measure of ^{economic performance} ~~national and company success~~, and accepted an extreme substitution of capital and resources for labor. The well-known displacement of farm labor is not an exception, but more like the rule. John Kendrick calculated that the ratio of capital to labor for a large group of industries in the United States rose at an average annual rate of 1.3 percent from 1899-1953 (5). That means a 100 percent increase over that 54-year period. More recently, the United States Department of Commerce studied nonfinancial corporations, 1948-1971. It found capital inputs growing at 4 percent yearly compounded and labor at 1.2 percent (6).

That means there was 2.5 times as much capital in 1971,

Predictably, the energy crisis produced a crop of energy fundamentalists who would measure all ^{is in energy} and economize only on energy. Their work is not worth citing here. There is some sophisticated work by E.R. Beards and D.O. Wood. "Technology, Prices, and the Derived Demand for Energy."

with 1.3 times as much labor, or 1.9 times as much capital per worker in 1971. Thus the rate of substitution seems to be increasing.

And that's not really the half of it. These studies omitted the public sector, the infrastructure into which we have poured so much public treasure at low interest rates. They omitted housing, which soaks up so much capital per job created. They omitted the recreation boom which requires so much more land and equipment per consumer hour, and per measure of personal joy, than the quiet pleasures of yesteryear. And they omit the swing of consumers toward goods and services like electric power and natural gas, whose production is capital-intensive, and whose prices fall relative to labor-intensive products when the capital input is subsidized. Producers as well as consumers use much more of these as inputs. A primary metal like aluminum will consume 135 kwh per dollar of value-added, compared to 10-20 in a normal manufacturing operation. It is energy-inefficient and thrives only on underpriced energy, thanks to which it is cheap relative to competing materials. For years we have been substituting capital and energy for labor and calling it progress and efficiency, only to find that capital and energy are scarce, and labor surplus. The route of true efficiency obviously is to use less of what is scarce and more of what is surplus.

There is a long, if intermittent, tradition, with mystic overtones, that has super-machines predestined to crowd out people and make labor obsolete. Karl Marx boosted it along. It peaked again in the under-consumptionism of Keynes, and again thirty years after in the ~~"triple revolution"~~ of the beat generation ^{of} and the ~~soaring~~ sixties. In this scenario an anti-Puritan ethic is called for which downgrades work

and apotheosizes consumption and leisure. Robert Theobald, Donald Michael and W. H. Ferry were among the spokesmen. "Cybernation: The Silent Conquest" appealed to science-fiction buffs compellingly. The insidious super-machines have already taken us from within; better relax and enjoy it.

While formal statements of this position have not fared very well, yet the undercurrents are everywhere and keep breaking through and affecting the thinking of many. It seems to take something shocking like the energy crisis, the capital shortage, or widespread famine to drive this vision away. The science-fiction world of super-cybernation is energy-intensive, capital-intensive, and counter-ecological. Now that these shocks of resource scarcity have occurred it is obvious, yet still worth underscoring, that there is no technological imperative compelling progress always to substitute capital and resources for labor. It depends on relative factor abundance and costs now as it always has and will. Proper care and conservation of the earth and of our treasure of capital will always call for the full measure of human effort.

2. The obstacle that labor is overpriced by unions and politics.

The whole problem, in one view, is that unions overprice their labor and minimum wage laws overprice non-union labor. Welfare cheques subsidize the holdout of labor, making unemployment half voluntary. The market solution is a free labor market where wage rates drop to an equilibrium, market-clearing level. This would cause employers to substitute labor for capital and land, soaking up the unemployed.

There is enough truth in that one-sided view of

things so we cannot laugh it off. So many economists are constantly making this particular case, however, that I will not supererogate. What is needed is rather to temper and balance. The evils of high, ratcheting wage rates are conventionally overstressed relative to other kinds of institutional bias that block the use of more labor. If we first took out these other biases we could proceed with clean hands against union abuses, girded with more righteousness and armed with more consistency than today. If we could create a strong reliable demand for labor, labor would enjoy needed security without having to submit to the unwelcome restraints and counter-productive rules imposed by many unions.

The ~~whole~~ tax system ~~conspires to add taxes~~ ^{relative to} ~~into~~ the cost of hiring labor, ~~while reducing~~ the cost of using land and capital. The U. S. social security payroll tax in 1975 raised \$73 billion, a sixfold increase since 1960, and 25% of all federal receipts. The personal income tax raised \$128 billions, or 44% of receipts. But the personal income tax has become primarily another payroll tax, thanks to generous loopholes for property income and niggardly ones for wage income. To the large federal exactions we must add substantial sums taken by state income taxes.

