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## The 1990s in Japan: A Lost Decade

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## Prosperity and Depression

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## **The 1990s in Japan: A Lost Decade\***

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### **Abstract**

This paper examines the Japanese economy in the 1990s, a decade of economic stagnation. We find that the problem is not a breakdown of the financial system, as corporations large and small were able to find financing for investments. There is no evidence of profitable investment opportunities not being exploited due to lack of access to capital markets. The problem then and still today, is a low productivity growth rate. Growth theory, treating TFP as exogenous, accounts well for the Japanese lost decade of growth. We think that research effort should be focused on what policy change will allow productivity to again grow rapidly. *Journal of Economic Literature* Classification Numbers: E2, E13, O4, O5,

*Key words:* growth model, TFP, Japan, workweek

## 1. INTRODUCTION

The performance of the Japanese economy in the 1990s was less than stellar. The average annual growth rate of per capita GDP was 0.5 percent in the 1991-2000 period. The comparable figure for the United States was 2.6 percent. Japan in the last decade, after steady catch-up for 35 years, not only stopped catching up but lost ground relative to the industrial leader. The question is why.

A number of hypotheses have emerged: inadequate fiscal policy, the liquidity trap, depressed investment due to over-investment during the “bubble” period of the late 1980s and early 1990s, and problems with financial intermediation. These hypotheses, while possibly relevant for business cycles, do not seem capable of accounting for the chronic slump seen ever since the early 1990s. This paper offers a new account of the “lost decade” based on the neoclassical growth model.

Two developments are important for the Japanese economy in the 1990s. First and most important is the fall in the growth rate of total factor productivity (TFP). This had the consequence of reducing the slope of the steady-state growth path and increasing the steady-state capital-output ratio. If this were the only development, investment share and labor supply would decrease to their new lower steady-state values during the transition. But, the drop in the *rate* of productivity growth alone cannot account for the near-zero output growth in the 1990s.

The second development is the reduction of the workweek length (average hours worked per week) from 44 hours to 40 hours between 1988 and 1993, brought about by the 1988 revision of the Labor Standards Law. In the most standard growth model, where aggregate hours (average hours worked times employment) enter the utility function of the stand-in consumer, a decline in workweek length does not affect the steady-state growth path because the decline is offset by an increase in employment. However, in our specification of the growth model, the workweek length and employment enter the utility function separately, so that a shortening of the workweek shifts the *level* of the steady-state growth path down. If the only change were a reduction in workweek length, the economy would converge to a lower steady-state growth path subsequent to the reduction in the workweek length.

We determine the consequence of these two factors for the behavior of the Japanese economy in the 1990s. To do this we calibrate our growth model to pre-1990 data and use the model to predict the path of the Japanese economy in the 1990s, treating TFP as exogenous and treating the workweek length as endogenous subsequent to 1993. The lost decade of growth is what the model predicts. Also predicted is the increase in the capital-output ratio and the fall in the return on capital that occurred through the 1990s. The only puzzle is why

the TFP growth was so low subsequent to 1991. We discuss possible reasons for this decline in the concluding section of the paper.

In Section 2, we start with a brief catalogue of some of the facts about the lost decade. We then proceed to examine the Japanese economy through the perspective of growth theory in Section 3. We then use this model economy to predict what will happen in the 1990s and beyond, taking the paths of productive efficiency, workweek lengths, capital tax rate, and the output share of government purchases as exogenous.

Growth theory gives no role to frictions in financial intermediation. To many this may appear a serious omission. It is natural to suspect that the collapse of bank loans that took place throughout the 1990s must have something to do with the output slump in the same decade. There is an emerging literature about Japan that asks (a) whether the decline in bank loans was a “credit crunch”—namely, a decline due to supply factors (such as the BIS capital ratio imposed on banks), and (b) if so, whether it depressed output by constraining investment.<sup>1</sup> In Section 4 of the paper, we present evidence from various sources that the answer to the first question is probably yes, but the answer to the second question is no. That is, despite the collapse of bank loans, firms found ways to finance investment. This justifies our neglect of financial factors in accounting for the lost decade. Section 5 contains concluding remarks.

## **2. THE JAPANESE ECONOMY 1984-2000**

We begin with an examination of the NIA (National Income Accounts) data for the 1984-2000 period and report the facts that are most germane to real growth theory, which abstracts from monetary and financial factors. In the next section, we will determine the importance of the TFP behavior and the reduction in the workweek length on the behavior of the Japanese economy in the 1990s.

### **Poor Performance in the 1990s**

Figure 1 documents Japan’s prolonged slump in the 1990s. The figure graphs the Japanese real GNP per adult

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<sup>1</sup> Kwon (1998) and Bayoumi (1999), using VAR analysis, concluded that fluctuations in asset prices affected output through bank lending. Ogawa and Suzuki (1998) find evidence from panel data on large Japanese firms that the price of land as collateral affected investment demand. Sasaki (2000) reports from micro data on Japanese banks that lending by “city” banks (large Japanese banks) was constrained by the BIS capital ratio requirement. Woo (1999) finds support for the BIS-induced capital crunch only for 1997. Ogawa and Kitasaka (1998, chapter 4) assert that the decline in asset prices shifted both the demand curve and supply curve of bank loans, which resulted in a fall in investment without noticeable change in lending rates. Motonishi and Yoshikawa (1999), while generally disagreeing with the view that investment was constrained by bank lending, find evidence for a credit crunch for 1997 and 1998.

(aged 20-69), detrended at 2 percent (which has been the long-run growth rate for the leader country over the past century) and normalized to 100 for 1990.<sup>2</sup> The performance of the Japanese economy was very good in the 1980s, growing at a much higher rate than the benchmark 2 percent, and looking as if poised to catch up with the United States. However, this trend reversed itself subsequent to 1991, and by 2000 the Japanese per adult GNP is less than 90 percent of what it would have been had it kept growing at 2 percent since 1991. Part of this slowdown is due to a decline in TFP growth. Over the 1983-1991 period, TFP grew at a more than respectable rate of 2.4 percent.<sup>3</sup> It fell to an average of 0.2 percent for 1991-2000.

### **Workweek Falls in the 1988-93 Period**

An important policy change occurred at the end of the 1980s. The workweek length declined from 44 hours in 1988 to 40 hours in 1993, as depicted in Figure 2. This decline was by government fiat. For the first time in 40 years, there was a major revision of the Labor Standards Law in 1988, which stipulated a gradual reduction in the statutory workweek<sup>4</sup> from 48 hours down to 40 hours (six down to five workdays per week), to be phased in over several years. The number of national holidays increased by three during this period. Government offices were closed on Saturdays every other week beginning in 1989, and since 1992 have been closed every Saturday. Financial institutions have been closed every Saturday since 1989. A new temporary law was introduced in 1992 to bring about further reduction in hours worked. The 1998 revision of the Labor Standards Law added one day to paid vacation. It appears that the government's drive to reduce workweek had a lot of public support, judging from newspaper accounts.

### **Capital Deepens as the Rate of Return Declines in the 1990s**

Figure 3 plots the nongovernment capital-output ratio. An accounting convention we follow throughout the paper is that all government purchases are expensed (i.e., treated as consumption) and that the current account balance (the sum of net exports and net factor income from abroad) is included as investment. Therefore, the

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<sup>2</sup> Our procedure for constructing data underlying this and other figures and tables is explained in the Data Appendix.

<sup>3</sup> The TFP is calculated as  $Y_t / (K_t^q L_t^{1-q})$  where the capital share  $q$  is set to 0.362,  $Y_t$  is GNP,  $K_t$  is the nongovernment capital stock,  $L_t$  is aggregate hours worked. The average annual TFP growth rate over 1983-1991 is  $(A_{1991} / A_{1983})^{1/(1991-1983)} - 1$ , which is approximately equal to the average of the annual growth rates between 1984 and 1991.

<sup>4</sup> The employer must pay a higher wage rate to have the employee work longer than this statutory limit.

capital stock excludes government capital but includes claims on the rest of the world (foreign capital). Following theory, we include inventory stocks as part of the capital stock. Looking at Figure 3, we note that there was a significant capital deepening, with the capital-output ratio increasing by nearly 30 percent, from 1.86 at the beginning of 1990 to 2.39 in 2000. (If the capital stock excludes foreign capital, the ratio increases from 1.67 in 1990 to 1.98 in 2000.) Associated with this capital deepening, there was a decline in the after-tax (and net) return on capital, depicted in Figure 4, from 6.1 percent in the late 1980s to 4.2 percent in the late 1990s.

Both these rate of return figures are too high because part of the return includes the return on land. To get a better idea of the levels of return as opposed to just the change in returns, we examine returns in the non-land intensive sectors, namely the corporate and foreign sectors. The decline in after-tax profits divided by capital stocks in these sectors is from 5.3 percent to 2.1 percent. This leads us to the assessment that the after-tax return on capital declined over three percentage points between 1990 and 2000: from over 5 percent to about 2 percent.

#### **Government Share Increases and Investment Share Decreases in the 1990s**

Figure 5 shows that the composition of output changed in the 1990s. The government's share of output increased from an average share of 13.7 percent in the 1984-90 period to 15.2 percent in the 1994-2000 period. Another change is the decline in private investment share from 27.6 percent to 24.3 percent in these periods. Most of the decline in investment occurred in the domestic investment component, not in the current account: the output share of domestic investment declined by 3 percentage points, from 24.6 percent to 21.7 percent. The decline in the late 1990s is rather substantial.

### **3. JAPANESE ECONOMY FROM THE GROWTH THEORY PERSPECTIVE**

In using growth theory to view the Japanese economy in the 1990s, we are using a theory that students of business cycles use to study business cycles and students of public finance use to evaluate tax policies. The standard growth model, however, must be modified in one important way — to take into account the consequences of a policy change that led to a reduction in the average workweek in Japan in the 1988-93 period. Taking as given the fall in the workweek length, the fall in productivity growth, and the increase in the output share of government purchases in the 1990s, we use the theory to predict the path of the Japanese economy after 1990.

### 3.1. The Growth Model

#### Technology

The aggregate production function is

$$Y = A K^q (h E)^{1-q}, \quad (1)$$

where  $Y$  is aggregate output,  $A$  is TFP,  $K$  is aggregate capital,  $E$  is aggregate employment, and  $h$  is hours per employee.

#### Growth Accounting

Having specified the aggregate production function, we can go back to the data on the Japanese economy and perform growth accounting. Our growth accounting, involving the capital-output ratio instead of the capital stock, is equivalent to, but differs in appearance from, the usual growth accounting. Let  $N$  be the working-age population and define:

$$y \equiv Y/N, \quad e \equiv E/N, \quad x \equiv K/Y. \quad (2)$$

Using these definitions on (1) and by simple algebra, we obtain

$$y = A^{1/(1-q)} h e x^{q/(1-q)}. \quad (3)$$

That is, output per adult  $y$  can be decomposed into four factors: the TFP factor  $A^{1/(1-q)}$ , the workweek factor  $h$ , the employment rate factor  $e$ , and the capital intensity factor  $x^{q/(1-q)}$ . Our growth accounting is convenient because the growth rate in the TFP factor coincides with the trend growth rate of output per adult, namely the growth rate when hours worked  $h$ , the employment rate  $e$ , and the capital output ratio  $x (= K/Y)$  are constant.

Table I reports the growth rate of each of these factors for various subperiods since 1960. The capital share parameter  $q$  is set at 0.362 (see our discussion below on calibration). The contribution of TFP growth between 1983-1991 and 1991-2000 accounts for nearly all the decline in the growth in output per working-age-person.<sup>5</sup> In spite of the low TFP growth in the 1973-83 period, output per adult increased at 2.2 percent. The reason that growth in output per adult was higher in the 1973-83 period than in the 1991-2000 period is that in the earlier period there was significantly more capital deepening and a smaller reduction in the labor input per working-age-person.

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<sup>5</sup> The average annual TFP growth rate over 1983-1991, for example, is calculated as  $(A_{1991}/A_{1983})^{1/(1991-1983)} - 1$ .

## Households

We model workweek length  $h$  as being exogenous prior to 1993 and endogenous thereafter. Following Hansen (1985) and Rogerson (1988), labor is indivisible so that a person either works  $h$  hours or does not work at all. There is a stand-in household with  $N_t$  working-age members at date  $t$ . The size of the household evolves over time exogenously. Measure  $E_t$  of the household members work a workweek of length  $h_t$ . The stand-in household utility function is

$$\sum_{t=0}^{\infty} \mathbf{b}^t N_t U(c_t, h_t, e_t) \quad \text{with} \quad U(c_t, h_t, e_t) = \log c_t - g(h_t)e_t, \quad (4)$$

where  $e_t \equiv E_t/N_t$  is the fraction of household members that work and  $c_t \equiv C_t/N_t$  is per member consumption.

As policy decreased the workweek length over time, the disutility of working depends on  $h$ . This disutility function is approximated in the neighborhood of  $h = 40$  by a linear function

$$g(h) = \mathbf{a}(1 + (h - 40)/40). \quad (5)$$

For this function, if not constrained, the workweek length chosen by the household is 40 hours. This follows from household first-order conditions (11) and (12) below.

To incorporate taxes, we assume that the only distorting tax is a proportional tax on capital income at rate  $\tau$ . We could also incorporate a proportional tax on labor income. Provided that the rate is constant over time, the labor tax does not affect any of our results. This is because the labor tax, if included in the model, will be fully offset by a change in the calibrated value of  $\mathbf{a}$  (see the consumption-leisure first-order condition (11) and (12) below to see this point more clearly). Since 1984 there has been no major tax reform affecting income taxes, it is reasonable to assume that the average marginal tax rate on labor income (i.e., the marginal tax rates averaged over different tax brackets) has been constant. We treat all other taxes as a lump-sum tax. The resulting period-budget constraint of the household, which owns the capital and rents it to the business sector, is

$$C_t + X_t \leq w_t h_t E_t + r_t K_t - \mathbf{t}(r_t - \mathbf{d})K_t - \mathbf{p}_t. \quad (6)$$

Here  $w_t$  represents the real wage,  $\mathbf{p}_t$  the lump sum taxes and  $r_t$  is the rental rate of capital.

