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ABSTRACT

Policy discussions in Japan have increasingly recognized the important role of land values and land-use patterns in Japanese macroeconomic adjustment. In Japan in recent years, land wealth constitutes more than half of financial wealth, a proportion that is much higher than in the United States and other industrialized economies. Consequently, shifts in land-use patterns can have important effects on Japanese savings and investment patterns, and thereby on the Japanese trade balance and current account. This papers studies the implications of land-use policies for the Japanese macroeconomy using both a theoretical model and a multi-sectoral dynamic simulation model.

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Japanese Structural Adjustment and the Balance of Payments

A major goal of current Japanese economic policy is to shift from export-led growth to domestic demand-led growth, as part of a process of worldwide economic adjustment. The general objective is a reduction of the Japanese trade surpluses in future years (at least as a proportion of Japanese GNP), in line with a reduction of the U.S. trade deficits, in a manner which maximizes Japanese economic welfare and minimizes the economic volatility during the adjustment process.

The case for domestic demand expansion is made on several interrelated levels. A major argument is Keynesian. It is widely assumed the U.S. policy of reducing government deficits will reduce Japanese aggregate demand. In this view, policy should attempt to offset that contractionary force with a domestic demand expansion. This same argument is sometimes put in terms of Japan's global responsibilities: as the U.S. ceases to be the engine of global growth, some assert that Japan should substitute for the U.S.

Another case sometimes made for domestic-demand-led growth is that Japan is misusing its high savings by investing heavily abroad rather than at home. The argument holds that domestic distortions in the Japanese economy reduce domestic investment (e.g. in housing) and favor foreign investment, even though the social returns of incremental domestic investment would be higher. In this view, greater domestic demand in the form of efficient domestic investment should be encouraged. Yet another argument is that Japan should

reduce its large trade surpluses in order to reduce the risks of protectionism abroad.

There are significant differences of opinion both within Japan and in the rest of the world about the kind of policies that Japan should pursue to spur domestic demand. In part those differences reflect different assessments of the functioning of the macroeconomy, and in part they reflect the fact that there are many differing motivations for wanting to spur domestic demand in the first place. There are three main schools of thought regarding possible policy measures. One view holds that as the U.S. policy mix changes (towards fiscal contraction and monetary ease), and the dollar depreciates, normal market mechanisms will lead to a rise of Japanese domestic demand, even without major policy actions by the Japanese government.[1] A competing view holds that such a market-based expansion would be insufficient to counterbalance a U.S. fiscal contraction, and that Japanese fiscal policy should therefore turn more expansionary, for its own sake and for the rest of the world.[2] A third view stresses the role of microeconomic policy actions in spurring domestic demand. An important argument is that changes in land-use policy (including zoning, land taxation, and import liberalization for foodstuffs) could spur housing demand, and well as investment in nonresidential structures, and thereby overall aggregate demand.[3]

The goal of this paper is to highlight some of the important effects which various policy options, particularily those relating to land-use, might have upon the Japanese economy. The linkages we discuss have not, to our knowledge, been examined in the literature to date, and we consider their potential role from both a theoretical and empirical perspective. The empirical work relies heavily on simulation models of the world economy, and

of the Japanese economy. One contribution of the paper is to illustrate how a multi-sector dynamic model of the Japanese economy can be used to assess the potential role of land-use policy in Japanese demand management. Our contribution here is mostly conceptual, however, since considerable further work will be required to properly incorporate the range of factors which currently affect land-use, in particualr the role of fiscal policy and tax regulations.

The paper is organized as follows. In Section 2, we briefly discuss the reasons for the global trade imbalances in the 1980s, and for Japan's large trade surpluses in particular. The following sections then turn to a multi-sector simulation model of the Japanese economy, in order to evaluate (or at least show how to evaluate) the interactions of land-use measures and the macroeconomic balance. Section 3 considers the theoretical arguments for linking land use, the demand for structures (including housing and nonhousing structures), and the trade balance. Section 4 presents a formal theoretical model, while Section 5 introduces the multi-sector model, and describes some of the simulation results. Since the results are very preliminary, there is ample reason in the concluding Section 6 to suggest future lines of research in this area.

Section 2. Source of Global Imbalances and Japanese Policy Responses

General public opinion makes the fundamental mistake of viewing trade imbalances as a reflection of trade distortions, rather than as a reflection of savings and investment behavior usually unrelated to trade policies. While

we will indeed argue later on that there may be an effect of Japanese trade liberalization on the Japanese trade balance (through effects on savings and investment behavior that are typically neglected), there is little reason to believe that the growing trade imbalances since the early 1980s have been related in any important way with changes in trade policies in this decade. Ample research has stressed several macroeconomic phenomena, rather than trade policies, that adequately account for the growing imbalances.

We enumerate the following major factors.

(1) The Japanese liberalization of the financial markets in the early 1980s, especially regarding international capital movements, which allowed for the relatively free outflow of Japanese excess savings to the rest of the world;

(2) The divergent fiscal policies in the OECD countries, especially the growth of U.S. fiscal deficits and the reduction of fiscal deficits in Germany and Japan; and,

(3) The cutoff in lending to the debtor developing countries, which by forcing a reduction in trade deficits in the debtor countries, resulted in a corresponding increase in trade deficits in the rest of the world.

In Sachs and Roubini (1987), a multi-country simulation model was used to assess, however roughly, the quantitative role of these factors in accounting for the trade imbalances in the United States and Japan. For the U.S. trade balance, the Japanese trade balance, and the Yen-Dollar real exchange rate, the effects of the three factors were quantified, with the results reproduced in Table 1. In each case, the column labelled "actual change" records the change of the variable in 1985 relative to its value on average during 1978-

Table 1. Decomposition of Changes in the External Balance and Bilateral Exchange Rate of the United States and Japan

	Actual Change	Predicted Change	Decomposition of Predicted Change				
			Fiscal Policies:			LDC Lending	Monetary Policies
			US	J	ROECD		
Variable:							
U.S. Trade Balance	-1.9	-1.8	-1.0	-0.2	-0.0	-0.4	-0.2
Japan Trade Balance	3.2	2.8	1.4	1.9	-0.1	-0.6	0.3
U.S.-Japan Real Exchange Rate	24	28	11.8	10.6	-0.0	-0.1	6.6

Notes: The "actual changes" measure the 1985 value of the variable compared with the average value of the variable during 1978-80. The trade balance is measured as a percentage of GNP. The real exchange rate measures the percentage change in the relative CPIs of the U.S. and Japan, corrected for changes in the nominal exchange rate. The positive value signifies a real appreciation of the U.S. of 24 percent. The predicted changes come from a simulation of the McKibbin-Sachs model based on changes in fiscal policies in the the U.S., Japan (J), and the rest of the OECD (ROECD) of the historically observed magnitudes; an exogenous reduction in lending to the LDCs; and offsetting monetary policies in the industrial countries. For details, see Sachs and Roubini (1987).