These taxes are a big factor, obviously, in overpricing labor. This part of the price is not exacted by labor but by the Treasury. It is hard to study the tax code without inferring that legislators regard giving and receiving work to be some kind of public nuisance, to be penalized and suppressed by all means not inconsistent with the rights of property.

The employee finally gets his take-home pay in cash.

To convert cash to real values, however, he is taxed again on retail sales. Many kinds of property income, on the other hand, avoid or defer sales taxes -- a good example is the imputed income from residential and recreational property.

When it comes to holding land, the tax system presents a smiling and sympathetic face. The income tax code is geared to share the costs and magnify the rewards. I have treated this matter in an earlier submission to this Committee.⁽⁷⁾ The basic preferences for land may be summarized as follows:

1. Covert write-off of undepreciated and appreciated land value (as by allocating part of it to an old building);
2. Exemptions of imputed income of homes and resorts, coupled with deduction of interest and property taxes; exemptions of unrealized appreciation; of gain at death; of bequests; of gain realized by "non-profit" owners;
3. Deferral of tax on gain until realized by sale, coupled with expensing of carrying costs;
4. Capital gains exemption for realized gains, coupled with ordinary offset of holding costs and (some) losses;
5. Possible further deferral of tax beyond date of sale;
6. Deferral of land-use income where there is intertemporal interdependence of income.

The result of all that is a highly inflated incentive to buy more land than ^{under a neutral tax system,} ~~needed~~, sooner, ~~than needed~~, and to hang onto it longer, ~~than needed~~. This in turn results in spreading people and capital out thin over much more land.

^{otherwise} than needed. And the last, finally, necessitates pumping billions of dollars of capital into stretched-out roads, pipes, lines, wires, and other linkages that tie the fragile web of society and economy together. Localities attract large capital resources to sink into extensions of low productivity, high risk, and deferred or imagined benefits by mortgaging the tax power to general obligation bonds. State and federal governments pour in additional capital, as by the highway trust fund. None of this public capital is subject to any property tax, and he would be an eccentric public accountant who added a shadow tax to the capital to show its real social cost. Thus the substitution of land for labor converts itself into an inflated demand for roading and utilities, all of which are highly capital-intensive. Net result: substituting land for labor on private land causes substitution of capital for labor as well.

Turning to the tax treatment of capital, it, too comes off well compared to labor. ^AThe major exception to this might seem to be the property tax, but the appearance is deceiving. To begin, half or more of all capital is either exempt or else underassessed and undertaxed. Public capital is exempt. Timber is preferentially underassessed. Most cattle and mobile capital are exempt; many jurisdictions exempt machinery and equipment; and so on.

Buildings bear most of the property tax. This would seem to constitute a bias against use of capital, and it certainly is a bias against improving land. But the effect on the individual building is reversed because the property tax is levied locally and local governments use zoning and other controls to protect and fortify their tax bases. The thrust of local zoning, building codes, subdivision

controls, occupancy limits, condemnation power, and "sewer power" is to raise the capital requirements of residing in a town. The net result is doubly bad. We get more sprawl, raising infrastructure capital needs, and more capital per dwelling unit on the land that is used.

Turning to the income tax, it contains many loopholes and abatements for capital, and these generally are geared to favor capital of longer life. (We will be seeing that longer life is identical with greater capital-intensiveness.) I have treated this matter at length elsewhere, ⁽⁸⁾ and will merely summarize my position here. It is useful to distinguish growing capital like cattle, which yield a lump of value at end of life, from "flowing" capital like machines which yield a flow of cash or service over life.

Flowing capital receives the following preferences:

- Fast write-off and expensing of outlays for durable capital;
- Double-depreciation of capital when resold, inadequately offset by capital gains treatment of recapture;
- Exemption of imputed income of consumer capital;
- Expensing of interest and property tax;
- Investment tax credit.

In addition the abatements are biased among forms of capital, favoring the longer-lived. Capital ^{turning over} ~~cycling~~ in less than a year is treated harshly. Cost and recovery are reported on the same tax return - there is no interest-free loan from the Treasury, as ~~with~~ durable capital, ^{enjoys when it gets a} ~~getting~~ fast write-off. There is no gain in straddling the year-ends, either, ~~because the cost of deducting cost~~ ^{one year and declaring income a year later. The I.R.S. guards against this by} ~~ing that the cost of~~

goods not sold is not deductible at all.