The after-tax interest rate equals

$$i_t = (1 - \mathbf{t})(r_{t+1} - \mathbf{d}). \quad (7)$$

The reason that we include a capital income tax is that a key variable in our analysis is the after-tax return on capital and this return is taxed at a high rate in Japan, even higher than in the United States.

### Closing the Model

Aggregate output  $Y_t$  is divided between consumption  $C_t$ , government purchases of goods and services  $G_t$ , and investment  $X_t$ .<sup>6</sup> Thus

$$C_t + X_t + G_t = Y_t. \quad (8)$$

Capital depreciates geometrically, so

$$K_{t+1} = (1 - \mathbf{d}) K_t + X_t. \quad (9)$$

The government budget constraint is implied by the household budget constraint (6) and the resource constraint (8). By treating the capital tax income rate  $\mathbf{t}$  as a policy parameter, we are assuming that changes in government purchases are financed by changes in the lump-sum tax  $\mathbf{p}_t$ . Thus, Ricardian Equivalence holds in our model.

### 3.2. Calibration

We calibrate the model to the Japanese economy during 1984-89. There are five model parameters:  $\mathbf{q}$  (capital share in production),  $\mathbf{d}$  (depreciation rate),  $\mathbf{b}$  (discounting factor),  $\mathbf{a}$  (disutility of working), and  $\mathbf{t}$  (capital income tax rate). The data on the Japanese economy that go into the following calibration (such as data on taxes on capital income) are described in the Data Appendix.

$\mathbf{q}$  The share parameter is determined in the usual way, as the sample average over the period 1984-89 of the capital income share in GNP.

$\mathbf{d}$  This is set equal to the sample average over the 1984-89 period of the ratio of depreciation to the beginning-of-the-year capital stock

$\mathbf{t}$  This is set equal to the average rate in the 1984-89 period.

$\mathbf{b}$  The discount factor is obtained from the intertemporal equilibrium condition.

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<sup>6</sup> Recall that in our accounting framework government investment is included in  $G$  and that investment consists of domestic private investment and the current account surplus. Hence (8) holds with  $Y_t$  representing GNP.

$$\frac{U_{c_t}}{U_{c_{t+1}}} = \frac{c_{t+1}}{c_t} = \mathbf{b} [1 + (1 - \mathbf{t})(r_{t+1} - \mathbf{d})], \quad (10)$$

where  $U_{c_t}$  is the marginal utility of consumption for the period-utility function given in (5) and  $r_{t+1}$  is the marginal productivity of capital. We average this equation over the 1984-89 period and solve for  $\mathbf{b}$ .

**a** The disutility of work parameter  $\mathbf{a}$  is obtained from the household maximization conditions for  $e$  and  $h$ :

$$c_t g(h_t) = w_t h_t \quad (11)$$

$$c_t g'(h_t) E_t = w_t E_t \quad (12)$$

Equation (11) holds whether or not  $h$  is constrained and is the equation used to calibrate  $\mathbf{a}$ . The calibrated value is the average value for the period 1993-2000, the years that the workweek was not constrained.

The calibrated parameter values are displayed in Table II.

### 3.3. Findings

We have calibrated the growth model to the Japanese economy for the 1984-89 period. We now use this calibrated model to predict what will happen in the 1990s and beyond.

#### Initial Conditions and Exogenous Variables

The simulation from year 1990 takes the actual capital stock in 1990 as the initial condition. The exogenous variables are  $(A_t, N_t, \mathbf{y}_t)$ , where  $\mathbf{y}_t$  is  $G_t / Y_t$ , the GNP share of government purchases. We also take hours worked  $h_t$  to be exogenous for  $t = 1990-1992$ . We need to specify the time path of those exogenous variables from 1990 on. For the 1990s ( $t = 1990, 1991, \dots, 2000$ ), we use their actual values. For  $t = 2001, 2002, \dots$ , we assume the following. The TFP factor  $A_t^{1/(1-q)}$  is set to its 1991-2000 average of 0.29 percent. We assume no population growth so that  $N_t$  is set to its 2000 value. The government's share  $\mathbf{y}_t$  is set equal to its value in the 1999-2000 period of 15 percent.

Our simulation is deterministic. The issue of what TFP growth expectations to assign to the economic agents is problematic. We do not maintain that the decline in the growth rate of the TFP factor in the 1990s was forecasted in 1990, even though we treat it as if it were. The justification is that a deterministic model is simple and suffices for answering our question of why the 1990s was a lost decade for the Japanese economy. If

expectations had been modeled in any not unreasonable way, the key predictions of the model would be essentially the same. In particular, the magnitudes of the increase in the capital-output ratio and the fall in the return on capital would be the same.

Figures 6-8 report the behavior of the model and actual outcomes. As can be seen from Figure 6, the actual output in the 1990-2000 period is close to the predictions of our calibrated model. Theory with TFP exogenous predicts Japan's chronic slump in the 1990s.

The observed deepening of capital and the decline in the rate of return, noted in Section 2 and reproduced in Figures 7 and 8, are also predicted by the model. The capital-output ratio rises as output growth falls because the capital-output ratio associated with a lower productivity growth is higher. This can easily be seen from equation (10). In the new steady state with lower productivity growth, the consumption growth rate is lower, which means that the rate of return from capital is lower. Under diminishing returns to capital, the capital-output ratio must therefore be higher.

The difference in the precise paths of the model and actual path of the capital-output ratio is not bothersome given the model's assumption that the future path of the TFP factor was predicted perfectly by the economic agents when in fact it is not. Neither is the discrepancy between model and actual returns in Figure 8 bothersome. This is as expected given actual returns include return on land as well as capital as discussed in Section 2.

The model's predictions for the 1990s are not sensitive to the values of the exogenous variables for the years beyond 2000. The predictions for the first decade of the twenty-first century, however, depend crucially on the values of the exogenous parameters for that decade. The most important variable is TFP. If the TFP growth rate increases to the historical norm of the industrial leader, Japan will not fall further behind the leader — rather, it will maintain its position relative to the industrial leader. If on the other hand, TFP growth is more rapid than the leader, Japan will catch back up. We make no forecasts as to what TFP growth will be, and emphasize that this forecast is conditional on the TFP growth rate remaining low.

Assuming that TFP growth remains low, Japan cannot rely on capital deepening for growth in per-working-age-person output as it did in the past, as the Japanese capital stock is near its steady-state value. On the other hand, decreases in the labor input (aggregate hours) will not reduce growth as it has in the past, because, under our specification (5), average hours worked  $h$  will not magnify the disutility of aggregate hours worked when it is less than 40 hours. The Japanese people now work approximately the same number of hours as do Americans. If TFP growth again becomes as rapid as it was in the 1983-1991 period, the labor input will increase

and this will have a positive steady-state level effect on output.

#### 4. WAS INVESTMENT CONSTRAINED?

An important alternative hypothesis about Japan's lost decade is what we call the "credit crunch" hypothesis. It holds that, for one reason or another, there is a limit on the amount a firm can borrow. If bank loans and other means of investment finance are not perfect substitutes, an exogenous decrease in the loan limit constrains investment and hence depresses output.<sup>7</sup> This hypothesis is becoming an accepted view even among academics. It has an appeal because the collapse of bank loans and the output slump occurred in the same period (the 1990s) and because the collapse of bank loans seems exogenous, taking place when the BIS capital ratio is said to be binding for many Japanese banks. In this section, we confront this "credit crunch" hypothesis with data from various sources.

##### 4.1. Evidence from the National Accounts

As mentioned at the end of Section 2, the output share of domestic investment declined substantially in the 1990s. If this decline is due to reduced bank lending, we should see much of the decline in investment by nonfinancial corporations. The Japanese National Accounts has a flow-of-funds account (called the capital transactions account) for the nonfinancial corporate sector that allows us to examine sources of investment finance. The cash flow identity for firms states that

$$\begin{aligned} \text{investment (excluding inventory investment)} & \qquad \qquad \qquad (13) \\ & = \text{(a) net increase in bank loans} \\ & + \text{(b) net sales of land} \\ & + \text{(c) gross corporate saving (i.e., retention plus accounting depreciation)}^8 \\ & + \text{(d) net increase in other liabilities} \\ & \qquad \qquad \qquad \text{(i.e., new issues in shares and corporate bonds plus net decrease in financial assets).} \end{aligned}$$

The capital transactions account in the Japanese National Accounts allows one to calculate items (a)-(d) above for the nonfinancial corporate sector.<sup>9</sup>

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<sup>7</sup> See, e.g., Kashyap and Stein (1994) for a fuller statement of the hypothesis.

<sup>8</sup> Since investment excludes inventory investment here, retention is defined as sales (rather than output) minus the sum of costs, net interest payments, corporate taxes, and dividends.

<sup>9</sup> The nonfinancial corporate sector in the Japanese National Accounts includes public nonfinancial corporations (such as corporations managing subways and airports), which get funding from the Postal

Figure 9 shows investment (excluding inventory investment) and item (a) (net increase in bank loan balances) as ratios to GNP. (The difference between the two, of course, is the sum of items (b), (c), and (d).) There are two things to observe. First, the dive in the output share of domestic investment, shown in Figure 5, did not occur in the nonfinancial corporate sector. The output share of investment by nonfinancial corporations remained at 15 percent, except for the “bubble” period of the late 1980s and early 1990s when the share was higher. Second, investment held up despite the collapse of bank loans in the 1990s.<sup>10</sup> That is, other sources of funds replaced bank loans to finance the robust investment by nonfinancial corporations in the 1990s. To corroborate on this second point, Table III shows how the sources of investment finance changed from 1984-88 to 1993-99 (thus excluding the “bubble” period). In the 1980s, bank loans and gross corporate saving financed not only investment but also purchases of land (see the negative entry for “sale of land” in the Table) and a buildup of financial assets (see the negative entry for “net increase in other liabilities”). In the 1990s, firms drew down the land and financial assets that had been built up during the 80s to support investment. These observations are inconsistent with the “credit crunch” hypothesis.

#### **4.2. Evidence from Survey Data on Private Nonfinancial Corporations**

The preceding discussion, based on the National Accounts data, ignores distributional aspects. For example, large firms may not have been constrained while small ones were. As is well known (see, e.g., Hoshi and Kashyap (1999)), as a result of the liberalization of capital markets, large Japanese firms scaled back their bank borrowing and started to rely more heavily on open-market funding, and the shift away from bank loans is complete by 1990. It is also well known that for small firms, essentially the only source of external funding is still bank loans. Therefore, if investment is constrained for some firms, those firms must be small firms. How did the collapse of bank loans affect small firms?

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Saving System (a huge government bank) through a multitude of government accounts collectively called the Fiscal Investment and Loan Program (FILP). It is not possible to carry out the flow-of-funds analysis for private nonfinancial corporations by excluding public corporations, because the Japanese National Accounts do not include a separate capital transactions account for this sector. However, the income-expenditure account for this sector, which is available from the National Accounts, indicates that public nonfinancial corporations are a minor part, less than 10 percent of the nonfinancial corporate sector in terms of income (defined as operating surplus plus property income). Since the nonfinancial corporate sector is the object of our analysis here, the privatization of two large public corporations, Japan Railway and NTT (Nippon Telegraph and Telephone), does not have to be taken into account in our analysis.

<sup>10</sup> Bank loans here include loans made by public financial institutions. If loans from public financial institutions are not included, the decline in bank lending in the 1990s is more pronounced.

The most comprehensive survey of private nonfinancial corporations (a subset of the nonfinancial corporate sector examined above) in Japan is a survey by the Ministry of Finance (MOF).<sup>11</sup> From annual reports of this survey published by the MOF, sample averages of various income and balance sheet variables for “small” firms (whose paid-in capital is less than 1 billion yen) can be obtained for fiscal years (a Japanese fiscal year is from April of the year to March of the next year). Figure 10 is the small-firm version of Figure 9. The difference between investment and bank loans in the 1980s is much smaller in Figure 10 than in Figure 9, underscoring the importance of bank loans for small firms. In the 1990s, however, as in Figure 9, investment held firm in spite of the collapse of bank loans. The sources of investment finance for small firms are shown in Table IV. It is not meaningful in the MOF survey to distinguish between items (c) (gross saving) and (d) (net increase in liabilities other than bank loans) in the cash-flow identity (13). For example, suppose the firm reports hitherto unrealized capital gains on financial asset holdings by selling those assets and then immediately buying them back. This operation increases (c) and decreases (d) by the same amount. Therefore, in Table IV, items (c) and (d) are bundled into a single item called “other.” The Table shows that small firms, despite the collapse of bank loans, continued to increase land holdings in the 1990s. That is, gross corporate saving and net decreases in financial assets combined were enough to finance not only the robust level of investment but also land purchases – as all the while the loan balance was being reduced.

As just noted, it is not possible to tell from the MOF survey which component -- saving or a running down of assets -- contributed more. It is, however, instructive to examine the evolution of a component of financial assets whose reported value cannot be distorted by inclusion of unrealized capital gains. Figure 11 graphs the ratio of cash and deposits to the (book value of) capital stock. First of all, the ratio is huge. The ratio for the nonfinancial corporate sector as a whole in the Japanese National Accounts is about 0.4. In contrast, the U.S. ratio for nonfinancial corporations is much lower, less than 0.2, according to the Flow of Funds Accounts compiled by the Board of Governors. For some reason the ratio was high in the early 1980s.<sup>12</sup> It is clear from this and previous figure that small firms during the “bubble” period used the cash and bank loans for financial investments. Second, turning to the mid to late 1990s, Figure 10 indicates that small firms relied on cash and deposits as a buffer against the steep decline in bank loans.

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<sup>11</sup> See the Data Appendix for more details on this MOF survey.