Source: Sachs and Roubini, 1987

80. In this period, for example, the Japanese trade balance improved by 3.2 percent of Japanese GNP, compared with 2.9 percent predicted by the multi-country model. Of the predicted 2.9 percent accounted for by the model, 1.9 percent of GNP improvement resulted from the Japanese fiscal contraction, 1.4 percent from the U.S. fiscal expansion, 0.3 percent from monetary policies in the various regions, and -0.6 percent of GNP from the cutoff in lending to the LDCs.

The Japanese liberalization of capital movements comes into these estimates indirectly. Sachs and Roubini point out that in the absence of liberalization of international capital movements, the large Japanese trade imbalances could not have occurred. The Japanese fiscal contraction, for example, rather than inducing a capital outflow and a trade surplus, would instead have reduced domestic interest rates in Japan, thereby reducing private savings and increasing private investment. The fall in government dissavings would have then been balanced by a rise in private investment net of private savings.

It is evident from Table 1 that even a complete reversal of the U.S. fiscal policy expansion of the first half of the 1980s would not substantially eliminate Japan's large trade surpluses. This is because those surpluses have resulted not mainly from the U.S. fiscal expansion, but from the contemporaneous Japanese fiscal contraction. According to the model in Roubini and Sachs, each reduction in U.S. government expenditure of 1 percent of GNP (which reduces the deficit by about 0.8 percent of GNP) reduces Japan's trade surplus by 0.4 percent of Japanese GNP. Even a deficit reduction of 3 percent of U.S. GNP (about $125 billion in 1987) would have the effect of reducing the Japanese surplus only by about 1.5 percent of Japanese GNP.

Is there a case then for augmenting a U.S. fiscal contraction with a Japanese fiscal expansion (i.e. to reverse, on both sides, the fiscal events of the 1980s)? On this we are sceptical, at least regards a significant fiscal expansion (Japan introduced a very modest fiscal expansion in 1987, which has probably had a minor stimulative effect).[4] The best possible argument for an offsetting Japanese fiscal expansion is that a U.S. fiscal expansion would have highly contractionary demand effects on the Japanese economy. But the theoretical and empirical evidence on behalf of that proposition is remarkably weak. In Roubini and Sachs it is explained at some length that a policy mix of U.S. fiscal contraction and monetary ease (the present settings of U.S. policy) would likely be stimulative on balance for the Japanese economy, holding fixed the Japanese fiscal policy and money supply.[5] The traditional Keynesian thinking holds that such a policy mix, by weakening the dollar, will tend to depress Japanese export demand, and thereby lower Japanese overall demand. What that analysis underestimates empirically is that the policy mix will also allow for a significant reduction in interest rates, which will spur the non-export portion of Japanese demand. In other words, a tight-fiscal, easy-money policy in the U.S. will automatically spur Japanese domestic demand at the same time that it depresses demand for Japanese exports. In sum, the overall effects of the U.S. policy mix on the level of Japanese output will probably not be large, and may well be positive.

There is a final important point to make in assessing the effects of U.S. policy changes on other economies, such as Japan. The size and even direction of responses outside of the U.S. depend on the nature of wage setting in the foreign economies. In general, the high flexibility of

Japanese labor costs will tend to mute any employment effects of U.S. macroeconomic policy changes. Japanese nominal wages will tend to adjust rapidly to offset any contractionary effects of U.S. policy actions.

The case for a significant Japanese fiscal expansion might still be made, not on aggregate demand grounds, but on the putative urgency of reducing the Japanese trade surplus at any cost. It is indeed true that a Japanese fiscal expansion would have a significant effect in reducing the trade surplus (approximately 0.7 percent of GNP for each 1 percent of GNP fiscal expansion, according to the estimates in Sachs and Roubini, and by a similar amount in the model reported below). But in balancing the benefits of a reduced trade surplus (in terms of reduced international tensions) with the harms of renewed large fiscal deficits, it seems to us that the "cure" of a fiscal expansion could well be worse than the "disease". The same is true of a return to capital controls. A reimposition of capital controls, even with unchanged fiscal policies, could substantially reduce Japan's trade surpluses. Such a policy would prevent further capital outflows, and thereby tend to reduce Japanese interest rates and to spur private investment. But again, there would be high costs (both to the financial sector and to the economy as a whole) of reversing several years of financial liberalization, and the putative benefits of reduced international frictions from a cut in the trade surpluses probably do not justify such a course of policy.

III. Land Use Policies and the Japanese Balance of Payments

Because of the obvious shortcomings of renewed fiscal deficits, or renewed

capital controls, policymakers have been examining other methods of spurring domestic investment (and with less enthusiasm, of reducing private savings). One set of policies, outside of the focus of this paper, involves a possible broad-based tax reform to encourge investment and discourage savings. Another set of policies involves land-use management, with a focus on new means of stimulating housing investment (and perhaps investment in nonresidential structures) by shifting more of Japan's scarce land resources into structures and out of alternative uses.

Japan's land scarcity puts the macroeconomic role of land in Japan into unusual macroeconomic prominence. Land is rarely discussed in macroeconomic models (including, unfortunately, standard macroeconomic models of the Japanese economy), but its central and unique macroeconomic significance in Japan should be noted. Remarkably, as seen in Table 2, the value of claims to land in Japan accounted for about 54 percent of financial wealth in Japan in 1984, as opposed to a mere 24 percent in the United States. The value of land equalled about 317 percent of GNP in 1984, as opposed to 80 percent of GNP in the United States. For this reason, changes in land values should be expected to have major significance for patterns of savings and consumption in Japan.