Growing capital is treated even better. The basic preference is deferral of tax to date of sale. Congress couples this with a high propensity to grant the expensing privilege to outlays for growing capital. A farmer for example may expense outlays that actually go into or are part of a final salable product: feed, seed, stud fees, costs of raising livestock, and starting orchards and vineyards. He may not expense machinery and building improvements. In either case he writes off interest and any property taxes in the year paid, regardless of deferral of tax liability.

The result of this sort of tax bias is a set of false price signals broadcast in the factor markets. The signals overprice labor and underprice property. The signals make us respond to a shortage of labor when in fact there is a glut, and waste capital and land when we should be sparing them.

If tax bias were the only institution to favor wealth over labor, we could say it may offset other biases, but in fact there are reinforcing biases, which I will

t p. 16A { ~~merely list: subsidized low-interest loans; regulatory bias and Averch-Johnson effect; licensing laws which dispose of resources, franchises, monopolies, etc. subject to heavy capital requirements; use of low interest rates in planning public works; ignoring opportunity costs of public land; logrolling, overcommitment, and resulting stretchout of public works; the Highway Trust Fund; the failure to provide any police or administrator-enforced abatement of pollution, leaving the citizen no recourse but the larger lot, farther out; and the price-umbrella~~

--- merely list: subsidies which take the form of loans at low rates of interest, such as ^{housing} loan made or insured ~~for housing~~ by a propensity of Federal agencies; the capital-intensive bias that is inherent in allowing regulated industries a rate of return based on ^{total} their invested capital, regardless of low marginal productivity (an effect now called the Averch-Johnson effect); licensing laws for the disposal of natural resources which impose heavy capital requirements — examples are western water laws which ^{often} in effect divide water in proportion to the diversion capacity of rival appropriators, and fishing bag limits in proportion to numbers of boats;

effect that builds excess capacity into cartels. There are more, and I know of no comparable set of biases favoring inputs of labor.

3. The obstacle that labor produces capital.

All right, so efficiency as well as full employment call for increasing the labor coefficient of land and capital. How do we do that? Anyone can see what it means to use more workers per acre--no problem there. Anyone can see, too, what it means to use more men per crew, or use more shifts with given plant, machinery and equipment. Ah, it should be so simple. But who then produces the plant, machinery and equipment--who but labor? There is the problem. Capital is stored-up labor. If we use less stored-up labor per worker, are we not just substituting labor for labor? What is the difference; where the net gain of jobs?

Shop A may equip each of its workers with a smaller or less sophisticated machine, and use more workers. Then Shop B, which produces the machines, needs fewer workers. And Shop A itself may produce cement, the capital for Shops C, D,...Z, capital whose obviation would close Shop A. It is tempting to gloss over all that by saying if every shop and farm, mill and mine, office and store, firm and agency, gang and crew, squad and corps, family and kitchen, all up and down the line from the earth to the mouth just used less capital per worker it would all work out. Maybe it would, but maybe is not good enough. If we hadn't enough doubts of our own, modern macro-economics which dominates this field would force us to analyze how capital formation makes jobs.

Modern macro-economics has made much of the fact

that labor finds work producing capital, only with the emphasis on the obverse: investment employs labor (to produce capital, of course). Indeed it goes much farther. Investment not only makes some jobs, it is a prime mover, a First Cause that moves independently and exerts enormous leverage over other income-creating flows, which respond dependently. There is a mechanical relation such that aggregate income rises and falls by multiples of changes in investment. Such is the stuff of which macro-economic models are built. Investment is more important than other flows of equal value because it is autonomous and determining, they are reactive and determinate. It is fickle and must be wooed, they tag along and may be slighted. The key to full employment is finding investment opportunities and outlets to absorb the flow of savings. In such a model, reducing capital coefficients to make jobs is dangerous and self-defeating.

Right or wrong, the orthodox macro-economic model and paradigm, in whose grooves and patterns most thought has become channeled, is vertically integrated. The emphasis is on investment employing labor, not on the capital coefficient at a given time. It sees the relations of capital and labor in sequence, rather than in parallel; labor producing capital, rather than using it or competing against it. This perception is far too dominant to be ignored or brushed aside. If we would give and receive signals in macro-economics we must make the same switch, and think vertically. What is the relationship between labor and the capital which it produces? What does it mean to use less capital per worker? How do we accomplish it?

The quantity of labor input, worker-hours, is a product of workers and time. Similarly the capital input is a product of capital and time, say "dollar-years." Although

capital takes as many forms as Brahma, the basic idea or transcendental essence is simple enough: capital is something of value produced but not yet fully consumed by users ^{and} ~~or~~ recovered by investors. The more years elapse between production and recovery the more dollar-years of service are rendered by capital. Unrecovered capital is said to be "tied-up" or in service. ⁽⁹⁾

How to use less dollar-years of capital per worker is now evident: recover it faster. We can't cut down on the dollars, they have to cover the payroll. We can cut down the dollar-years of capital combined with payroll by cutting down the years. We accomplish the goal of reducing capital coefficients by modifying the capital stock so capital returns home faster to the investor.† The capital financing each payroll is tied up a shorter time with it. The short phrase for it is, make capital that turns over faster.