<sup>12</sup> Some of the cash and deposits must be compensating balances. We do not have statistics on compensating balances, however.

### 4.3 Evidence from Cross-Section Regressions

In the early 1990s, there was an active debate in the United States about whether the recession in that period was due to a credit crunch. To answer this question, Bernanke and Lown (1991) examined evidence from the U.S. states on output and loan growth. Based on a variety of evidence, including a cross-section regression involving output and loan growth by state, they concluded that the answer is probably no. In this subsection, we estimate the same type of regression for the 47 Japanese prefectures.

For the recession period of 1990-91, Bernanke and Lown (1991) find that employment growth in each state is related to contemporaneous growth in bank loans, with the bank loan regression coefficient of 0.207 with a  $t$  value of over 3. A positive coefficient in the regression admits two interpretations. The first is the “credit crunch” hypothesis that an exogenous decline in loan supply constrains investment and hence output. The second is that the observed decline in bank loans is due to a shift in loan demand. Bernanke and Lown (1991) prefer the second interpretation because the positive coefficient became insignificant when loan growth is instrumented by the capital ratio.

For Japan, we have available GDP by prefecture for fiscal years (April to March of the following year) and loan balance (to all firms and also to small firms whose paid-in capital is 100 million yen or less) at the end of March of each year.<sup>13</sup> The regression we run across prefectures is

$$\text{GDP growth rate} = \mathbf{b}_0 + \mathbf{b}_1 \cdot \text{bank loan growth rate.} \quad (14)$$

According to the official dating of business cycles (published by the ESRI (Economic and Social Research Institute of the Cabinet Office of the Japanese government), there were five recessions since 1975: from March 1977 to October 1977, from February 1980 to February 1983, from June 1985 to November 1986, from February 1991 to October 1993, and from March 1997 to April 1999. Without monthly data, it is not possible to align these dates with our data on GDP and bank loans. We therefore focus on the three longer recessions.

Our results are reported in Table V. In the regression for 1996-98, for example, the dependent variable is GDP growth from fiscal year 1996 (April 1996 - March 1997) to fiscal year 1998 (April 1998 - March 1999). This GDP growth is paired with the growth in loan balance from March 1996 to March 1998.<sup>14</sup> The loan growth is for all firms in Regression 1 and for small firms in Regression 2. Regression 1 is comparable to the state-level regression in Bernanke and Lown (1991) for the U.S. states, except that the measure of output growth here is

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<sup>13</sup> See the Data Appendix for more details.

<sup>14</sup> If the loan growth from March 1997 to March 1999 is used instead, the  $t$  value on loan growth is much smaller.

GDP growth, not employment growth.<sup>15</sup> Overall, the loan growth coefficient is not significant, which is consistent with our view that there may have been a credit crunch but it didn't matter for investment because firms found other ways to finance investment.

The significant coefficient for 1996-98 suggests that the recession in the late 1990s was partly due to a credit crunch, but this period is special. The three-month commercial paper rate, which has been about 0.5 to 0.6 percent since January 1996, shot up to above 1 percent in December 1997 and stayed near or above 1 percent before coming down to the 0.5 to 0.6 percent range in April 1998. During this brief period, various surveys of firms (for example, the Bank of Japan's survey called *Tankan Survey*) report a sharp rise in the fraction of small firms that said it was difficult to borrow from banks. The regression result in Table V, which detects a significant association between output and bank loans for 1996-98 but not for other periods, gives us confidence that the "credit crunch" hypothesis, while possibly relevant for output for a few months from late 1997 to early 1998, cannot account for the decade-long stagnation.<sup>16</sup>

## 5. CONCLUDING COMMENTS

In examining the virtual stagnation that Japan began experiencing in the early 1990s, we find that the problem is not a breakdown of the financial system, as corporations large and small were able to find financing for investments. There is no evidence of profitable investment opportunities not being exploited due to lack of access to capital markets. Those projects that are funded are on average receiving a low rate of return.

The problem is low productivity growth. If it remains lower in Japan than in the other advanced industrial countries, Japan will fall further behind. We are not predicting that this will happen and would not be surprised if Japanese productivity growth returned to its level in the 1984-89 period. We do think that research effort should be focused on determining what policy reform will allow productivity to again grow rapidly.

We can only conjecture on what reforms are needed. Perhaps the low productivity growth is the result

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<sup>15</sup> Published data on employment by prefecture are available for Japan, but only for manufacturing and at the ends of calendar years. When we replaced GDP growth by employment growth in the regression, the loan growth coefficient was less significant. For example, if employment growth from December 1996 to December 1998 replaces the GDP growth from 1996-98, the  $t$  value on the loan growth coefficient is 0.35. Furthermore, in this employment growth equation, if the loan growth is for manufacturing firms, the loan growth coefficient is negative and insignificant.

<sup>16</sup> Our view that the "credit crunch" hypothesis is applicable only for the brief period of late 1997 through early 1998 is in accord with the general conclusion of the literature cited in footnote 1, particularly Woo (1999) and Motonishi and Yoshikawa (1999).

of a policy that subsidizes inefficient firms and declining industries. This policy results in lower productivity because the inefficient producers produce a greater share of the output. This also discourages investments that increase productivity. Some empirical support for this subsidizing hypothesis is provided by the experience of the Japanese economy in the 1978-83 period. During that five-year period that the 1978 “Temporary Measures for Stabilization of Specific Depressed Industries” law was in effect (see Peck, et al., 1988), the TFP growth rate was a dismal 0.64 percent. In the three years prior, the TFP growth averaged 2.18 percent and in 6-year period after, it averaged slightly over 2.5 percent.

We said very little about the “bubble” period of the late 1980s and early 1990s, a boom period when property prices soared, investment as a fraction of GDP was unusually high, and output grew faster than in any other years in the 1980s and 1990s. We think the unusual pickup in economic activities, particularly investment, was due to an anticipation of higher productivity growth that never materialized. To account for the bubble period along these lines, we need to have a model where productivity is stochastic and where agents receive an indicator of future productivity. But the account of the lost decade by such a model would be essentially the same as the deterministic model used in this paper.

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## Data Appendix

This appendix is divided into two parts. In the first part, we describe in detail how we constructed the model variables used in our neoclassical growth model. The second part describes how the data underlying the tables and figures in the text are constructed. All the data are in Excel files downloadable from <http://www.e.u-tokyo.ac.jp/~hayashi/hp>.

### Part 1. Construction of Model Variables

The construction can be divided into two steps. The first is to make adjustments to the data from the Japanese National Accounts, which is our primary data source, to make them consistent with our theory. The second step is to calculate model variables from the adjusted national accounts data and other sources. The exact formulas of these steps can be found in the Excel file “rbc.xls” downloadable from the URL mentioned above.

#### Step 1: Adjustment to the National Accounts

Various adjustments to the Japanese National Accounts are needed for three reasons. First, depreciation in the Japanese National Accounts is on historical cost basis. Second, in our theory all government purchases are expensed. Third, starting in 2001 the Japanese National Accounts (compiled by the ESRI (Economic and Social Research Institute, Cabinet Office of the Japanese government)) adopted a new standard (called the 1993 SNA (System of National Accounts) standard) that is different from the previous standard (the 1968 SNA).

**Extension to 1999 and 2000.** For years up to 1998, the *2000 Annual Report on National Accounts* has consistent series under the 1968 SNA standard. The *2001 Annual Report*, which adopted the 1993 SNA standard, has series only for 1991-1999. The ESRI also releases series on the 1968 SNA basis for years up to 2000, but those series are only for a subset of the variables forming the income and product accounts. Furthermore, those accounts divide the whole economy into subsectors in a way different from the sector division in the *2000 Annual Report*. From these three sources, it is possible, under the usual sort of interpolation and extrapolation, to construct consistent series for all relevant variables under the 1968 SNA standard up to 2000 (consult the Excel file mentioned above for more details). On the left side of Table A-I, we report values (relative to GNP) of items in the income and product accounts thus extended to 2000, averaged over 1984-2000. Also reported are capital stocks relative to GNP. Beginning-of-year (end-of-previous year) capital stocks for years up to 1999 are directly available from the *2000 Annual Report*; capital stocks at the beginning of 2000 are taken from the *2001 Annual Report*.

**Capital consumption adjustments** The Japanese National Accounts include the balance sheets as well as the income and product accounts for the subsectors of the economy. In the income and product accounts, depreciation (capital consumption) is on historical cost basis, while in the balance sheets, capital stocks are valued at replacement costs. As was pointed out in Chapter 11 of Hayashi (1997), replacement cost depreciation implicit in the balance sheets can be estimated -- under a certain set of assumptions -- from various accounts included in the National Accounts. For years up to 1998, this Hayashi estimation of replacement cost depreciation is possible from the *2000 Annual Report*, which conforms to the 1968 SNA standard and which includes data for years up to 1998. The procedure is in the Excel file “japsave.xls”, downloadable from the URL mentioned above. The *2001 Annual Report*, which adopted the 1993 SNA standard, actually reports replacement cost depreciation in its balance sheet section for 1991-1999. However, since the class of assets in the new SNA is broader, we use only the 1999 value and use it only to obtain our estimate of the 1999 value from the 1998

Hayashi estimate. For 2000, we linearly extrapolate from the 1998 and 1999 numbers. Consult the Excel file “rbc.xls” mentioned above for more details. From the estimate of replacement cost depreciation, an estimate of capital consumption adjustment can be obtained as the difference between the replacement cost depreciation thus calculated and the historical cost depreciation reported in the National Accounts. We use this capital consumption adjustment to make the National Account variables consistent with replacement cost accounting. For example, we add this capital consumption adjustment to (book value) depreciation to obtain depreciation at replacement costs, and we subtract the capital consumption adjustment from operating surplus.

**Treatment of Government Capital.** In our theory, all government purchases are expensed. Consequently, government consumption in the product account includes government investment, and capital consumption on government capital is subtracted from GNP to define (adjusted) GNP.

These two adjustments, capital consumption adjustments and expensing of government investment, are shown on the right side of Table A-I, where we provide descriptions of the adjustments and the adjusted values (relative to the unadjusted GNP).

## **Step 2: Calculation of Model Variables from the Adjusted National Accounts**

The variables of our model are the following:

$W$  (wage income),  $R$  (capital income),  $DEP$  (depreciation),  $Y$  (adjusted GNP, exclusive of capital consumption on government capital),  $C$  (private consumption),  $X$  (investment, domestic investment plus investment in foreign assets),  $G$  (government consumption),  $K$  (capital stock),  $h$  (hours worked per employed person),  $E$  (number of employed persons),  $N$  (working age population), and taxes on capital income.

Of these,  $W$ ,  $R$ , and  $DEP$  are used to calculate the capital income share  $q$  as described in Section 3.2 of the text.

**Income and Product Account Variables.** Table A-II explains how the variables comprising the income and product accounts are constructed exclusively from the adjusted National Accounts. Imputed rent, which is the housing component of operating surplus in the noncorporate sector, is included in capital income. We assume that 80 percent of operating surplus in the nonhousing component of the noncorporate sector is wages. We need to divide indirect taxes between wages and capital income. For lack of good alternatives, we simply split it in half. Statistical discrepancy is allocated proportionately between  $W$ ,  $R$ , and  $DEP$ . Thus, by construction, the sum of  $W$ ,  $R$ , and  $DEP$  equals  $Y$  (GNP exclusive of capital consumption on government capital).

**Capital stock,  $K$ .** Capital stock excludes government capital but includes capital in foreign countries. Capital in Foreign Countries ( $KF$ ) was calculated in the following way:  $KF(1989) = 25 * \text{Net Factor Payments}(1989)$ ,  $KF(t+1) = KF(t) + \text{Net Exports}(t) + \text{Net Factor Payments}(t)$ .

**Average hours worked,  $h$ .** This variable is from an establishment survey conducted by the Ministry of Welfare and Labor (this survey is called *Maitsuki Kinro Tokei Chosa*). We use a series, included in this survey, for establishments with 30 or more employees. (There is a series for establishments with 5 or more employees, but this series is available only since 1990.)

**Employment,  $E$ .** The number of employed persons for 1970-98 is available from the National Accounts (see

Table I[3]-3 of the *2000 Annual Report on National Accounts*). The *Labor Force Survey* (compiled by the General Affairs Agency) provides a different estimate of employment from 1960 to the present. To extend the estimate in the NIA back to 1960, we multiply the Labor Force Survey series by the ratio of the National Accounts estimate to the Labor Force Survey estimate for 1970.

**Working-age Population,  $N$ .** The working-age population is defined as the number of people between ages 20 and 69.

**Taxes on Capital Income.** This variable is used to calculate the tax rate on capital income, denoted  $\tau$  in the text. It is defined as the sum of direct taxes on corporate income (available from the income account for the corporate sector in the National Accounts), 50 percent of indirect business taxes, and 8 percent of operating surplus in the nonhousing component of the noncorporate sector.

## Part 2. Data Underlying Tables and Figures

Figures 1-5 and Table I use the model variables described in Part 1 of this appendix. Figures 6-8 are based on the simulation described in Section 3 of the text. The underlying data are in Excel file “rbc.xls”.

Figure 9. Data on investment and bank loans are from the capital transactions account for nonfinancial corporations in the Japanese National Accounts (Table 1-[2]-III-1). For 1984-98, the data are from the *2000 Report on National Accounts*, and the GNP used to deflate investment and bank loans are constructed as in Part 1 of this appendix. For 1999, the data are from the *2001 Report on National Accounts*. The GNP for 1999 used to deflate is directly from this report. This is because the definition of investment in the *2001* report is based on the 1993 SNA definition. The data underlying this figure and Table III are in Excel file “nonfinancial.xls” downloadable from the URL already mentioned.