High land prices mean that a significant proportion of the cost of housing and non-residential investments in structures is due to the cost of the land component of the investment. For all structures (including housing and nonresidential structures), the share of land in the <u>total</u> value of structures (i.e. the sum of reproducible capital plus land) averaged about 71 percent in Japan in 1984 (the data available to us did not allow us to break out housing versus nonresidential structures). In the U.S., this ratio was on the order of 31 percent.[6] In heavily concentrated urban areas, especially in Tokyo, the

land component is far higher. A recent estimate holds that for public investment spending in the Tokyo area, costs of land acquisition account for about 95 percent of project costs.[7]

Such a high share may have profound implications for the effectiveness of fiscal policies. To the extent that bond-financed public investment spending covers mainly the costs of land acquisition, rather than an expenditure on final goods and services, the public spending is really a swap of assets (land for bonds) rather than a purchase of goods and services. The aggregate demand effects of such an asset swap are certainly less stimulative (if present at all) than are the demand effects of a bond-financed purchase of final goods.[8] The price of land has recently had an even more direct effect on macroeconomic policies in Japan, since the Bank of Japan has cited sharply rising land prices in 1987 as a reason to avoid further monetary expansion or further cuts in interest rates.[9]

The argument made for land-use changes revolves around various policies that currently act to raise the price of land for residential housing and business investment in structures, and thereby contribute to a lower flow of structures investment and a lower stock of structures capital. Japan's housing stock as a percent of GNP is also shown in Table 2. It is clear that Japan's stock of physical capital in housing, equal to 53 percent of GNP, and only 9 percent of net worth, is significantly below the shares in the U.S., which are 90 percent of GNP and 27 percent of net worth. The share of housing capital in GNP is also below the ratios in the U.K. and Germany (for which comparable data are available). Interestingly, no shortfall is evident in nonresidential structures: in Japan they equalled 51 percent of GNP, versus 52 percent of GNP in the U.S.There is apparantly a considerable amount of land in

agriculture in Japan that could provide space for housing. Farmland accounts for 19 percent of the total land value in Japan, and much of it is close to urban areas. Tokyo alone has about 130 kilometers square of farmland in the metropolitan area.[10] In terms of total area, farmland accounts for roughly 15% of total land, while housing takes up only 3.8%.[11]

Four kinds of policies are alleged to contribute to the high costs of residential investment. First, protectionist agricultural policies, especially for rice, keep domestic food prices far above world levels, and encourage the use of domestic land for inefficient agricultural production rather than investment in housing and other structures. Approximately half of all Japanese arable land is in rice production.

Second, various tax policies favor the use of land for agriculture rather than for housing. Inheritance taxes on agricultural land are far more favorable than similar taxes on residential real estate. Similarly, property taxes are far higher on residential than on agricultural properties. Another indirect factor comes from the ability of farmers to hide their income more easily than salaried workers. It is often reported in the Japanese press that only one-third of farm incomes are ever actually reported to the tax authorities. These tax differentials of course give the incentive to limit the land available for housing, as well as to maintain employment in agriculture.[12]

Third, various zoning laws raise the amount of land required per unit of housing services, by limiting the development of high-rise units in urban areas that could economize on land requirements. These zoning laws include so-called "sunlight provisions", which ostensibly given homeowners the property right to sunlight and thereby hinder the construction of buildings

that would block the sunlight of existing buildings, as well as archaic anti-earthquake zoning ordinances, that have been rendered obsolete by new construction methods. The result is that Tokyo, for example, is one of the least dense of the very large cities in the industrialized world.

A fourth limitation on land use is the large proportion of land that is held, and not developed, by the government. The Japan National Railway is reported to be the country's largest landowner, with very extensive holdings of undeveloped land. This suggests that a fiscally neutral way to finance future public investment spending could be through large-scale asset sales of public land holdings. The sales would both provide revenues for fiscal expenditure, and also contribute to a rise in housing investment by increasing the available stock of land.

These restrictions on land use are at the center of public discussion, though not yet at the center of technical economic analysis. Several major commissions, including the Maekawa Commission and the Okita Commission, have urged changes in these four policy areas as ways to spur domestic demand and to improve the nation's housing stock.[13] Surprisingly, however, standard macroeconomic models have paid little attention to these possible channels.[14] A complete discussion of the whole range of channels linking land-use policy and macroeconomic performance is beyond the scope of this paper, so the rest of this section is devoted to introducing a simple framework for analyzing a particular set of channels, and the next sections embeds that framework in a large-scale simulation model. It is important to point out that there are many linkages between land-use and tax and trade policies, and that the following discussion is only a preliminary look at the nature and extent of a subset of these linkages.[15]

The key to modelling the land-use issue is to recognize that land is both a critical store of value as well as a factor of production. Moreover, as a factor of production, there are competing demands for land in agriculture, housing, and other commercial and public uses. We will focus mainly on the simple case in which land is used solely for agriculture and housing. In the following sections we explicitly allow for land use in non-residential structures, but for analytical purposes we focus upon this simple case in order to provide the basic intuition into the linkages we wish to discuss.

The total stock of land will be denoted $\bar{L}$, of which L_F is in the food (agriculture) sector, and L_H is in the housing sector. The main analytical point is that changes in land-use patterns between the agricultural and housing sectors affect both savings and investment. A policy of trade liberalization, for example, will depress domestic food prices and thereby reduce the value of wealth in agricultural land. This decline in land values represents an important decline in wealth for consumers, and hence will tend to reduce consumption and raise national savings. On the other hand, the lower land prices will generally reduce the cost of providing housing services (which include both the cost of the land and the physical capital in housing), and thereby stimulate housing investment until the stock of housing reaches a new higher plateau. Thus, both savings and investment tend to rise, with the effect on Japan's overall external balance determined by the change in savings minus the change in investment.