At the same time we can use larger crews to operate and maintain each plant of given value, which is the horizontally integrated perception of substituting labor for capital. In pure logic this second idea is implied by the first, but there is no harm in stating it separately (so long as we don't later lead ourselves into double counting). The idea is to shorten the pipeline between work and use, to move labor downstream closer to the consumer. That implies, at every step, using more warm labor with the frozen labor in machines, materials, plant and equipment.

must p. 19A → Lowering the capital coefficient per worker is, to many people, a structural or allocative question, in a box called "micro economics." But when we understand it

Fast tax write-off is a travesty of this principle that does not accomplish the social end. Fast write-off lets the private investor recover his capital faster only by us getting an advance from the Treasury, i.e. from other taxpayers. True capital recovery only occurs when ripe goods are delivered to consumers, thus unlocking the value.

Take as an example farm machinery. A farmer ~~can~~ substitutes labor for capital when he invests in a lighter, cheaper machine that returns its cost to him in fewer years. He is reducing the dozen-years of his capital which he combined with the factory labor in the machine. In addition he can use more field labor, and fewer, smaller, ~~lighter~~ machines. Now he is substituting field labor for factory labor. But the field labor is a step nearer the consumer, obviating the investment of capital in farm machines (and all the capital required to produce steel, fuel, rubber, paint, and other machine components.) Moving labor downstream reduces capital needs.

from the vertically integrated viewpoint it becomes a macro-economic effect of the most central kind. Turnover means sale and reinvestment. Sale means supply to consumers; reinvestment means payrolls and incomes. Added supply prevents inflation, added payrolls mean more jobs.

"Capital is kept in existence from age to age not by preservation but by perpetual reproduction" (J.S.Mill). Labor consumes capital in return for reproducing capital. The flow of payback from capital sold as goods and services is reinvested continually in payrolls in a steady ongoing process, to create new capital. Investment makes payrolls, but most investment is reinvestment, the recycling of past accumulations. The faster capital recycles, the greater is the flow of labor putting value into the pool of capital, and volume of goods and services flowing out. Faster recycling is capital "quickenning." The quicker the capital, the higher rises the flow-to-fund ratio. That means the more employment and production are financed with any given fund of capital, so long as there is idle labor to soak up. ~~There is a lot there: think about it.~~

^{That}
~~It~~ leads to a major proposition: "Turnover limits national income." Otherwise put, "Paybacks deferred are payrolls denied." ^{Capital that investors recover quickly is} ~~Hard capital and heavy capital and far-distant capital are slow capital. Soft, light and near-capital are "quick capital."~~ Quicker capital flows through and delivers value to consumers sooner. Sales mean payback. Payback means money recovered to finance new payrolls. Payrolls mean aggregate demand to match the added sales. It all balances out, but at a higher volume.

next p. 20 A, B. → Investment employs labor, yes. But almost all of

Some examples of slow capital are the following.

~~Natural regeneration of forest~~

Timber may tie up capital over 100 years before there is any payout, (although the cutting cycle is highly variable and can be greatly shortened). Subeconomic highways never pay out, either in cash or any other way -- non-recovery is the slowest of all, of course. Housing may not pay out ^{completely} for 50 years, varying with particular, of course, (but unlike timber it begins to pay out from an early date). Minerals' prospecting gets decided ahead of ~~the~~ payout. And so on.

To quicken a nation's capital we need reduce such uses and put more into other goods ^{and services}, like the following.

Retail inventories ^{and well-trained clerks.} Monitoring, measuring and ~~regulating~~ ^{scheduling} equipment to get more use out of heavy capital items.

Swing and graveyard shifts. Maintenance, operating, and repair personnel. Growing crops. Bus service.

Retraining programs. Craftsmanship. Personal service.

Home delivery. Cleanup, collection and recycling.

Rehabilitating and remodeling sound old buildings. Conserving water and energy in lieu of developing more. And so on.

gross investment is reinvestment of funds recovered from turnover and amortization of existing capital, (including inventories.) There is no imperative that says we must accelerate the growth of capital coefficients in order to sustain the flow of income-creating investment.