Table III. This too is calculated from the capital transactions account for nonfinancial corporations, available from the *2000 Report* (for data for 1984-1998) and the *2001 Report* (for 1999). Investment (excluding inventory investment), gross saving (defined as net saving plus depreciation), bank loans, and sale of land are directly available from the capital transactions account. Net increase in other liabilities is defined as investment less the sum of bank loans, sale of land, and gross saving. So the net increase in other liabilities, bank loans, sale of land, and gross saving add up to investment.

Figure 10. The data source is *Hojin Kigyo Tokei (Incorporated Enterprise Statistics)* collected by the MOF (Ministry of Finance). It is a large sample (about 18 thousand) of corporations from the population of about 1.2 million (as of the first quarter of 2000) listed and unlisted corporations excluding only very tiny firms (those with less than 10 million yen in paid-in capital). In the second quarter of each year, a freshly drawn sample of firms report quarterly income and balance-sheet items for four consecutive quarters comprising the fiscal year (from the second quarter of the year to the first quarter of the next year). The sampling ratio depends on firm sizes, with a 100 percent sampling of all “large” firms (about 5,400 firms, as of fiscal year 2000) whose paid-in capital is 1 billion yen or more. The MOF publishes sample averages by firm size. The sample averages we use are for “small” firms whose paid-in capital is less than 1 billion yen. For each fiscal year (April of the calendar year to March of the following year), investment for the fiscal year is the sum over the four quarters of the fiscal year of the sample average of investment (excluding inventory investment). The net increase in bank loans for fiscal year  $t$  is the difference in the loan balance (defined as the sum of short-term and long-term borrowings from financial institutions) between the end of fiscal year  $t$  (i.e., the end of the first quarter of calendar year  $t+1$ ) and

the end of the previous fiscal year (i.e., the end of the first quarter of calendar year  $t$ ). Information on the balance sheet at the end of the previous fiscal year is available because the MOF collects this information for the firms newly sampled in the second quarter of year  $t$ . The GNP used to deflate is constructed as described in Part 1 of this appendix. The data underlying this figure, Table IV, and Figure 11 are in Excel file “mof.xls” downloadable from the URL already mentioned.

Table IV. The MOF survey is the source of this table also. Calculation of investment and bank loans is already described above for Figure 10. Sale of land for fiscal year  $t$  is the difference in the book value of land between the end of fiscal year  $t$  and the end of the previous fiscal year. The value for “other” is calculated as investment less the sum of bank loans and sale of land.

Figure 11. This too is calculated from the MOF survey. It is the ratio of the sample average of cash and deposits for the small firms to the corresponding sample average of the book value of fixed assets (excluding land) at the end of each quarter.

Table V. Data on prefectural GDP for fiscal years are available from the *Report on Prefectural Accounts* (various years) published by the ESRI. Loan balance for domestically chartered banks by prefecture at the end of each March is available from *A Survey on Domestically Chartered Bank Lending by Prefecture and by Client Firm's Industry* by the Statistics Department of the Bank of Japan. The underlying data are in “prefecture.xls” downloadable from the URL already mentioned.

**Table I: Accounting for Japanese Growth per Person Aged 20-69**

| Period    | Growth rate | Factors    |                   |                 |                 |
|-----------|-------------|------------|-------------------|-----------------|-----------------|
|           |             | TFP factor | Capital intensity | Workweek length | Employment rate |
| 1960-1973 | 7.2%        | 6.5%       | 2.3%              | -0.8%           | -0.7%           |
| 1973-1983 | 2.2%        | 0.8%       | 2.1%              | -0.4%           | -0.3%           |
| 1983-1991 | 3.6%        | 3.7%       | 0.2%              | -0.5%           | 0.1%            |
| 1991-2000 | 0.5%        | 0.3%       | 1.4%              | -0.9%           | -0.4%           |

**Table II: Calibration**

| Parameter | Value |
|-----------|-------|
| $q$       | 0.362 |
| $d$       | 0.089 |
| $b$       | 0.976 |
| $a$       | 1.373 |
| $\tau$    | 0.480 |

**Table III: Sources of Investment Finance for Nonfinancial Corporations**

| <b>Sources of fund as</b><br>fraction of investment | 1984-88 | 1993-1999 |
|---|---------|-----------|
| (a) Bank loans                                      | 52.2%   | -4.8%     |
| (b) Sale of land                                    | -6.9%   | 5.7%      |
| (c) Gross savings                                   | 79.2%   | 88.1%     |
| (d) Net increase in other<br>liabilities            | -24.5%  | 11.0%     |
| Total   | 100%    | 100%      |

**Table IV: Sources of Investment Finance for Small Nonfinancial Corporations**

| <b>Sources of fund as</b><br>fraction of investment | Fiscal year<br>1984-88 | Fiscal year<br>1993-2000 |
|---|------------------------|--------------------------|
| (a) Bank loans                                      | 64.5%                  | -12.6%                   |
| (b) Sale of land                                    | -18.3%                 | -20.8%                   |
| (c) + (d) other                                     | 53.8%                  | 133.4%                   |
| Total   | 100%                   | 100%                     |

**Table V: Cross-Section Regression of GDP Growth on Loan Growth**

|                 | <b>Regression 1</b>   | <b>Regression 2</b>   |
|-----------------|---|---|
| Recession years | Independent variable is loan growth to all firms from March to March over indicated years | Independent variable is loan growth to small firms from March to March over indicated years |
| 1979– 1982      | 0.046 (0.3)   | 0.125 (0.9)   |
| 1990 - 1993     | 0.090 (1.0)   | 0.049 (0.6)   |
| 1996 - 1998     | 0.125 (2.0)   | 0.120 (1.7)   |

Note: *t* values in parentheses. The dependent variable is GDP growth rate over indicated fiscal years. The coefficient on the constant in the regression is not reported.

**Table A-I: National Income Accounts Adjustments**

| National Income Accounting Concept |                                       | value | Adjustments   | value |
|------------------------------------|---------------------------------------|-------|---|-------|
| Income                             | Compensation of Employees             | 0.546 |   | 0.546 |
|                                    | Operating Surplus                     | 0.223 |   | 0.198 |
|                                    | corporate                             | 0.105 | -Adjustment of Capital Consumption in Corporate(0.014)                | 0.091 |
|                                    | noncorporate                          | 0.118 |   | 0.107 |
|                                    | housing                               | 0.050 | -70% Adjustment of Capital Consumption in Noncorporate(0.008)         | 0.042 |
|                                    | non-housing                           | 0.068 | -30% Adjustment of Capital Consumption in Noncorporate(0.003)         | 0.065 |
|                                    | Capital Consumption                   | 0.151 |   | 0.170 |
|                                    | government                            | 0.006 | -Capital Consumption in Government(0.006)                             | 0.000 |
|                                    | corporate                             | 0.099 | + Adjustment of Capital Consumption in Corporate(0.014)               | 0.114 |
|                                    | noncorporate                          | 0.045 | + Adjustment of Capital Consumption in Noncorporate(0.011)            | 0.056 |
|                                    | Indirect Business Taxes               | 0.072 |   | 0.072 |
|                                    | Net Factor Payments                   | 0.008 |   | 0.008 |
|                                    | Statistical Discrepancy               | 0.000 |   | 0.000 |
|                                    | Total Income                          | 1.000 |   | 0.994 |
| Product                            | Consumption                           | 0.684 |   | 0.732 |
|                                    | private                               | 0.589 |   | 0.589 |
|                                    | government                            | 0.095 | +Fixed Capital Formation in Gov't-Capital Consumption in Gov't(0.049) | 0.143 |
|                                    | Investment                            | 0.288 |   | 0.233 |
|                                    | inventory                             | 0.004 |   | 0.004 |
|                                    | fixed capital                         | 0.285 |   | 0.230 |
|                                    | government                            | 0.055 | -Fixed Capital Formation in Government(0.055)                         | 0.000 |
|                                    | private (corporate plus noncorporate) | 0.230 |   | 0.230 |
|                                    | Current Account                       | 0.028 |   | 0.028 |
|                                    | net exports                           | 0.020 |   | 0.020 |
| net factor payments                | 0.008                                 |       | 0.008   |       |
| Total Product                      | 1.000                                 |       | 0.994   |       |
| Capital Stocks                     | government                            | 0.647 | -Government Fixed Assets (0.647)                                      | 0.000 |
|                                    | corporate                             | 1.031 |   | 1.031 |
|                                    | noncorporate                          | 0.575 |   | 0.575 |
|                                    | inventories, corporate                | 0.148 |   | 0.148 |
|                                    | inventories, noncorporate             | 0.021 |   | 0.021 |
|                                    | foreign capital                       | 0.000 | + Net capital stock abroad(0.221)                                     | 0.221 |
| Total Capital Stock                | 2.422                                 |       | 1.996   |       |

Note: averages of ratios to unadjusted GNP over 1984-2000.

**Table A-II: Model Variables and Relation to Adjusted NIA Data**

| <b>Variable</b>   | <b>Name</b>         | <b>Components</b>  |
|-------------------|---------------------|--|
| <b><i>W</i></b>   | Wage Income         | Compensation of Employees +<br>0.8 * Operating Surplus in Non-housing Non-corporate Sector +<br>0.5 * Indirect Business Taxes +<br>Proportion of Statistical Discrepancy   |
| <b><i>R</i></b>   | Capital Income      | Operating Surplus in Corporate Sector +<br>Operating Surplus in Housing Non-corporate Sector +<br>0.2 * Operating Surplus in Non-housing Non-corporate Sector +<br>0.5 * Indirect Business Taxes +<br>Proportion of Statistical Discrepancy +<br>Net Factor Payments |
| <b><i>DEP</i></b> | Depreciation        | Total Capital Consumption (Corporate + Non-corporate) +<br>Proportion of Statistical Discrepancy   |
| <b><i>Y</i></b>   | Income = Output     | <b><math>W + R + DEP = Y = C + G + X</math></b>  |
| <b><i>C</i></b>   | Private Consumption | Private Consumption  |
| <b><i>G</i></b>   | Gov't Expenditure   | Adjusted Government Consumption  |
| <b><i>X</i></b>   | Investment          | Total Investment (Corporate + Non-corporate) +<br>Net Exports +<br>Net Factor Payments   |
| <b><i>K</i></b>   | Capital Stock       | Total Capital Stock (Corporate + Non-corporate +<br>Stock of inventories) +<br>Capital in Foreign Countries  |

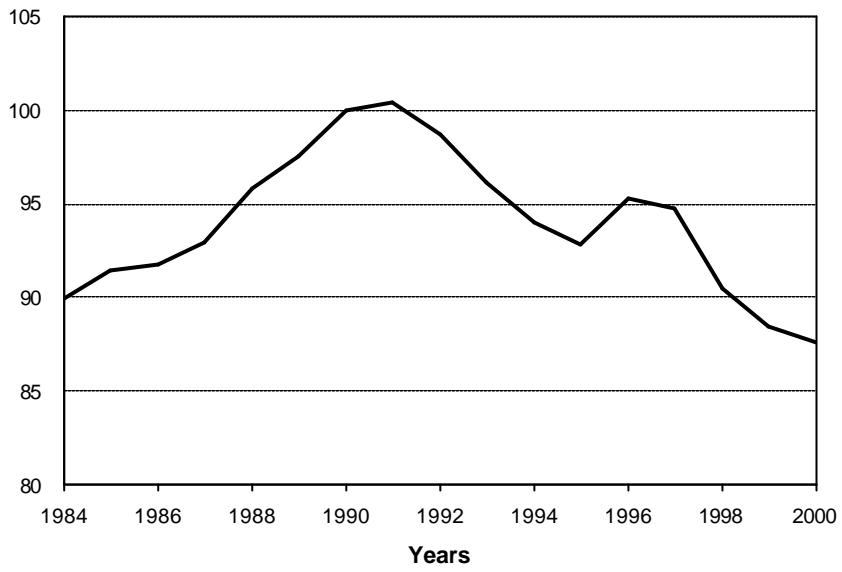


Figure 1: Detrended real GNP per working-age person (1990=100)