The effect of the various policies upon macroeconomic variables depends crucially upon the wealth effect on savings. The magnitude of the change in total savings will depend upon how large the change in land values actually is, and upon how much individuals adjust savings in response to these changes

in wealth. The change in total land values will depend upon a number of inter-realted issues. In this paper we focus on one linkage: the relationship between the price of agricultural goods and the price of land. Thus any change in the price of food is assumed to result in an equal percentage change in the marginal product and hence value of land. In actual fact there are a number of factors, most notably the tax regulations described above, which could also critically affect the value of land, and which might break the one-to-one link between food prices and land values. In our theoretical model we allow for this in the case where there are lump sum tax subsidies to land, and in the simulation model we make adjustments so that the fall in land wealth is not proportional to the fall in food prices, but further research will be necessary to properly study these other linkages, and we point out that our findings could change substantially once these factors are incorporated.

The effect of the change in land values upon personal savings will depend on the demographic distribution of land holdings and the nature of intertemporal transfers. In an overlapping generations (OLG) model, for example, all assets (including land, housing, equity claims, foreign bonds)[16] are held by the older generation, since the young start off only with their labor income, and accumulate assets over time to finance consumption in old age. Assuming no bequests, the old sell off their assets to young, and use the proceeds to finance expenditures after retirement. In this framework, a decline in land values has a very large effect on consumption, since the old must reduce their consumption <u>one-for-one</u> with a capital loss on land. Thus, if a trade liberalization occurs which depresses farm land prices, the older generation will sharply cut back on consumption. At the same time, the young will neither cut back nor sharply increase their consumption, since their

labor income is not directly affected by the trade liberalization. The result is a significant increase in the national savings rate. Because of the rise in the savings rate, the current account surplus could well increase, despite a significant rise in housing investment in the short term.

Indeed, we will note below that in one important model, an economy starting in current account balance will run a cumulative current account surplus during the adjustment period after a fall in land prices. The investment boom in housing is short-lived, ending once the stock of houses reaches its new plateau. On the other hand, the depressing effect of lower land prices on consumption persists, leading to trade surpluses, and an accumulation of foreign assets. The foreign assets ultimately grow enough in the model below to push consumption back up and to rebalance the current account. Over the course of adjustment, then, the trade liberalization leads to an increase in net foreign assets.

The liklihood of trade deficits immediately following a liberalization of food trade (or other policies that lower land prices) rises with the length of the planning horizon of the households. With long-lived households, the drop in land wealth does not produce a matching one-for-one drop in consumption, but rather a much more modest drop in consumption. The loss of wealth is now smoothed over a very long consumption horizon. For example, an infinite-lived household can maintain a constant consumption stream by always consuming an amount equal to the interest rate times its wealth (i.e. by consuming the income earned on the stock of total wealth). If a component of wealth falls, therefore, complete consumption smoothing would require that the household reduce its spending not by the full amount of the wealth loss (as in the OLG model), but by the interest rate times the wealth loss. Thus, the fall in

national consumption is much lower, the rise in national savings much less, and the chance much greater that the induced rise in housing investment will exceed the rise in national savings.

The long-run effects of a trade liberalization on the net foreign investment position of the economy can be understood in another way. Most models of savings behavior of finite-lived households produce equilibria in which the economy has a fixed steady-state ratio of financial wealth to human wealth. This is because the accumulation of financial wealth comes from savings of the young out of their labor earnings. Financial wealth includes claims on land, housing, and foreign assets. When land values decline because of a reduction of food prices, the value of land in total wealth falls. Assuming that total wealth is unchanged in the new long-run equilibrium (which will be the case if labor earnings are not directly affected by the trade liberalization), the decline in wealth held in the form of land must be balanced by a rise in wealth held in the form of housing and foreign assets. But the value of wealth held in the form of housing is equal to the discounted value of consumer expenditures on housing services, which itself will tend to be a fixed proportion of human wealth assuming that a constant share of spending is allocated to housing. Thus, if land wealth falls, and housing wealth remains unchanged, net foreign assets must rise in order to keep total wealth unchanged. In long-run equilibrium, therefore, the fall in land wealth is balanced by a rise in net claims on the rest of the world. On the transition path, there must be current account surpluses on balance in order to generate the steady-state rise in net foreign assets.

Section 4. A Formal Model of Land Use in the Macroeconomy

Consider the following formal framework, which is the basis of the large simulation model in the next section. The stock of land is distributed between housing and agriculture as previously described:

$$(1) \quad L = L_F + L_H$$

Food is produced using only land (this assumption is made here only for convenience; it is relaxed in the simulation model). Without loss of generality, we normalize units so that one unit of land produces one unit of food:

$$(2) \quad F = L_F$$

For simplicity, the output all other final goods is denoted by Q, and is assumed to be fixed, produced by a fixed stock of labor.

$$(3) \quad Q = \bar{Q}$$

The discounted value of the stream of current and future Q is the value of human wealth in this model. The output Q is used for investment in housing, I; final domestic consumption expenditure C_Q; and exports, X; so that $Q = I + C_Q + X$.

The housing stock (and also the flow of housing services, which is assumed to be a fixed ratio of the housing stock) depends on reproducible capital in housing, K , and land, according to a fixed proportions production technology:

(4) $H = \min [K / u , L_H / v]$

We assume that housing is provided by a housing industry, which purchases the land and makes the capital investment. A unit increase of housing stock requires u units of physical capital, and v units of land, and so has a total purchase price of: $u + v * q_F$ where q_F is the price of a unit of land. Equilibrium requires that the market value of an existing house, q_H, should also equal its reproduction cost. (This arbitrage relationship assumes that there are no costs of adjustment in altering the stock of housing either in a positive or negative direction. In the simulation model, costs of adjustment due to capacity constraints in the construction industry alter the arbitrage relationship slightly.) Therefore:

(5) $q_H = u + v * q_F$

In addition to the problem of adjustment costs, there are several important qualifications that must be made to (5). Most importantly, the model so far assumes that all land is homogeneous, and equally substitutable between housing and agriculture. Land, however, is almost inherently heterogeneous, in that land in different locations will earn differing spacial rents. Land in downtown Tokyo of course greatly exceeds the price of land on the metropolitan fringe. There is another factor of production, location, that earns rents and contributes to the value of houses. Empirically, it will be important to account for those spatial rents. A percentage change in q_F will have a far larger effect on the proportionate change in housing costs in the

fringe than in the city center. We return to the theme of spatial rents in a later subsection.