Reinvestment does just as well, and is much more weighty overall. ~~The nation's capital stock is variously estimated in the neighborhood of~~ ~~A 1% rise of reinvestment raises gross investment three times its output, indicating a turnover of one third a year.~~ ~~ment as much as about a 20% rise in net investment, because the one is so much greater than the other.~~ They are not alternatives; we can raise both, so long as there is more labor to employ. But raising turnover is much the more potent.

The upshot is that the process of substituting labor for capital creates the very macro-economic flows required to employ the extra labor. Micro- and macro- are unified. Solve the problem one way and we solve it the other way in the same stroke. Circulate capital faster, thus matching the given fund of capital with more labor, and generating added investment flows to hire it. One wants to shout such good news in the forum.

4. The obstacle of inadequate investment outlets.

Macro-economics is a quest for the bottlenecks of the economy--what keeps us from employing everyone? Turnover is clearly a potential bottleneck. One firm can invest in excess of capital recovery, but only by tapping others. An economy cannot tap others. It is a closed system with a zero sum of capital transfers. The only source of investment funds other than capital recovery is net saving, but net saving is very small next to capital recovery. Essentially labor finds work pouring value into the pool of capital, and sustenance taking it out again. The flow through the pool is virtually the national income (less

Net investment and savings each year are a small fraction of total income-creating spending, well under 10%

(and not really known precisely, when you look at the data sources.) The massive bulk of income-creating spending has to be reinvestment of funds recaptured by sales to consumers. A terribly careless and misleading convention obtains of treating short investments of under one year as non-investment, and limiting the word to longer-lived assets, but this convention has no intellectual substance and is not used here. The nation's total capital stock is a Great Revolving Fund, whose value is variously (and imperfectly) estimated to be around three

times national output. A slight percentage increase
in the rotation of this enormous mass of real value
~~time~~ will have major effects. We need not make an
issue whether capital turnover or capital formation is
preferable, for they (back to p. 21)

a few fringes small enough to leave as secondary matters). The flow is capital (K) times its turnover (T) or $K \times T$.

Dominant macro-economists have not much inquired into the role of restricted turnover as a bottleneck. Their focus has been on another possible bottleneck which is the recycling of money. Capital was pictured (if one thought of it at all) as a pile of finished goods seeking buyers, always ready for delivery, only wanting the trigger of consumer spending to release the flow. Spending controlled turnover, so much so that one need never think it had other controls, much less be a prime mover, as it is, which itself controls spending. The prevailing tendency is to bury the question by implicitly assuming automatic replacement of goods and service flows consumed, so in macro-economic models "consumption" creates income.

The question rarely arises explicitly because if it does the answer is built into the assumptions and would run like this. The cycle of spending has a fatal tendency to run down because of an excessive propensity to save from income, higher than there are investment outlets to absorb. The problem is always to find outlets which are scarce and to be treasured. The goal of policy is to increase investment opportunities (as by tax loopholes for investors, or public works). Recovering funds from sale of goods adds to gross saving, but saving, net or gross, is not a limit on autonomous investment. There is always a bottomless cornucopia of funds available to invest.[‡] Gross saving just adds to the problem--more leakage from the spending stream that has to be offset by using the precious rare investment outlets.

On the positive side, in the Keynesian picture, sale of goods leaves an empty slot to refill, and this is an

[‡] There is a backing away from the infinite liquidity trap in current neo-Keynesian orthodoxy, but it is always there to clinch an argument in a pinch, and in my observation is the operating assumption in practice, regardless of textbooks.

investment outlet. To the pessimist, however, this is uncertain, since there is an excess of goods anyway. Only the gross saving is certain. It is preferable to sequester capital in very hard, heavy, remote goods from which the payback is slow. Delivery to consumers is also slow, but there is an excess of goods seeking sale anyway so that is no problem. On the contrary, deferring deliveries helps offset the basic depressing imperative of our dying economy to sink into morbid deflation and choke on its own surplus of final goods wanting buyers.

Happily, we can now discard the idea that spending or recycling money is a bottleneck limiting national income. It does not at all square with the facts today, if it ever did. Instead of running down, the turnover of demand deposits has risen rapidly for many years now, even as the money supply does, and banks press on their reserve requirements to meet the demand for loans. Instead of a fatal deflationary imperative, there have been years of violent inflation which failed to solve the fatal unemployment problem. New Economists have mastered all too well the arts of creating and spending money. Delivering the goods is where they fail, and it is real goods ready to consume that turn play money into real money.

Instead of a glut of loanable funds and a shortage of investment outlets there is a capital shortage. Instead of a glut of goods there are shortages, an energy crisis, materials scarcities, limited selections in inventory, delivery delays, islands of famine and fears of world hunger. Labor may be in long supply. Money undoubtedly is. It is land, materials, commodities and investment funds that are short.