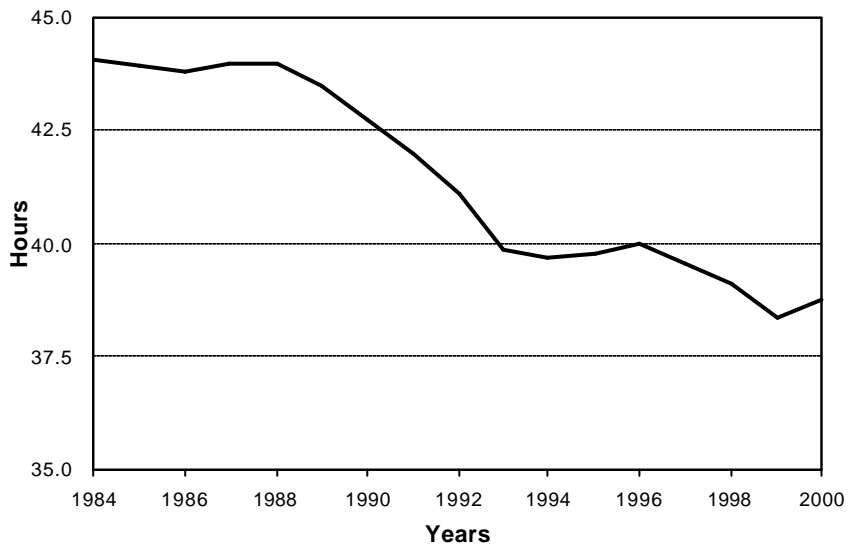


Figure 2: Length of workweek

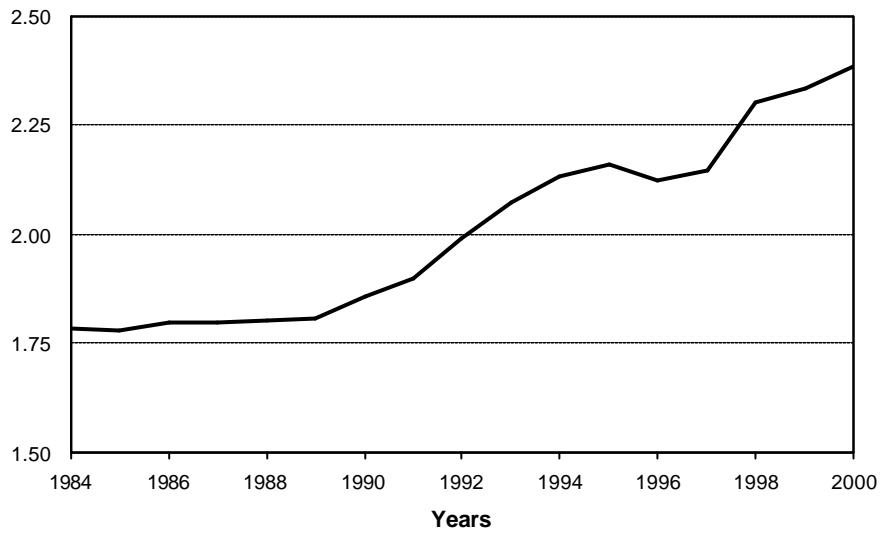


Figure 3: Capital-output ratio

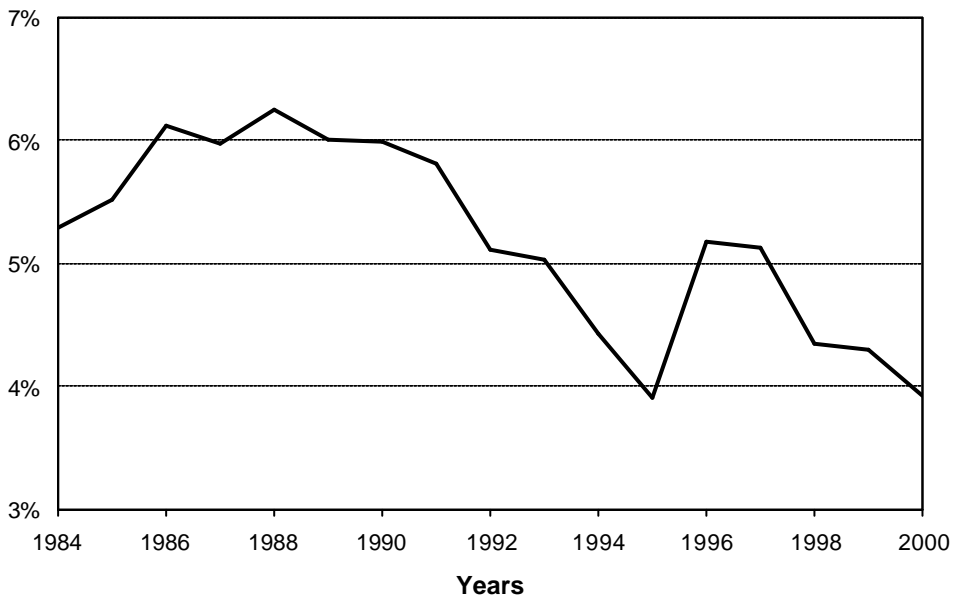


Figure 4: After-tax rate of return

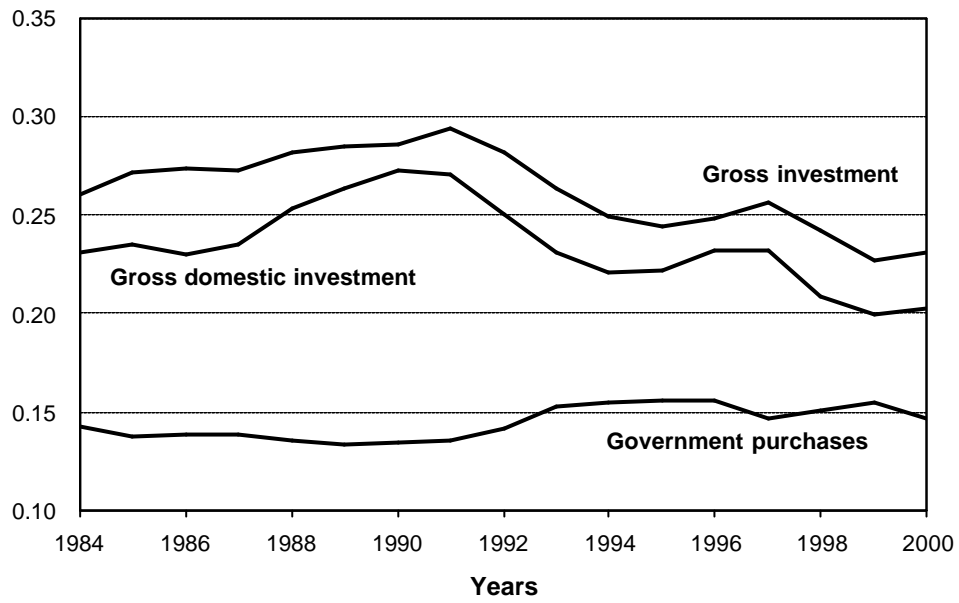


Figure 5: Government purchases and investment as a share of output

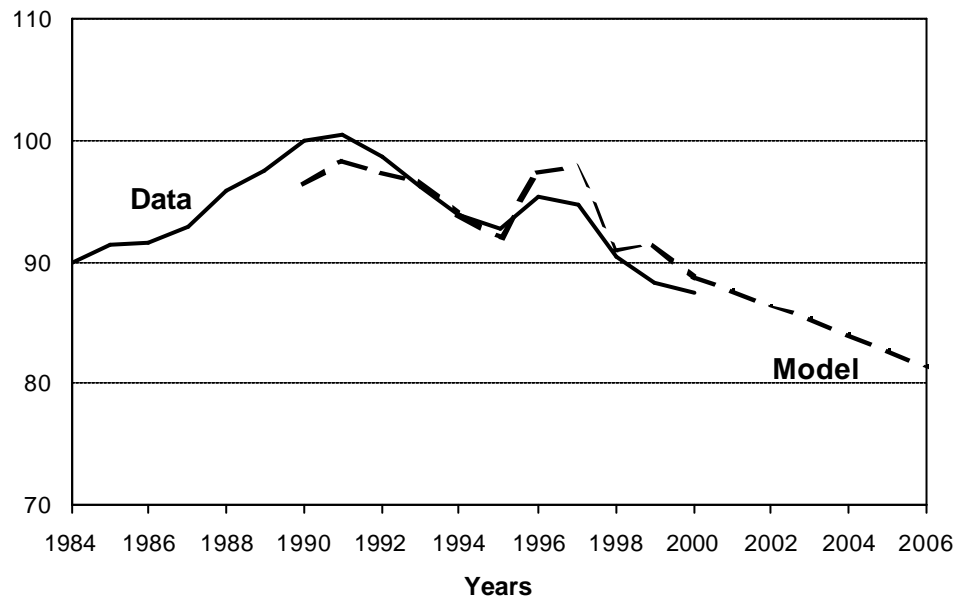


Figure 6: Detrended real GNP per working-age person (1990=100)