The price of a unit of land is given by the discounted value of future marginal value products of land in the agricultural sector, plus any subsidies s that might be given to landowners. Each year, a unit of agricultural land earns a rental p_F plus the subsidy s . The price of land is such that the total yield on land (capital gains plus rental yield inclusive of the subsidy) should equal the market interest rate:

$$(6) \quad q_F / q_F + (p_F + s) / q_F = r$$

In a full steady state, with p_F , s , and r all constant, (6) reduces simply to:

$$(6') \quad q_F = (p_F + s)/r$$

Of course the land subsidy would have to be financed through other taxes, T, with a present value $T = (s * F)/r$.

Similarly, the full return on a house should also equal the market return. With rental payments equal to p_H we have the following:

$$(7) \quad q_H / q_H + p_H / q_H = r$$

In a steady state, with p_H and r constant, we have:

$$(7') \quad q_H = p_H / r$$

The model is closed by specifying consumption demand and the market clearing conditions. We use here, without detailed elaboration, the Blanchard model of identical individuals who maximize intertemporal expected utility, subject to the probability p of death each period. When p=0, the model behaves like the case of households with an infinite horizon. When p is close to one, the model behaves more like an overlapping generations model.

Intertemporal optimization leads to a simple formulation for consumer behavior. Each household consumes a constant proportion of its total wealth each period, with the proportion equalling d+p, where d is the subjective rate of time discount:

$$(8) \quad C = (d + p) W$$

We assume that the parameters have values such that: $r > d > r - p$. The first inequality assures that the stock of non-human wealth is positive. The second inequality is made to assure stability.[17]

One criticism of our model specification is that it ignores the possibility of target savings for house purchases. Ito, Hayashi, and Slemrod(1987), amongst others, have discussed how savings in Japan may be artifically high due to credit market imperfections which cause the young to save for large down payments towards housing purchases. Any policy which resulted in a change in the price of a housing unit could in turn affect the steady-state level of wealth by changing the savings of the young for this purpose. Our model, which assumes perfact capital markets, ignores this so-called "house savings" phenomenon. Both the dynamic and long-run effects of changes in the

price of land on savings due to this motive are quite complicated. In particular, they will depend upon the nature of the underlying liquidity constraint, upon the elasticity of demand for housing services, and upon whether or not the optimal timing of an initial purchase changes when housing prices change. The linkage of "house savings" and land values will be considered in future research.[18]

Total wealth, W, is the sum of human wealth, E , foreign assets, B, housing wealth $q_H * H$, and wealth in farmlands, net of taxes T:

$$(9) \quad W = E + B + q_H * H + q_F * F - T$$

Human wealth is just the discounted value of the exogenous output flow Q. A key to Blanchard's model is to note that for an individual agent, human wealth is discounted by (r + p) rather than simply r, since after the agent dies, the flow of labor income associated with the particular agent vanishes. Thus,

$$(10) \quad E = Q/(r + p)$$

We will denote all wealth except E as non-human wealth NE = W - E.

Finally, we divide total consumption among its constituent parts. We assume that households spend a constant share of their consumption on food, housing, and the rest, so that:

$$(11)(a) \quad p_F * C_F = s_F * C$$

$$(b) \quad p_H * H = s_H * C$$

$$(c) \quad C_Q = (1 - s_F - s_H) * C$$

Total exports are given by output Q minus C_Q, minus investment in housing, I. Total imports are simply net imports of food, given by $C_F - F$ (we assume, without loss of generality, that the world prices of Q and F are both equal to 1.0). Thus, the trade balance is given by:

$$(12) \quad TB = Q + F - (C_Q + C_F) - I$$

The overall current account, with equals the instantaneous change in B, is then given by:

$$(13) \quad B = rB + TB$$

We assume perfect capital mobility with the interest rate r fixed exogenously in world markets such that agents can borrow and lend freely at the international rate r, subject only to their long-term budget constraint.

The model is closed with alternative assumptions about the food market. Under conditions of completely prohibited trade in food, as now exists in Japan with respect to rice, the food market must obey $C_F = F$, with the domestic price p_F greater than the world price $p_F^* = 1$. Alternatively, with free trade in food, we must have domestic and world prices equal. Thus, we will use two alternative assumptions:

$$(14)(a) \quad C_F = F \qquad \text{(food autarky)}$$

$$(b) \quad p_F = p_F^* = 1 \qquad \text{(free trade in agriculture)}$$

It is useful to note that under either assumption, the current account equation in (13) can be rewritten as GNP net of total consumption and total investment (the term in parantheses is GNP):

$$(13') \quad \dot{B} = (rB + Q + p_F * F + p_H * H) - C - I$$

To see how to get from (13) to (13'), note that we can add and subtract $p_H * H$ to the right hand side of (13) to obtain as the RHS, $rB + Q + F + p_H * H - (C_Q + C_F + p_H * H) - I$. Then note that $F - C_F$ equals $p_F * (F - C_F)$ under either (14)(a) or (14)(b). Then, we can substitute for $F - C_F$ in the RHS of (13), and replace the sum of the components of consumption by overall consumption C. We thereby arrive at (13').

We now consider a number of alternative experiments. The first is trade liberalization, i.e. a shift from equation (14)(a) to equation (14)(b). Then, we turn to a shift in land taxes and a change in the land-house ratio. In the next subsection we analyze the steady-state implications of these changes, and in the subsequent subsection we examine the dynamics.