There is no need to Trump up investment outlets.

The true benefit of fast turnover is not the decay

of capital, not the drawing down of stocks, not the creation of empty niches for new investment to refill. Planned obsolescence is not a macro-economic benefit. The true benefit of fast turnover is the delivery of value to consumers and the recovery and recycling of capital by investors. The gain is not from wasting, as implied in Keynesian models; the gain is in saving capital, by untying it quicker.

Unhappily, the concerns that prevailed when the twig of the New Economics was bent are built into its axioms, laws, models, circuitry and conditioned reflexes. In addition they drew upon deep springs in the cultural subconscious. "New" Economics was always a misleading name. It was more of a regression.. "There is not an opinion more general among mankind than this, that the unproductive expenditure of the rich is necessary to the employment of the poor. Before Adam Smith the doctrine had hardly been questioned;...if consumers were to save... the extra accumulation would be merely so much waste, since there would be no market for the commodities..." (J. S. Mill). Now everything is different but this mode of thinking which prevails at the top of the economics profession and leads us ever deeper into error and trouble. Only now it is the unproductive consumption of the military and the welfare dependents on which we rely. "Every cut-back of a dollar in defense will cut two dollars from overall GNP and drag down a lot of jobs..." is the statement of Lawrence Klein.⁽¹⁰⁾ Reporter Ernest Volkman quotes one Pentagon budget expert, "...at least 20 per cent of this budget amounts to a federal work-relief program to stimulate the economy. Defense contracts, especially the big ones, have an immense ripple effect." Ironical, is it

not, that the study of economics, that niggardly art of scrimping with limited resources inverts so easily into an exaltation of the God of Waste. Military waste is the last refuge of a bankrupt philosophy. We must do better - and we can. We can do it by realizing it is the real circulation of real capital, not the circulation of play money that makes the big wheel turn.

New Economists have sharply attacked, rejected and even ridiculed the optimistic J.B. Say for proclaiming that there can be no general overproduction because "Supply creates its own demand." Yet today supply seems to do that and then some. Today one often hears a concern lest increased payrolls just cause inflation. Whether they do depends on where the money comes from. If it is new money why yes, of course. But when the added flow of investible funds has its source in delivery of finished goods to buyers then no, of course not. There is a matching added flow of supply to answer the added demand. Supply and demand still meet but at higher volume. Added flows are synchronized at both ends of the pipeline. The pipeline itself in this metaphor is shortened to speed the throughput and widened to carry more volume.

Keynesian pessimism sees supply overwhelming demand. Inflationary pessimism sees demand overwhelming supply. A confirmed pessimist sees both calamities at once, and there are those who do. Yet each calamity is the counterpart to and solution of the other. Calamity results from neither, but from restrictive and braking policies of other kinds adopted or tolerated by pessimists who believe or proclaim that they must forestall these imagined problems. These are the real macro-economic bottlenecks, the real limits to growth.

5. The obstacle of inflation associated with high employment.

There is a fatalistic notion abroad that high employment has to go with inflation, either as cause or effect. The notion receives high-level aid and comfort from the dominant Phillips Curve school of macro-economists. The foregoing analysis refutes the idea, but I will recapitulate briefly.

The idea underlying most modern analysis is that spending gradually leaks out of the system into savings. Government can raise employment by spending to offset this, injecting new spending by borrowing, usually coupled with some creation of new demand deposits, or money. But wage rates rise before everyone has a job. To beat this, government must keep a step ahead by injecting more new spending than expected. Result: inflation.

Now it is true, if government seeks to initiate a real increase of demand by printing money, inflation results. The present proposal is different. Increase the flow of investment spending by quickening the recovery of funds from existing capital. The funds are recovered quicker because the value in the capital is delivered quicker to consumers. Thus the flow of real goods to consumers rises just so as to match and meet the rise of payrolls. The flow of capital to consumers is what backs the higher payrolls and prevents inflation.

Nothing is more common than public works spending to make jobs. This indeed creates payrolls without goods and invites inflation. Public works soak up a maximum of capital per job created, and yield a minimum of subsistence to advance to labor for the next job. Public works to make jobs are one of history's great self-defeating, self-deluding tragic ironies. There is only a one-shot payroll,

after which the capital stops recycling for a long time, often forever. One of the great stupidities of all time, surely, was the English effort to relieve the Irish potato famine of 1845-49 by hiring Irishmen to build roads. 570,000 men, a large fraction of the working population, toiled for the Board of Works while food prices took off like a bird and while half the people died of starvation.⁽¹¹⁾ The people needed subsistence for tomorrow morning, while public policy directed their effort to the next century.