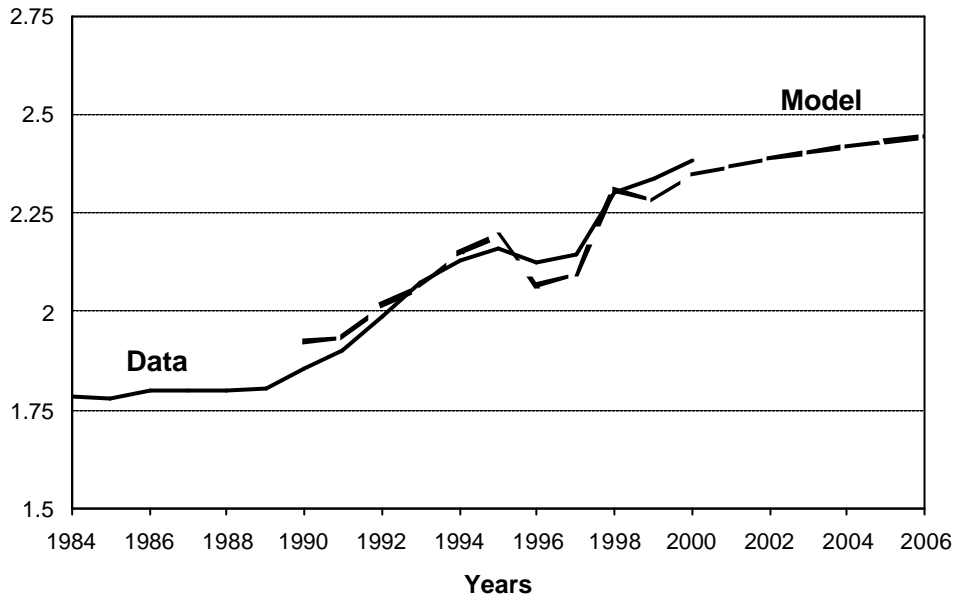


Figure 7: Capital-output ratio

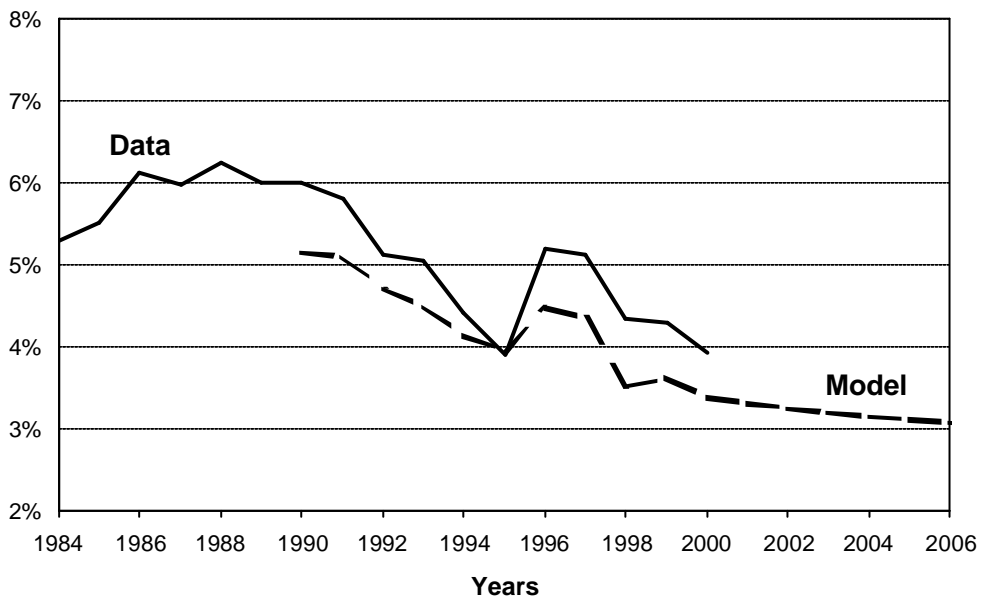


Figure 8: After-tax rate of return

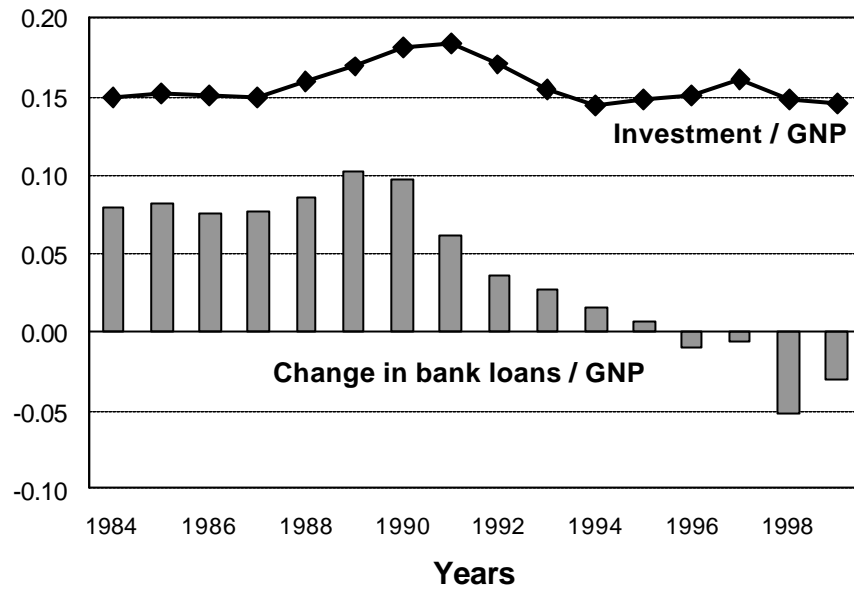


Figure 9: Collapse of bank loans: nonfinancial corporate sector

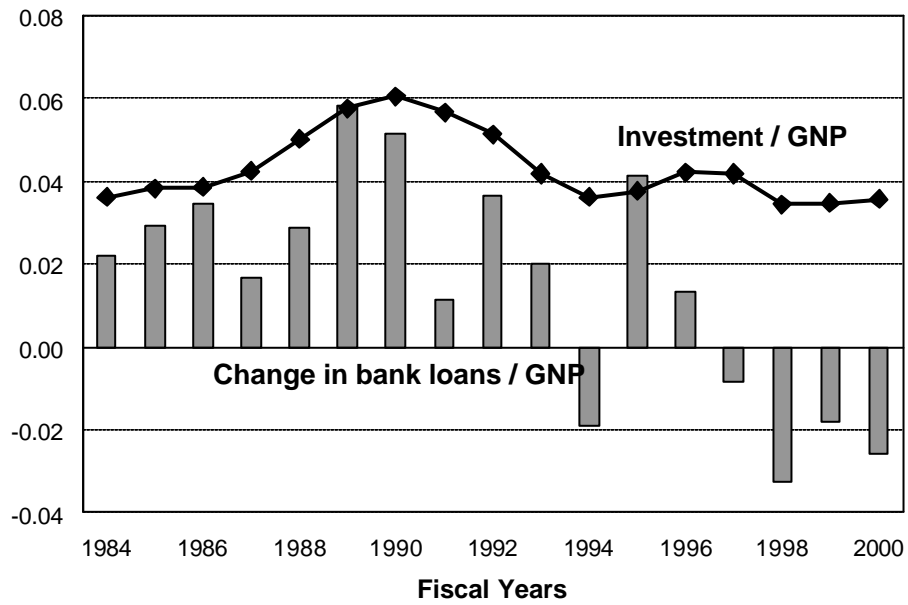


Figure 10: Investment finance: small firms

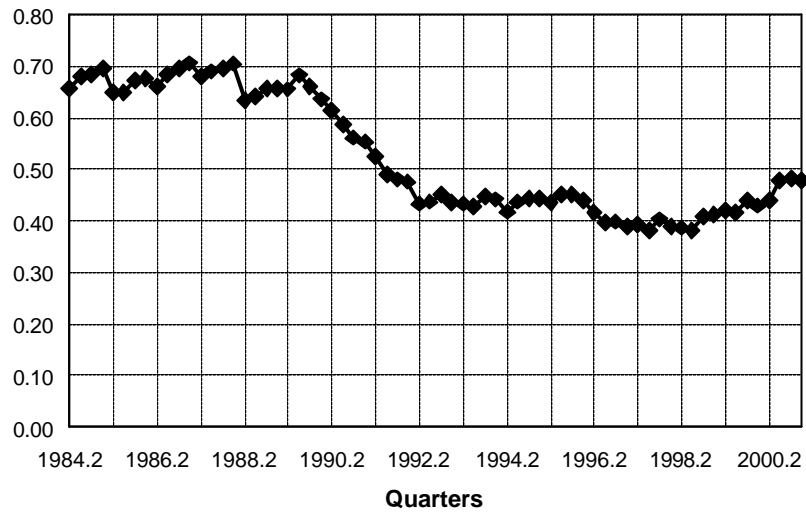


Figure 11: Ratio of cash plus deposits to capital stock: small firms



# Prosperity and Depression<sup>\*</sup>

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<sup>\*</sup> I would like to thank my colleagues at the University of Minnesota and the Federal Reserve Bank of Minneapolis for helpful discussions and comments. In particular, I would like to thank Tim Kehoe and Ellen McGrattan for their help. I also would like to thank Martin Weale and Franck Portier for providing the British and French tax information used in this lecture. Thanks also go to Sami Alpanda and James MacGee for research assistance and helpful discussions. This lecture draws heavily on collaborative research with Fumio Hayashi. I thank the Economic and Social Research Institute, Cabinet Office, Government of Japan and the U.S. National Science Foundation for financial support.

## 1. Introduction

Prosperity and depression are relative concepts. Today both Japan and France are depressed relative to the United States or equivalently the U.S. is prosperous relative to these countries. I say that these countries are depressed relative to the United States because their output per working-age person is 30 percent less than the U.S. level. An interesting and important policy question is why are these countries depressed. The reasons for these depressions turn out to be very different.

The reason that the United States is prosperous relative to France is that the U.S. intra temporal tax wedge that distorts the tradeoff between consumption and leisure is so much smaller than the French wedge. As will be shown, if France modified its intra temporal tax wedge so that its value is the same as for the United States, French welfare in consumption equivalents would increase by 19 percent. This means that consumption would have to be increased by 19 percent now and in all future periods to achieve as large a welfare gain as that resulting from this tax reform.

The reason that the United States is prosperous relative to Japan is that production efficiency is higher in the United States than in Japan. In the United States total factor productivity is approximately 20 percent higher than in Japan. If suddenly Japan became as efficient in production as the United States, its welfare gain in consumption equivalents would be 39 percent.

Equally interesting and important are the big changes over time in relative output (per working-age person) across countries. Why are the Swiss and New Zealand economies depressed by over 30 percent relative to their 1970 trend-corrected levels? This is an important question if you are a Swiss or a New Zealander. Both these countries have small populations, but the depression problem is not restricted to small countries. Japan with its 125 million people is now depressed by 20 percent relative to its 1991 trend corrected level. On the prosperity side, why are South Korea and Ireland so prosperous now relative to their 1970 trend-corrected levels?

This lecture, as these questions suggest, is concerned primarily with big international differences among relative rich industrial countries and changes in these differences over time. The countries that receive primary attention all have market economies and the populations are healthy and well educated.

In the countries considered the variations in aggregate output per working-age person are large and there are reasonably good measures on the factor inputs. This permits, in many cases, the identification of the change in policy or difference in policy that gave rise to a prosperity or depression. This is in contrast to business cycle theory, which provides little guidance to policy except for the important policy implication that

a stabilization effort will either have no effect or a perverse effect. The output variations studied and analyzed in this lecture are big being an order of magnitude larger than the much-studied business cycle fluctuations. The variations studied, however, are an order of magnitude smaller than the much-studied differences between the richest and poorest countries.

Surprisingly, only recently have depressions been systematically studied from the perspective of growth theory, which is the theory used to study not only secular growth but also business cycle fluctuations. Cole and Ohanian (1999) break the taboo against studying depressions from this perspective in their study of the Great U.S. Depression. Very recently, in January 2002 issue of *The Review of Economic Dynamics*, edited by Kehoe and Prescott (2002), a number of the Great Depressions of the twentieth century are examined from the perspective of growth theory. This lecture draws heavily on these studies.

In the above discussion, the inter-temporal comparisons have no meaning until the term trend growth is defined. This growth is the result of growth in the stock of world knowledge that can be accessed at modest cost and that enhances production possibilities. Trend growth is important for understanding why countries are so much richer today on average than they were fifty or a hundred years ago. It is not important for understanding relative levels across countries and changes in relative levels across countries over time, which are the topics of this lecture.

A question that arises is what rates should be used for trend growth. I assume the stock of world knowledge useful in production grows smoothly over time. In this lecture I will use a 2 percent constant annual growth rate throughout the twentieth century. This is the average growth rate of output per working-age person

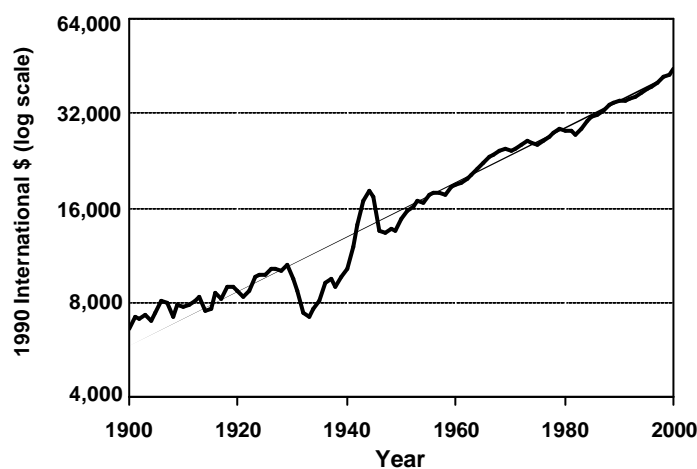
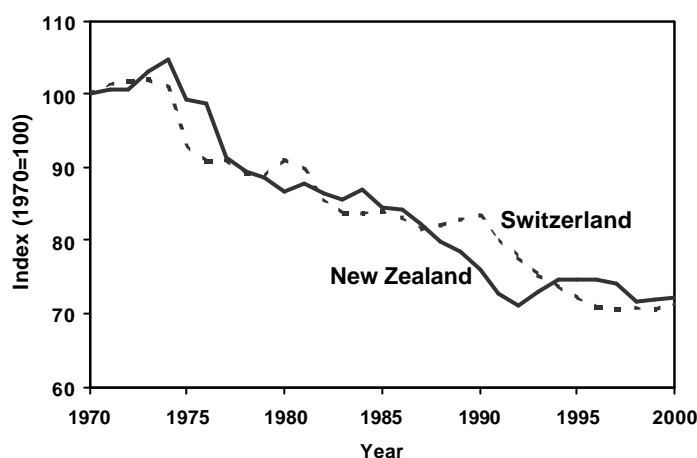


Figure 1: U.S. GDP per Person Aged 15-64

in the United State in the twentieth century. Figure 1 shows that the only large deviations of U.S. output per working age person in the twentieth century from a 2 percent trend are the Great Depression of the 1930s and the World War II output boom. I see the use of a 2 percent trend growth rate as being a much better procedure than ignoring it completely in the tradition of NBER business cycle analyses.

Returning to the questions, why are New Zealand and Switzerland now depressed by 30 percent relative to their 1970 trend corrected level, a fact depicted in Figure 2.



**Figure 2: Two Contemporary Depressions**

The only other OECD member that is depressed to a significant extent relative to its 1970 trend is Mexico. Japan is currently depressed relative to its level in 1991, but not relative to its level in 1970. The two OECD members that currently are significantly more prosperous relative to their trend corrected 1970 levels are Ireland and Korea. Ireland is now 60 percent above its 1970 level and Korea a 160 percent above its 1970s level.

Still another question is why did Belgium, France, Italy, Netherlands and Germany all increase their trend corrected productivity level by 80 percent relative to their pre World War II levels. Table 1 shows that these countries prospered in the post war period relative to their pre-war trend. Some economic policy change that resulted in productivity increasing to 180 percent of its pre World War II trend is the reason that these original EU countries are prosperous relative to their pre war trend corrected levels. Later in this lecture I will discuss what I see as the key change in policy that may have given rise to this increase.

The theoretical framework used in this lecture is the growth model. The key elements of the theory

**Table 1**

Detrended Labor Productivity (1913=100)  
Original EU Countries

| Year | EU  |
|------|-----|
| 1913 | 100 |
| 1929 | 102 |
| 1938 | 96  |
| 1950 | 75  |
| 1973 | 162 |
| 1992 | 181 |

Source: Maddison (1992); Table J-5; page 245. The EU countries are Belgium, Germany, France, Italy and the Netherlands.

are the aggregate production function of the stand-in firm and the utility function of the stand-in household. The technology side specifies people's ability to substitute while the preference side describes people's willingness to substitute. With price taking behavior, the ability and willingness to substitute are equated.

In this lecture particular attention will be devoted to Japan, a very interesting country from the perspective of the theory given its growth miracle in the 1955-72 period and its current depressed state. Fumio Hayashi and I (2002) have recently studied this country to understand why the Japanese economy is now depressed relative to its level ten years ago. The amount of this depression is nearly 20 percent and getting bigger. A question of importance to the Japanese people is what set of policy reforms will lead to prosperity.

## **2. The Importance of National Income and Product Accounts**

The connection between Richard Ely and this lecture is through students of his students. Wesley Mitchell may well be Richard T. Ely's greatest student. Wesley Mitchell had at least two truly great students. One was Irving Fisher, who was one of the earliest to recognize that the principles applicable to static economic analyses are equally applicable to dynamic economic analyses once goods are indexed by date. It is this dynamic economic theory that is used in this lecture. Another of Mitchell's great students was Simon Kuznets, whose

statistical work measuring the performance of national economies is the genesis of the growth model. Kuznets (1926, 1937, 1941) measured gross national product and its investment and consumption sub components. He and his students measured categories of claims against this product.<sup>17</sup> He came up with a measure of aggregate capital inputs and others, in particular his student Kendrick (1956), came up with measures of the labor input and estimates of productivity.

The best accounting system from the perspective of growth theory, however, is the original modern U.S. national income and product system, the conceptual basis of which is in important due to George Jaszi (Ruggles, 1983, p. 23). This is the system used by Hayashi and Prescott (2002) in their study of the Japanese economy in the 1990s and in this lecture for the 1960-1990 period. GNP is used rather than GDP as this is the income of households in the growth model. If a single sector model is used, growth theory dictates the use of GNP rather than GDP with net exports and net foreign factor income being part of investment. With the original modern U.S. system, for example, earning on a foreign investment is treated as an export of capital services. With these accounting conventions, saving equals investment and output is the sum of private consumption expenditure, government purchases of goods and services, and investment.

Through the measurement of the inputs and outputs to the market sector, the performance of the market sector is measured. The performance of the market sector in turn measures the performance of economic policy. Bad performance of the market sector is the result of bad economic policies where policy is broadly defined to include the regulatory and legal environment as well as tax policies.

Americans are not the only important contributors to the development of the national income and product accounts. British economists developed a good system of national accounts, which are the basis for those used throughout most of the world today. For the conceptual ideas underlying their development, Richard Stone (1986) gives credit to Colin Clark (1937). Richard Stone, D. G. Champerowne, and J. E. Meade (1942), however, are the ones that formalize Clark's ideas and put them into a consistent accounting framework.

### **3. The Growth Model and an Accounting Framework**

The national income and product account statistics display certain regularities. These regularities are that relative constancy of factor income shares, investment-consumption shares, fraction of productive time

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<sup>17</sup> In 1934 Carl Warburton published a table that contained gross national product for the United States with a break down between consumption and investment (Ruggles, 1983, p. 17).

allocated to the market, and the capital output ratio. These observations along with the secular growth in output per working age person are what led to the growth model.

Real business cycle theorists are interested in business cycle fluctuations and extended the growth model in two respects. First they introduced uncertainty and second they made the labor-leisure decision endogenous. They, and I think the rest of the profession, were surprised to find the growth model extended in this way displayed the business cycle facts given the behavior of real shocks, that is the behavior of factors determining the steady state of the deterministic growth model. This was a great success for growth theory, which was designed to account for the growth facts. In this lecture this theory will be used to study periods of prosperity and depression. The model used is the same as the one used by the real business cycle theorists except that there will be no uncertainty. The focus will be on relative levels and equilibrium paths rather than statistical properties of the time series.

Business cycle theorists found that the stand-in household's elasticity of substitution between consumption and leisure must be large if the extended growth model is to display the business cycle facts. I see the micro evidence as being overwhelming that this elasticity is large, though many labor economists disagreed<sup>18</sup>. In this lecture I will report additional evidence in support of a high value for the value for this substitution. The first category of evidence is the non-constant growth behavior of the Japanese economy in the 1970-2000 period. The second category of evidence is the differences in market hours per working age person associated with differences in the intra-temporal tax wedge.