Steady-state effects of the policy changes

To understand the workings of the model, note first that there is a fixed ratio of non-human wealth, NE = W - E, total wealth, E, housing wealth, and total consumption spending, C, to Q. These ratios are found by setting the current account equal to zero, and substituting the various values for wealth and consumption. The results are as follows:

$$(15)(a) \quad NE = a_1 * Q$$

$$(b) \quad W = a_2 * Q$$

$$(c) \quad q_H * H = a_3 * Q$$

$$(d) \quad C = a_4 * Q$$

where $a_1 = (r - d)/[(d+p-r)(r+p)] > 0$; $a_2 = a_1 + 1/(r+p)$;

$a_3 = (s_H/r) * (d+p) * a_2$; $a_4 = (d+p) * a_2$

Now note what happens when a trade liberalization occurs. The price of food falls to world levels, and the price of land, which is the discounted value of food prices, also falls in the same proportion. It should be clear from (15) that total wealth and non-human wealth must remain unchanged in the new steady state after the shift in policy. Moreover, the wealth in the housing stock qH * H will also be unchanged, with q_H falling while the physical housing stock H rises. In the new steady state, the decline in land wealth will be matched by a rise in net foreign assets.[19]

To calculate the long-run decline in land wealth, note that the price of a unit of land falls in equiproportion to the drop in the price of food. This causes the value of a housing unit to fall by a smaller proportion, since land constitutes only a fraction of the value of a house. The change in the level of q_H is simply v multiplied by the change in q_F. The change in the quantity of housing is the inverse of the change in q_H, since the product $q_H * H$ does not change. The change in H determines the change in F, since H + F = L. Therefore, we can now calculate the total decline in land wealth, $q_F * F$, since we have derived the fall in F, and know the fall in qF already. The

rise in B in the steady state must match the fall in q_F * F, in order that total wealth remains unchanged.

As we will see in the next subsection, the dynamic adjustment path is more complicated, however, because the shift in policy spurs a rise in the physical quantity of the housing stock and the stock of non-residential structures. At the time of the liberalization, housing investment rises, tending to drive the economy into a temporary current account deficit. The boom in housing is short-lived (indeed instantaneous in this particular model), however, and the economy moves to trade surplus. Thus, the net foreign asset stock initially falls, but then rises again to above the initial level.

In the more carefully specified simulation model of the next section, the investment boom in housing extends beyond the first period. This is because housing investment in the more elaborate model is supplied by a construction industry, that produces houses with a rising marginal cost in the short term. Thus there are "external" costs of adjustment in the short-run housing boom, with the price of housing being bid up by the limited capacity of the construction industry. This short-run rise in construction costs has the effect of spreading out over several periods the adjustment of the physical stock of housing.

We can similarly use the theoretical framework to study the effects of other types of changes in land policy. Consider, for example, a policy of reducing the current tax preferences in favor of agricultural land, which are proxied by the subsidy s in the model. It is simplest to study a reduction of s in the free-trade version of the model, in which domestic food prices are fixed at world levels. In this case, the presence of the subsidy drives up the value of a unit of land q_F in the amount s/r, and thereby drives up the

value of a unit of housing, q_H, since q_H is equal (u + v * q_F).

Since q_H * H is a fixed multiple of Q, the rise in q_H due to the subsidy s must be matched by a fall in the physical housing stock H. Since total land is equal to L = F + v*H, lower H means greater F. In summary, a subsidy to agricultural land raises the price of farmland, and causes a shift in land allocation from housing to farmland.

Note that the subsidy on farm land must be financed with offsetting taxes. Each period the subsidy is s * F, so that the discounted value of offsetting taxes is T = (s * F)/ r . Note that the value of farm land net of taxes is q_F * F - T =

[(p_F + s)/r] * F - (s * F)/r = (p_F * F)/ r. Under free trade, p_F is fixed on world markets.

Now, suppose that s is reduced from a positive level to zero. Clearly, the housing stock H will rise and q_H will fall, with q_H * H remaining unchanged in the new equilibrium. The value of land net of taxes is reduced, since F will fall as H rises. Total wealth must remain unchanged, as do housing wealth and human wealth, while farm wealth net of taxes must fall. Therefore, net foreign assets B must rise. Once again, the shift in policy causes a rise in the physical stock of housing, as well as a rise in the long-run net foreign investment position. The result, therefore, is likely to be a short-run current account deficit as the investment boom in housing takes places, followed by even greater current account surpluses in the future as households rebuild their stocks of wealth.

As a third kind of experiment, consider a shift in zoning which allows for more housing per unit of land. A simple example would be an easing of restrictions on the construction of high-rise apartment buildings. In this

case, the parameter v is caused to fall, since v measures the land input to a unit of housing service. Consider the implications under a free trade regime, in which p_F is fixed on world markets. When v falls, the value of a unit of housing will also decline in the steady state, since $q_H = u + v * q_F = u + v * (p_F / r)$. The fall in q_H results in a rise in H in the long term, since the product of q_H and H are fixed. Therefore, as in the previous example, the land in farms, F, must fall, and the value of wealth in farmland must also decline. The result will be an offsetting increase in B. Once again, the likely time path for the economy will be that the reduction in v is followed by a housing boom and current account deficits in the short term, and a sequence of even larger current account surpluses in the future.

Dynamic Adjustments to the Policy Changes

With a little preliminary rewriting of the equations, the dynamic adjustment process is surprisingly easy to specify. We focus here on the example of trade liberalization. The other cases can be worked out by close analogy. The key is to consider the dynamics of wealth adjustment. Total wealth is equal to $W = Q / (r + p) + q_F * F + q_H * H + B - T$. From the housing arbitrage condition, $q_H = u + v * q_F$, so we can see that $q_F * F + q_H * H = q_F * (F + v * H) + u * q_H = q_F * L + u * H = q_F * L + K$, where L is total land, and K is the stock of housing capital. Moreover, for all of the experiments that we are considering, q_F is fixed (usually at $q_F = p_F^*/r = 1/r$) after the policy change. Thus, we may write:
$W = Q / (r + p) + q_F * L + K + B - T$. Along the adjustment path, the following variables are fixed: Q, r, p, q_F, L, and T. Thus, in rate of

change form, along the adjusment path we have:

$$(16) \quad \dot{W} = \dot{NE} = \dot{K} + \dot{B}$$

At the moment of a policy change, however, W will change discretely when q_F changes discretely. Let $d(W_0)$ signify the discrete change in wealth at the instant of the policy change. At the instant of the change, the only possible wealth effects are the change in q_F and the change in T, since the sum K + B is fixed at any instant. Thus:

$$(17) \quad d(W_0) = d(q_{F0}) * L - d(T_0)$$

(In the trade liberalization example, $d(T_0) = 0$).