The potato famine fallacy has never died. Governments still build monuments and sub-economic works of slow or negative return while the basic necessities of life rise in price. But a policy of directing investment into quick capital of fast results would make jobs and hold down prices at the same time.

6. The obstacle of a resource ceiling on throughput.

Some writers regard materials flow as a limit on growth. They regard durability very highly, and fast replacement as inherently wasteful of materials and of our limited capacity to dispose of wastes.

The proposal to quicken capital is not a proposal to waste materials. The idea is to shorten investment cycles, so value is shorter in transit from maker to user. And then must the residuals return to foul the earth? It is false to presume so. An "investment cycle" is a different animal from a materials cycle. "Dust Thou art to dust returnest" was not spoken of the soul, and value is the soul of capital.

There is a world of difference between economic flows and materials flows; between economic service life and carcass life. Maintenance, recycling, rehabilitating,

remodeling, rebuilding, timber stand improvement, retrofitting, veterinary medicine, salvaging, renewing, reclaiming, scavenging, reassembling, repair, and the like are all investments that extend the useful lives of old carcasses and slow down materials throughput. But they are investments of fairly short payoff and economic life, as a rule, that tie up capital and value a short time and speed up value throughput. It is possible and indeed normal and common to append many short investment cycles in repairs onto the tail end of a longer carcass cycle.

I have already noted that the shelter afforded by old houses is labor-intensive. When you think about it, that says a lot about materials flows. The old carcass dates 'way back, but the economically valuable services are more current. Each little outlay for repair, upkeep, maintenance, cleaning and remodeling is an investment of short life and fast payback. The advanced age of the old carcass is irrelevant. Again and again people wrongly assume that shortening investment cycles means tearing down old buildings and scrapping old cars. It is the other way around.

Even outright demolition, scrapping and replacement of a subsystem often extends the usefulness of the whole, like pulling a sick tooth. Replace the battery and save the car; replace old buildings and save a neighborhood and a city. Thus short investment cycles in no way imply short materials cycles.

There are other examples where the two kinds of cycles do vary together. But the shorter investment cycle may be less taxing to the environment. Many cities short of water have to choose between water meters to save water,

or new dams to develop virgin water. The dams will outlast the meters, but who now would think the dams were the environmentally sounder choice? Again, beef takes longer to grow than turnips, but turnips certainly return vastly more food value per acre than beef while improving instead of exploiting the soil. And again, 12" X 12" timbers outlast 1" X 1" lumber and particle board and cardboard and veneer, but should we then high-grade the forests, leave all the smaller logs on the ground, and burn all the chips? The more you look at examples, the less tenable is any generalization that short investment cycles must always increase materials flow and generate residuals.

Examples may disprove one rule without proving another. It is clear, though, that as we move labor downstream nearer the consumer, we need less material overall. Indeed a good deal of labor gets all the way downstream into service industry requiring no materials at all. At the other extreme producing raw materials from the earth, especially heavy ones, is as far from the consumer as you can get, and the net thrust of policies pushing labor downstream is probably to reduce materials' use. People have difficulty with abstract ideas and seek concrete counterparts. That is understandable enough, but the search must be guided by a correct grasp of the concept. Equating materials flow and economic flow is a misapprehension of the concept, a materialistic fallacy. Value is not just material, it is labor imprinted on material, with labor adding the larger share of value, as a rule. To shorten investment cycles we must lock and unlock the labor with material quicker by moving labor downstream. In the work of Mishan, Kneese, Boulding,

et al., materials flow has been elevated to a major issue; correlated, if not identified, with economic flows; and made into a limit on growth and an argument against turnover. It is none of these, and should not divert us.

Conclusion

The capital requirement of economic growth is not a fund of capital but a flow of gross investment, a flow that grows with the national payroll which it finances. The flow is the product of the fund times its turnover rate. Faced as we are today with massive capital needs beyond our means, and surplus labor, the way to go is obvious: speed up turnover. The price system will do it for us if we stop jamming its signals with faulty institutions like bias in taxation.

The land requirement of economic growth is the land we already have, or less if need be. After we've made two blades of grass grow where one grew before, we switch over to corn, then vines, then perhaps food markets. Beware of endless lateral expansion -- the world is round.

Subsidies to tap frontiers make land artificially abundant. This is supposed to help make outlets for labor, and in some ways does. But frontiering taps new land at the cost of sequestering capital. Frontiers soak up scarce capital and hold it so it stops cycling and creating payrolls. Abundant land can still be badly used, and centuries of Caucasian expansion in the new world in a futile flight from unemployment have shown frontiers are not enough. Labor doesn't need great reservoirs of underused land so much as pressure to use the land we already have, and working capital to help labor use it.