Accounting for differences in output levels is closely related to, but differs from, the growth accounting of Solow (1957), who developed his accounting procedure prior to the development of the general equilibrium growth model in which the consumption-investment decision and the labor-leisure decision are endogenous. The model has two central elements. The first is the technology, which consists of an aggregate production function and the capital accumulation equation. The aggregate production function is the stand-in for technology and there is some well know aggregation theory behind it (see McKenzie, 1981). The second is a utility function for the stand-in household that depends on the path of consumption and leisure. There is some not so well known aggregation theory behind the stand-in household utility function.<sup>19</sup>

The aggregate production function defines the maximum output that can be produced given the

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<sup>18</sup> The findings are consistent with those of Heckman and McCurdy (1980) when they estimate labor supply for females taking into consideration the employment rate margin.

<sup>19</sup> See Rogerson (1988), Hansen (1985), and Hornstein and Prescott (1993).

quantities of the inputs. With competition, this maximum output is, in fact, the equilibrium output. Further, payments to the factors of production exhaust product. Thus, the aggregate production function, along with competitive equilibrium, provides a theory of the income side of the national income and product accounts given the quantities of the factor inputs.

The near constancy of factor income shares across countries and time (See Gollin, forthcoming) leads to the Cobb-Douglas production function

$$C_t + X_t = Y_t = (Ae^{gt})^{1-q} K_t^q H_t^{1-q}. \quad (1)$$

Here  $K$  denotes the capital stock in period  $t$ ,  $H$  aggregate hours worked,  $C$  aggregate consumption, and  $X$  aggregate investment. The productivity or efficiency parameter  $A$  is a country specific productivity parameter that varies over time and is exogenous to the stand-in firm, but is determined by policies. It measures the efficiency with which inputs are used in producing output. The capital stock depreciates geometrically,

$$K_{t+1} = (1-d)K_t + X_t. \quad (2)$$

The stand-in household's utility function is

$$\sum_{t=0}^{\infty} \mathbf{b}^t N_{it} [\log c_{it} + \mathbf{a} \log(1 - h_{it})]. \quad (3)$$

Here  $N_t$  is the working-age population,  $c_t = C_t / N_t$ , and  $h_t = H_t / N_t$ .

Suppose that the working-age population grows at constant rates,  $N_t = N_0 \mathbf{h}^t$  and the country-specific productivity parameter  $A_{it}$  remains constant. Then this economy has a unique constant-growth path in which all the quantities per working-age person grow by the factor  $\mathbf{g}$ , with the exception of market hours per working-age person  $h$ , which is constant. It is this fact that motivates the accounting that we adopt.

Our level accounting rearranges terms in the production function and takes logarithms to decompose the determinants of output into trend and three factors. The advantage of this decomposition is that each of the three factors leads to the examination of a different set of policies. Using lower-case letters to denote the per working-age person value of a variable and taking logarithms, we write the production function as

$$\log y_t = \mathbf{g} t + \log A_t + \frac{q}{1-q} \log(k_t / y_t) + \log h_t. \quad (4)$$

This representation provides a decomposition of the log of output into the following four factors:

1. Trend growth  $\mathbf{g} t$ . (5)

2. Productivity factor  $\log A_t$ . (6)

3. Capital factor  $\frac{\alpha}{1-\alpha} \log(k_t / y_t)$ . (7)

4. Labor factor  $\log h_t$ . (8)

Along a constant-growth path, output per working-age person grows at the trend rate and each of the three other factors remains constant. Shifts in policy change the constant-growth values of these factors, and therefore change the intercept of the constant-growth path as well. Constraints imposed upon the way businesses operate, such as a requirement for extra staffing or a restriction on the adoption of a more efficient production technology, will reduce the productivity factor. A change in the tax system that makes consumption more expensive in terms of leisure will reduce the constant-growth value of the labor factor. A change in the tax system that taxes capital income at a higher level will reduce the constant-growth value of the capital factor.<sup>20</sup>

### ***Convergence to the constant growth path***

An essential feature of the constant-growth path is that, in the absence of a policy change, the equilibrium converges to constant growth path. Along a convergence path the capital and labor factor will not be zero. If the economy is below its constant growth path, the labor input will be high and the capital factor low. Both these factors converge to their constant growth values. As will be discussed, non constant-growth behavior characterized the Japanese economy throughout the last 40 years of the twentieth century.

In this lecture, I use a trend growth rate of 2 percent per year because this rate is the secular growth rate of the U.S. economy in the twentieth century,  $\mathbf{g} = 1.02$ . A motivation for using the U.S. growth rate is that the United States is large, diverse, and stable politically, and it was the industrial leader throughout the twentieth century. Perhaps in the twenty-first century, the European Union will become the industrial leader, and it will be appropriate to define the trend growth rate relative to that economy rather than to the U.S. economy. Perhaps the trend growth rate will increase or perhaps it will decrease. What will happen to trend growth  $\mathbf{g}$  is an interesting question, but not the one addressed in this lecture.

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<sup>20</sup> Klenow and Rodriquez (1997) use this capital factor in their accounting for international income differences.

### *Some level accounting*

As stated at the beginning of this lecture, France, Japan, and the United Kingdom are currently depressed relative to the United States by about 30 percent. The accounting for these depressions is in Table 2, where for each factor the U.S. level has been normalized to 1. The table shows that most of the French depression is due to the depressed labor factor, while most of the Japanese depression is due to a depressed productivity factor.

**Table 2**

| 1990 Capital Output Ratios |     |
|----------------------------|-----|
| Country                    | K/Y |
| Australia                  | 2.4 |
| Denmark                    | 2.7 |
| Finland                    | 2.7 |
| France                     | 2.2 |
| Germany                    | 2.7 |
| Italy                      | 2.6 |
| Japan                      | 2.5 |
| Norway                     | 2.6 |
| UK                         | 2.6 |
| US                         | 2.3 |

Source: Nominal Capital Stock numbers are from OECD (1997) except for Japan, which is from Japanese SNA and is for the year 1998. The series used is Net Stock of Fixed Capital. Government capital is not included in this number. Nominal GDP numbers are from OECD (2001).

#### **4. Introducing Taxes into the Model**

Taxes affect the constant growth path of this model. We introduce three proportional taxes: a consumption tax,  $\mathbf{t}_{ct}$ ; a labor income tax,  $\mathbf{t}_{ht}$ ; and a capital income tax,  $\mathbf{t}_{kt}$ . All receipts are distributed lump sum back to the stand-in household. This is not to say that there is no public consumption. Rather we combine public consumption with private consumption. Implicitly we are assuming public schools are a good substitute for

private schools, publicly provided police protection for privately provided security protection, public provided roads for tolls roads, etc.

If some small fraction of GNP is allocated to pure public goods, the conclusions of this analysis are unchanged. This assumption that not all public consumption is a good substitute for private consumption would not be reasonable if modeling an economy with large military expenditures, as was the case for the German in the 1936-45 period and the United States beginning in the 1942-45 war time period.

As I want to identify the role of consumption tax in the consumption-leisure decision, the price received by the producer is used for the consumption good. This is not the convention now followed in national income and product accounting, which is to use the price paid by the household for valuing consumption goods and services. The intertemporal budget constraint is

$$\sum_{t=0}^{\infty} p_t N_t [(1 + \mathbf{t}_{ct}) c_t + x_t - (1 - \mathbf{t}_{ht}) w_t h_t - r_t k_t - \mathbf{t}_{kt} (r_t - \mathbf{d}) k_t + T_t] \leq 0 . \quad (9)$$

Here the  $p_t$  are the inter-temporal prices faced by the household,  $r_t$  the rental prices of capital,  $w_t$  the wage rate, and  $T_t$  the transfer payment.

### ***The inter-temporal tax wedge***

In fact the tax system is more complicated than this with property taxes, investment tax credits, useful lives of capital equipment differing from book value lives, etc. These features of the tax system affect the capital factor, but the capital factors differs little across countries<sup>21</sup>. From the perspective of capital accumulation, tax systems in the major OECD countries are roughly equivalent. For this tax system considered, the inter temporal tax wedge is

$$r_t = i_t / (1 - \mathbf{t}_k) + \mathbf{d} . \quad (10)$$

### ***The intra temporal tax wedge***

Equating the marginal rate of substitution between leisure and consumption to their price in the household's budget constraint yields the condition

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<sup>21</sup> For a detailed examination for the United States in the post war period see McGrattan and Prescott (2001). All the factors that arise from the Jorgenson and Hall (1969) rental price of capital are incorporated in that analysis.

$$1 - h_t = \frac{(1 + t_{ct})}{(1 - t_{ht})} \frac{\mathbf{a} c_t}{w_t}. \quad (11)$$

where  $w$  is the wage rate and the tax rates are marginal rates. With convex tax schedules, the differences between the marginal tax rate on labor income times labor income and labor income tax paid is treated as a transfer to the household. A useful equilibrium relation for  $h$  is

$$h = \left[ 1 + \frac{\mathbf{a}(c/y)}{(1-q)} \frac{1+t_c}{1-t_h} \right]^{-1} \quad (12)$$

This is a useful relations because constant growth  $c/y$  does not depend upon either  $t_c$  or  $t_h$ . We define the intra-temporal tax wedge to be

$$\frac{1+t_c}{1-t_h} \quad (13)$$

This factor is what matters for labor supply in the following sense. The equilibrium is a function of the product of  $\mathbf{a}$  and this tax wedge, and not of  $\mathbf{a}$ ,  $t_c$  or  $t_h$  separately.

The assumption that the tax revenues are either given back to households as transfers or as goods and services matters. If these revenues are used for some public good or squandered, private consumption will fall and the tax wedge will have little consequence for labor supply<sup>22</sup>. If as we assume it is used to finance substitutes for private consumption such as highways, public schools, health care, parks, and police protection, then the  $c_t/w_t$  factor will not change when the intra temporal tax factor changes. In this case, changes in this tax factor will have large consequences for labor supply.

## 5. The Capital Factor

The capital factor is not an important factor in accounting for differences in incomes across the OECD countries. Table 3 reports the capital output ratios for all OECD countries for which data was available in the most recent OECD (1997) data set<sup>23</sup>. The capital stock is the tangible private capital stock including the capital

<sup>22</sup> See McGrattan and Ohanian (1999) and Fisher and Hornstein (2002). They find public expenditures used for military purposes are largely offset by reductions in private consumption as theory predicts.

<sup>23</sup> There also are capital stock data for Canada, but that country clearly used a different concept of capital when reporting to the OECD, as the number reported is near 1 GNP. The Japanese capital stock figure is obtained from the Japanese SNA and is for the year 1998. It was not until the year 1998 that the Japanese capital output ration was near its constant growth value.

stock of quasi corporations, which are government enterprises in the U.S. NIPA nomenclature. The ratio is between 2.2 for France and 2.7 for the other countries. The similarities of investment shares of product and growth rates suggest that the France number is higher than 2.2. Perhaps different accounting conventions are followed in France with respect to the useful lives of different types of capital. The low 2.3 number for the U.S. is reasonable given the lower U.S. savings rate and higher U.S. population growth rate.

**Table 3**

1998 Level Accounting Relative to the United States

| Country        | GDP  | Productivity<br>Factor | Capital factor | Labor Factor |
|----------------|------|------------------------|----------------|--------------|
| France         | -31% | 6%                     | 1%             | -37%         |
| Japan          | -31% | -33%                   | 3%             | -1%          |
| United Kingdom | -41% | -29%                   | 2%             | -13%         |

Source: GDP series are from OECD (2001). The series used was GDP at the prices and PPP's of 1995. The capital output ratios are from OECD (1997) except Japan, which is from the Japanese SNA. The capital output ratios are for the year 1996, which is the latest available year. The labor input was obtained by multiplying "Average actual annual hours worked per person in employment" and "Total Employment" series obtained from the Labor Market Statistics of the OECD Corporate Data Environment which is available online at <http://www1.oecd.org/scripts/cde>.

Using a capital income share of parameter of 0.3, which is the approximate capital share of total product for all the countries (See Gollin, forthcoming), the capital factor contributes at most 8 percent to the differences in income between any of these countries.

Bergoeing et al. (2002) find that Chilean and Mexican economies in the late 1980s are exceptions to capital factor being unimportant in accounting for differences in levels. At that time there was some changes that led to a higher constant growth capital-output ratio. In the case of Chile Bergoeing et al. (2002) subsequently found that a cut in the corporate income tax rate from 46 percent to 10 percent accounts for the change. In the case of Mexico there was no explicit change in the tax code. However, at that time the banking system was nationalized with most loans being made to state enterprises and firms that were effectively bankrupt, so there could have been a change in the effective tax rate on capital income.

## 6. The Labor Factor

The labor factor is an important factor in accounting for depressions. In some cases a low labor factor can be accounted for by high marginal taxes on labor income and consumption. In other cases, as we will see, other policies that distort labor markets must be the cause of the low labor input. It is also possible that the labor input is low because the economy's capital stock is above its constant growth path associated with its current policies. If the economy were near its constant growth path and there was an unexpected change in policy which lowered the constant growth path, the labor input would fall below its new constant growth level and then converge up to this new level.

### *Taxes, the cause of the current French depression*

France is currently depressed by about 30 percent relative to the United States with the labor factor accounting for nearly all the depression. The capital factor and the productivity factor are essential equal in the two countries, while market time is about 30 percent lower in France than it is in the United States currently. Some suggest that the difference may be that the French can make more productive use of their non-market time. But, why did they work 10 percent more than the Americans in the 1970s? My analysis finds that American and French preferences are similar and that the large difference in labor supply is the result of differences in policy that result in different intra-temporal tax wedges.