Now, turn to the balance of payments condition (15). We know that $Q + p_H * H + p_F * F + rB$ can be rewritten as $r * NE + (r+p) * E$, where NE is non-human wealth and E is human wealth.[20] Then, since $C = (d + p) * W$, we have:

$$(18) \quad B = (r-d) * E + (r - d - p) * NE - I$$

Now, bring I to the LHS of (18), and use (16) to write:

$$(19) \quad \dot{W} = (r-d) * E + (r - d - p) * NE$$

Finally, define $ne = NE - \overline{NE}$, where $\overline{NE}$ is the steady-state value of NE. Then, since E is constant in (19), and since W = E + NE, we can re-write (19)

as:

(20) $ne = -(d + p - r) * ne$

At any instant, the housing market must clear. Since there are no costs of adjustment in housing investment the housing stock can change discretely at any instant in order to maintain housing market equilibrium. This discrete change should be thought of as a very sharp, short-term housing boom, one which would be spread out over time in the presence of costs of adjustment to housing investment. Market clearing in housing requires that $p_H * H = s_H * (d + p) * W$. Moreover, $p_H = r * q_H$, $q_H = u + v * q_F$, and $H = K / u$, so that market clearing in housing requires that:

(21) $K = [u * s_H * (d + p) * W] / [u + v * q_F]$

At the moment of a policy change, both W and q_F fall, and the instantaneouse effect on housing demand is indeterminate. On the one hand, wealth falls, depressing housing demand. On the other hand, the price of housing falls. For a small change in q_F, a simple calculation establishes the following proposition:

The demand for housing rises (falls) on impact as long as the initial value share of land costs in total housing exceeds (is less than) the initial share of land wealth in total wealth.

The condition for a rise in housing demand upon a fall in q_F is almost surely satisfied, since actual data suggests that the share of land costs in housing appears to be well above the share of land wealth in total wealth (<u>including</u>

human wealth). Note that in long-run equilibrium, K must rise after a fall in q_F since the numerator in (21) returns to its pre-policy change level (i.e. W recovers to its initial value) while q_F in the denominator is permanently reduced.

At the moment of the policy change, the housing capital stock changes discretely in the amount $d(K_0)$. How is this discrete change in H financed? The answer is: foreign borrowing, i.e. the country runs an instantaneous current account deficit to finance the jump in K at the moment of the policy change. In particular, we have:

$$(22) \quad d(B_0) = -d(K_0)$$

Along the path of adjustment, wealth rises, and according to (21) so does K. The adjustment path is one of rising K, B, and overall non-human wealth, NE.[21]

We can now finally put the pieces of the dynamics together. Consider the effects of a trade liberalization that reduces p_F from a high, autarky level to the lower world level. On impact q_F falls, and so therefore does overall wealth. ne, which measures the gap between NE and its steady state value, becomes negative. Also, the demand for housing rises instantaneously because of the fall in land costs, and so the housing capital stock jumps discretely at the moment of impact, with the investment boom being financed by foreign borrowing. Over time, non-human wealth NE recovers to its long-run level, as the economy runs current account surpluses, and accumulates net foreign claims B. In the long run, B rises above its initial value. Along this path of

current account surpluses and rising wealth, the housing stock also rises, according to (21).

Some Spatial Considerations

Our model certainly overpredicts the wealth effects of a change in food prices, since land is treated homogeneously, and all land in the economy, whether in an agricultural district or in the Ginza, is assumed to fall in the same proportion. In fact, the value of land in advantageous locations will command a market price above the price available in agriculture, and the proportionate drop in land values will be less than for agricultural land. In this section we talk about some of the implications of introducing locational rents as a way to relax the unsatisfactory assumption of homogeneous land.

Consider the following elementary extension of the model. Suppose that proportion n of the population lives in the central city, and proportion $1-n$ lives in the outside of the city. All farm land is in the outside of the city as well. For the moment, suppose that because of the capacity of public amenities, the placement of job sites, etc., there is no migration of households between the two zones, so that the proportions n and $1-n$ are fixed. The two regions differ only in terms of land availability. In the city, land is fixed at L^C and is used entirely in housing, L_H^C, while in the outskirts, total L is equal to $L^O = L_H^O + L_F$. Urban land is scarce, so that the man-land ratio is much higher than in the outside of the city: $n/L^C >> (1-n)/L^O$. For all of the equilibria that we will look at, we will also assume that $n/L^C > (1-n)/L_H^O$.

Aside from location, all households have identical tastes. In particular,

they allocate an equal share of their consumption to housing. Under these assumptions, the land price in the city will of course be higher than the land price in the outside of the city. In particular, $p_H^C = n * (d + p) * W / (L^C / v)$, and $p_H^O = (1 - n) * (d + p) * W / (L_H^O / v)$, with $p_H^C > p_H^O$. In the outskirts, we have $p_H^O = u * r + v * q_F$, where q_F is the value of a unit of land in agriculture. Note that when q_F changes, say because of a liberalization in trade, only in the outskirts of the city will the price of housing change.

It can easily be checked that all of the earlier conclusions will still apply concerning the constancy of the ratios of Q to all of the forms of wealth. The magnitude of the wealth effects of the policy change will now be considerably smaller, however, because only (1-n) proportion of the population will experience a fall in land prices, and a consequent reduction in housing prices.

Now suppose that there is free mobility across the two regions. Suppose that the urban center is preferred because of amenities (e.g. schools, social services, public transport, etc.). The population will sort itself out until individuals are indifferent to living in the two regions. This will occur when the costs of housing in the urban center are sufficiently above the costs in the outskirts to compensate for the difference in amenities. Now, when agricultural land prices change, land prices both in the city and the outskirts will change, because lower land prices in the periphery will induce out-migration from the center, thereby relieving demand for the scare urban land. It is still probably the case, however, that the proportionate decline in land prices in the outskirts will be higher, and perhaps significantly so, than the

proportionate decline in land prices in the center.