Is it not retrogressive to reduce the capital used per man? We have seen that that is what quicker turnover implies and accomplishes. But we have also seen that progress in technology is to save what is most scarce, and today this is energy, land and capital. And there

is more. Saving capital has the beautiful by-product of quickening the application of progress, because each reinvestment presents a chance to embody new ideas in new things. We would not be so far ahead if the first generations of computers lasted sixty years. In all the furor over planned obsolescence (a travesty which I do not condone)-it is too easy to forget the fundamental rule that real obsolescence occurs as fast as people think. I am sure that people think faster, too, when their thoughts are used.

Finally, what about the distribution of wealth and income? Must a labor-intensive economy be a coolie economy? Not if we create it the right way. We can make labor cheaper, not by beating down wages but by lightening the tax burden on labor. We can make capital dearer not by raising the income of capital but by taxing it as heavily as we do labor. The same holds for land, only that the case is much stronger. Since labor income is distributed much more evenly than property, the result is not a coolie economy but a more egalitarian one than America has known for a long time. Longfellow dreamed of Acadia:

Neither locks had they to their doors,
nor bars to their windows:
But their dwellings were open as day
and the hearts of the owners;
There the richest was poor, and the
poorest lived in abundance.

The rich need not be poor, we are far beyond this. But it is quite feasible for most of the poor to become working poor, and for the working poor to live in abundance. We have the capital we need, if we have the compassion, the vision, and the good sense.

FOOTNOTES

1. Mason Gaffney, "Diseconomies Inherent in Western Water Laws", in Economic Analysis of Multiple Use, Proceedings of Western Agricultural Economics Research Council, Range and Water Section, 1961, pp. 55-82, 77ff. See also Irvin H. Althouse, "Water Requirements of Tulare County," Report to Tulare County Board of Supervisors, January, 1942, (mimeo) map in back pocket.

2. G. W. Dean and Chester O. McCorkle, Trends for Major California Fruit Crops, California A.E.S., Extension Service Circular 488, 1960. The source has extensive data on other crop averages.

3. William Shrader and N. Landgren, "Land Use Implications of Agricultural Production Potential," in L. Fischer, ed., Shifts in Land Use. Nebraska Agricultural Economics Service 1964.

4. See Appendix.

5. John Kendrick, Productivity Trends in the U.S. (Princeton: Princeton University Press, 1961) pp. 148-149, Table 39.

6. Cited in "The Push to get More from Men and Machines" Business Week, Sept. 9, 1972, pp. 80-81.

7. Economic Analysis and the Efficiency of Government, 1970, pp. 405-15.

8. M. Gaffney, "Toward Full Employment with Limited Land and Capital" in Arthur Lynn, Jr. (ed.), Property Taxation, Land Use and Public Policy (Madison: Univ. of Wisconsin Press, 1975) pp. 99-166, at pp. 128-136. These pages are submitted as App. 1.

9. In addition, often capital income goes unpaid. Then it is plowed back and becomes additional capital which claims compound interest. In this case the capital input grows more than in proportion to time. All the needed mathematics has been worked out for centuries and may be found in any HP-80.

10. "The Impacts of cuts in defense spending," Business Week, Jan. 19, 1976, pp. 51-52.

11. Cecil Woodham-Smith, The Great Hunger (New York: A Signet Book, 1964) pp. 137-160, et passim.

APPENDIX: CONSTRUCTION OF TABLE 3

Like any data, these might be massaged a good deal more. In particular I surmise that adding unrealized appreciation to profits would raise the profits per employee more for the top ten than for the others, since six of the top ten are oil companies, and all ten are major mineral owners. But this information is not available.

The lowest ten include one net loser, without which the profits per employee would be \$690 instead of \$297. However, negative profits are also relevant, and there are twelve firms in the 500 with net losses. Most of these are in the lowest 100, so it is representative to find one loser among any group of ten. Therefore \$297 seems more accurate than \$690.

Net worth was used for ranking in order to reduce the bias of ~~the~~ regression fallacy. (Had I ranked by profits, the top ten would not have changed much but the lowest ten would have been firms with negative profits.) Although it is only partly successful in that, the trends shown are strong enough to survive further purification.

Future researchers will want to rank also by gross worth; by current appraised value of assets; and other suitable measures that add more dimensions to what this line of inquiry reveals. The present data, however, ~~support~~ show a relationship so strong and unambiguous it is unlikely to be reversed by modifying details.