For France and the United Kingdom, I now determine how much of the difference in their labor supply is due to differences in the intertemporal tax wedge. An estimate of the consumption tax rate  $t_c$  and the marginal tax rate on labor income  $t_h$  are needed to calculate the intra temporal tax wedge. These tax rates are estimated as follows<sup>24</sup>.

My estimate of the consumption tax rate is the ratio of indirect taxes divided by private consumption net of indirect taxes.<sup>25</sup> The motivation for this procedure is as follows. Most of indirect taxes, including sales and value-added taxes, are consumption taxes. A property tax on an owner-occupied house is equivalent to a consumption tax on the consumption services that the house provides to the owner. The small part of indirect taxes fall on investment and public consumption will be ignored. Given that the same procedure is being used for each of the countries, this will not affect our conclusions.

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<sup>24</sup> The source of the data used for the calculations of the tax rates is the United Nations (2000). These tax rates are the average for the years 1993-95, which are the latest years for which there are the needed data.

<sup>25</sup> See McGrattan and Prescott (2000, 2001) for more on taxes.

The procedure for calculating the marginal tax rate on labor income is more complicated. First I calculate the average social security tax rate on labor income by dividing social security taxes by an estimate of labor income. The estimate of labor income is the labor share parameter times output, where output is GDP less indirect taxes. The labor share parameter used is 0.70.

Next I calculate the average tax rate on factor income and assume the average tax rate on factor income is equal to the average tax rate on labor income. The estimated average tax rates on labor income are direct taxes paid by households divided by GDP less the sum of indirect taxes and depreciation. Given the progressivity of the tax systems, these average tax rates are multiplied by 1.6 to obtain my estimates of marginal income tax rates on labor income not including the social security tax.

A summary of the tax rates for France, the United Kingdom and the United States are reported in Table 4. The table reveals that the intra temporal tax wedge is large. In France, if someone works more and produces an additional unit of the consumption good, that individual gets to consume less than 0.40 units of consumption. In the United States the additional consumption is 0.60 units and in the United Kingdom the additional consumption is 0.54 units.

**Table 4**  
Current Intra-temporal Tax Wedge for  
France, the United Kingdom, and the United States

|                          | France | U.K. | U.S. |
|--------------------------|--------|------|------|
| $t_c$                    | .33    | .26  | .13  |
| $t_h$                    | .49    | .31  | .32  |
| social security tax      | .33    | .10  | .12  |
| marginal income tax      | .15    | .21  | .20  |
| Intra-temporal tax wedge | 2.58   | 1.82 | 1.46 |
| Hours h                  | .183   | .235 | .268 |
| Predicted h              | .189   | .250 | .268 |

Source: United Nations (2000).

These marginal tax rates are roughly what are obtained if one considers a typical household. In the United States in 1997, the average marginal federal income tax rate of working age people was 19.5 percent.<sup>26</sup> This number was computed as follows. The IRS reports the number of single returns and the number of joint returns by marginal tax rates. I doubly weighted the number of joint returns in the calculation of this average marginal tax rate as most of these households had two working age members. Some labor income is in the form of untaxed fringe benefits. This lowers the 19.5 percent number. However, there are also state and city income taxes, which works in the opposite direction. These considerations lead me to the conclusion that the 20 percent for the marginal tax rate is a reasonable number.

Major findings:

1. France is depressed by 30 percent relative to the United States because the French labor factor is 30 percent lower. The difference in the labor factors is due to differences in the tax system.
2. The welfare gain in consumption equivalents of France reducing or reforming its tax system so that its tax intertemporal tax wedge is the same as the U.S. tax wedge is 19 percent.

I find it remarkable that virtually all the large difference in labor supply between France and the United States is due to differences in tax systems. I expected institutional constraints on the operation of labor markets and the nature of the unemployment benefit system to be more important. I was surprised that the welfare gain from reducing the intra temporal tax wedge is so large. Welfare gains associated with reforming tax systems are typically closer to two percent than to 20 percent. Table 4 reports that both the intra temporal tax wedges for the United Kingdom is between that of France and the United States as is its labor factor. An interesting question is whether the U.S. boom of the 1980s was the result of lowering marginal tax rates on labor income in the 1986 Tax Reform Act. The increase in the labor factor in that decade suggests that it might be.

### ***Labor market distortions and the interwar German and U.K. depressions***

Taxes are not the only reason that the labor factor differs. An example of this is the inter war U.K. depression. As reported by Cole and Ohanian (2002), this depression began in 1920 and continued into the late 1930s. They also report that between 1913 and 1929, real output per adult fell by one percent in the United Kingdom while in the rest of the world it rose by 30 percent. The labor factor accounts in large part for the United

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<sup>26</sup> We used the U.S. IRS (1999) *Individual Income Returns 1997*, Table 3.6 to obtain these fractions.

Kingdom being depressed in 1929 by about 30 percent relative to its trend corrected pre World War I level.

The Cole and Ohanian (2002) analysis find that government social policies were undoubtedly the cause of the UK's interwar period depression. There were high levels of unemployment benefits and housing subsidies in conjunction with the need for labor to move from the depressed northwest to southern England where the jobs were much more plentiful. Cole and Ohanian (2002) write in their conclusion

Benefits were particularly attractive to workers in export industries, because they faced high costs of leaving depressed regions due to local housing subsidy policies.

As has been shown by Ljunqvist and Sargent (1998), some social policies that work well in times when there is little need to reallocate labor work poorly when there is the need for large reallocations as there was in the United Kingdom in the inter war period.

The inter war German depression is another dramatic example of labor market policies giving rise to a depression. Fisher and Hornstein (2002) find that associated with the 30 percent fall in output and employment, there was a 10.9 percent increase in the trend corrected real wage. Once the real wage was again at trend, the German economy quickly recovered and returned to trend.

The German recovery is not because of large increases in public consumption. Most of the recover occurred prior to the increase in government expenditures. Another success of the growth model is that it correctly predicts that large increases in military expenditures would be at largely at the expense of private consumption as they were.

## **7. The Productivity Factor**

The productivity factor is the most important factor in accounting for prosperity and depressions. This is consistent with what development economists (see Hall and Jones (1999) and Klenow and Rodriquez (1997)) have found, namely that international income differences are in large part accounted for by differences in total factor productivity even after correcting for the quality of the labor input.<sup>27</sup> It is consistent with the findings of real business cycle theorists that in the post war period productivity shocks are the major contributor to business cycle fluctuations.

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<sup>27</sup> Not all accept these findings. In particular Robert E. Lucas (2002) conclude that country-specific productivity factors are second order in understanding international income differences, as do Jones and Manuelli (1997).

The productivity factor is the major one in accounting for both the Switzerland and New Zealand depressions that began in 1970 (Kehoe and Prescott, 2002); in accounting for Chilean depression that began in 1980 including the spectacular recovery (Bergoeing et al. 2002); in accounting for the Mexican depression that began in 1982 and still continues (Bergoeing et al. 2002); in accounting for the Argentinean depression that began in the early 1970s (Kydland and Zarazaga, 2002); in accounting for the 1928-37 German depression and recovery (Fisher and Hornstein); in accounting for the 1929-1940 Canadian depression (Amaral and MacGee, 2002); in accounting for the 35 percent trend corrected decline in output in the United States in the 1930-1933 period (Ohanian, 2001). We know show that the productivity factor is the major determinant of the behavior of the post war behavior of the Japanese economy, which I now turn to.

*Japan in the post war period*

The accounting for changes in output per working age person is in Table 5. The motivation for breaking up the time period this way is that with subperiods, productivity growth is relatively constant; and between adjacent subperiods, it is very different. Given the behavior of the productivity factor, the non constant growth behavior of the capital and labor factor are in conformity with the predictions of theory.

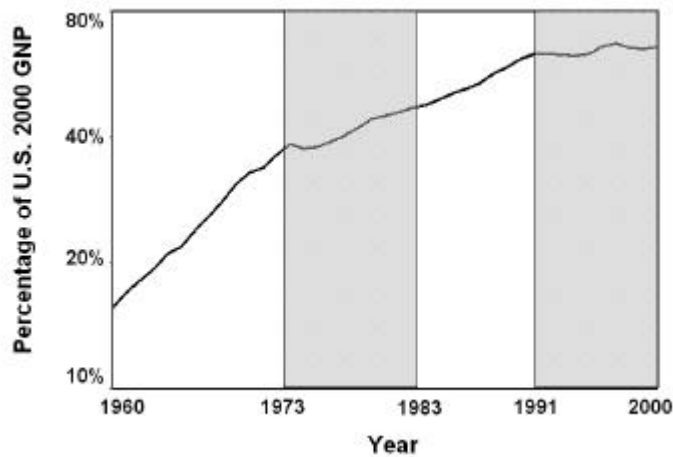
**Table 5**

Accounting for Japanese Growth per Person Aged 20-69

| Period    | Growth rate | Factors      |              |         |       |
|-----------|-------------|--------------|--------------|---------|-------|
|           |             | Trend growth | Productivity | Capital | Labor |
| 1960-1973 | 7.2%        | 2.0%         | 4.5%         | 2.3%    | -1.5% |
| 1973-1983 | 2.2%        | 2.0%         | -1.2%        | 2.1%    | -0.7% |
| 1983-1991 | 3.6%        | 2.0%         | 1.7%         | 0.2%    | -0.4% |
| 1991-2000 | 0.5%        | 2.0%         | -1.7%        | 1.4%    | -1.3% |

Source: Hayashi and Prescott (2002).

There were remarkable changes in the Japanese economy in the 1960-2000 period. Figure 3 plots GDP per person 20-69 for Japan relative to the 2000 U.S. level. As the figure reveals, there was a growthmira-



**Figure 3: Japanese GNP per Person Aged 20-69**

cle in the 1960-1972, a period when the country-specific productivity factor increased. Growth was slightly above trend growth trend growth in the 1973-83 period with the positive capital contribution being offset by the negative productivity contribution. The productivity factor again contributed positively to growth in the 1983-91 period, a period characterized by rapid but not spectacular growth.

The Japanese economy lost ground relative to trend in the 1991-2000 period. The problem was the country specific productivity factor, which fell 17 percent in the ten-year period 1991-2000. The growth in GDP per person 20-69 was 7.2 percent a year in the period 1960-72, which is miraculous. In the 1960s, Japan living standards doubled, which requires 35 years for a country growing at the trend rate. As theory predicts there was capital deepening and the labor input declined as the economy reduced the distance it was below its constantly changing constant growth path. In the 1973-1983 productivity growth plunged. The growth in this period was in important part due to an increase in the capital factor.

***How does the theory do in the earlier period?***

An estimate of each parameter can be obtained using only the observations for a single year and the consumption for the subsequent year. If the parameter estimates stay relatively constant over time and display no trend, the predicted path of the economy will be close to the actual. In making these predictions, productivity, population and the tax parameters taken as exogenous. For the Japanese economy these

parameters are nearly constant from 1970-2000 as can be seen in Table 6.<sup>28</sup>

**Table 6**

Average Parameter Estimates for Japan

| period  | <i>d</i> | <i>q</i> | <i>b</i> | <i>a</i> |
|---------|----------|----------|----------|----------|
| 1960-69 | 0.131    | 0.385    | 0.933    | 1.781    |
| 1970-79 | 0.101    | 0.351    | 0.971    | 2.321    |
| 1980-89 | 0.094    | 0.354    | 0.971    | 2.277    |
| 1990-99 | 0.096    | 0.363    | 0.967    | 2.424    |

Parameter constancy, however, does not hold for the 1960s. In the 1960s the value of *b* was a lower than subsequent to 1970, and more importantly, the disutility of work as measured by *a* increased steadily over the decade. Perhaps, for the extremely long workweeks of the 1960s, there were decreasing returns to longer workweek lengths. If so, a better modeling of the employment-hours decision is needed.<sup>29</sup>

## 8. Conclusions

Depressions are not a thing of the past even for the rich industrial countries. Switzerland is currently depressed 30 percent relative to its trend corrected 1970 level and Japan is currently depressed 18 percent relative to its 1991 level and continues to become more depressed. On the prosperity side, Ireland is 60 percent more prosperous than in 1970 correcting for trend growth.

Growth theory is a powerful tool for studying a depression and prosperity. The French, Japanese and Americans all have very similar preferences. The French are not lazy or better at enjoying leisure than Americans or the Japanese. The Japanese are not compulsive savers. In this lecture I use this theory to develop

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<sup>28</sup> The reason that the capital share parameter in the production function is greater than the typical 0.30 number for other countries is the high value of land in Japan relative to GNP.

<sup>29</sup> Hayashi and Prescott (2002) found that the workweek in the late 1980s was longer than what the Japanese people wanted. The labor input fell when it was reduced from 44 to 40 hours a week to be consistent with people's preferences in the 1989-92 period, the labor input fell. Their representation of preferences is a local approximation.

a system of accounting for differences in output per working age person. The first factor is exogenous technological level. It is the common across countries and grows smoothly over time. The second factor is the capital factor, which depends upon how capital is taxed and the nature of capital market distortions. This factor turned out not to be very important in accounting for differences across countries and time.

The labor factor, however, turned out to be important. The differences in the consumption and labor tax rates in France and the United States account for virtually all the 30 percent difference in the labor input per working age person. The welfare gains associated with France reducing its intra temporal tax wedge are large. An interesting question is whether the low labor supply of the Italians, Germans and Spaniards are also due to a tax system that makes consumption very expensive in terms of leisure. Other labor policies also have large macro effects as evidenced by the Great U.K. Depression that began in 1920 and continued for nearly 20 years and the inter war German Depression.

The final factor, productivity, is the most important one. It accounts for the behavior of the Japanese economy in the 1960-2000 period, a period in which there was both a growth miracle and a depression. This factor account for the New Zealand, Swiss, and Mexican economies being depressed by about 30 percent relative to their trend corrected 1970 level. In this lecture I presented some evidence as to policies that determine the productivity factor, that is the efficiency with which output is produced. More industry studies are needed with careful micro measurement along with better theory are needed for a good understanding of how policy determines productivity.

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