Section 5. Structural Change and the Balance of Payments in A Dynamic Multi-Sectoral Simulation Model

In this section, we attempt to take a step toward empirical implementation of the preceeding model by specifying a more appropriate multi-sectoral simulation model of the Japanese economy. The exercises in this section are still not true "empirical" estimates in the normal sense, however, for two reasons. First, the model itself is in a very preliminary form (we offer it here as a spur to research more than an illustration of finished research). While we a still rather crude attempt to calibrate the model to mimic the Japanese economy, we do not make econometric estimates of the key behavioral relations in the model, but rather make "guesstimates" of parameter values. These guesses must be subjected to statistical scrutiny in later work.

The model that we will describe takes as given the values of key variables in the international economy, especially U.S. interest rates and the levels of output in the U.S., Europe and the developing countries. We are planning in the near future to integrate this model into the multi-country simulation model that we discussed at the beginning of the paper, both to study the effects of foreign policies on Japan, as well as to allow for the effects of Japanese policy on international variables such as U.S.-dollar interest rates.

The model is described in some detail in the appendix. It is a five-sector model of the Japanese economy, focussing on: food, manufacturing, services, durables, and construction. The "durables" sector is a sector that produces

equipment capital for investment, as well as non-housing consumer durables for households. The manufacturing sector includes all manufacturing except that which is produced by the durable goods sector. These sectors each use primary inputs (capital and labor, and land in the case of food and construction) to produce value added, which is then combined with inputs of the other sectors, and with imported intermediate inputs, to produce final outputs. In addition, the agriculture sector and the housing sector use land in producing value added.

An input-output structure among the sectors is specified, with the input requirements depending on relative prices in the economy. The input-output structure works as follows. All sectors use manufacturing and services as intermediate inputs, while food, durables, and construction are not intermediate inputs into the other sectors. The durables sector, as just indicated, produces the good used for equipment investment throughout the economy, as well as the non-housing durables for households. The construction sector produces physical capital for housing, and physical capital for non-residential structures.

The housing sector is specified slightly differently from the preceeding theoretical model, though without important economic effect. In the simulation model, owners of housing physical capital do not own the land under their buildings. Rather, they rent the land each period, at the same rental rate as the land in agriculture. Since the discounted value of those rents is equal to the value of a unit of land, the owners of housing are indifferent to paying a per-period rental (as in this model) or to owning the land, as in the theoretical model of the previous section.

Empirically, we allow for heterogeneity in land holdings by assuming that

land in the urban centers is a fixed constant price above the price of land at the periphery (where the agriculture/housing margin is shifting). Thus, when agricultural land values decline, so to do urban land prices, by the same absolute amount (and obviously, by a smaller proportionate amount). In the calibration of the model, we assume that urban land not at the margin of substitution averages approximately three times the value of agricultural land.

Each of the sectors is assumed to be perfectly competitive, with value-maximizing firms. In each period, the capital stock in the sector is given, though labor may flow freely across the sectors in each period. Thus the wage is equalized across sectors and frictional employment problems resulting from sectoral changes are ignored at this point. The nominal wage is set one period in advance, at a level that in expectation will be compatible with full employment. Thus, in the absence of a contemporaneous unexpected disturbance, employment will always be at the full-employment level. This specification is made to reflect the high degree of flexibility of Japanese labor costs in response to disturbances in the economy, though the assumed flexibility is perhaps too extreme in the current version.

Firms make investment decisions subject to convex costs of adjustment in the firm's capital stock, along the lines of Hayashi (1982). This makes the firm's investment decision a function of Tobin's q, which is the ratio of the firm's equity value to the replacement cost of capital. In this now-familiar specification, shocks to the sector which increase current and future profitability lead to a rise in Tobin's q, which may be thought of as the discounted value of future marginal products of capital, divided by the replacement cost of capital. The rise in Tobin's q then induces an

accumulation of capital in the sector. Over time, as the capital stock increases, there is a decline in the marginal product of capital today and in the future. Tobin's q falls, and the investment boom subsides.

The fact that firms make investment decisions based on rational expectations of the entire time path of future profitability sets this model apart from standard CGE models, which typically specify myopic investment behavior. Sachs has assumed dynamic investment optimization in several earlier simulation models, such as in Lipton and Sachs (1983) and dynamic models of McKibbin and Sachs. Most of those earlier models focussed, however, on the interaction of several one-sector economies. A recent extension of the Tobin's q approach to a one-country model with a multi-sectoral economy is Goulder and Summers (1986), who use the approach to study the effects of U.S. tax code changes on U.S. investment. The present paper is close in spirit to that of Goulder and Summers, though unlike the Goulder and Summers study, our model is a monetary model, and allows for a full linkage of the economy to international trade and capital markets.

We assume that the economy is completely open to international movements of capital, and that domestic and foreign assets are perfect substitutes, in the sense that expected yields on yen and dollar (i.e. international) assets are equalized period to period. The world interest rate in dollars is fixed, so that the period-to-period expected return on domestic assets, when expressed in dollars (i.e. when corrected for expected changes in the exchange rate), is fixed at the international level. All domestic assets are also considered to be perfect substitutes among themselves. Thus, the financial yields on land, housing, domestic equities in each sector, government bonds, and foreign bonds, all have the same ex ante returns in every period. Household

behavior is along the lines of Blanchard(1985), as described in the previous section. Households with a random time horizon, and a fixed probability of death each period, make optimizing intertemporal consumption decisions. Once the total amount of consumption each period is decided upon, the consumption spending is allocated to several final goods according to a Cobb-Douglas utility function. Thus, the share of consumption allocated to the various consumption goods is fixed. The consumption goods are: food, housing, other consumer durables, other consumer non-durables. The other consumer non-durables include domestic goods as well as imported final goods.

Consumer durables are handled in a special way, deserving separate note. We assume that there is a separate consumer durables industry that rents consumer durables (which we define to include housing and all other durables) to the household sector. The supply of durables thus depends on the investment decisions of the durables sector, and the rental rates on consumer durables clear the durables market period to period.

The model is specified in non-linear form, and then numerically linearized around an initial equilibrium. Certain variables are linearized in the levels (generally, output quantities), while other variables are linearized in the logs (in most part, wages, prices, and the exchange rate). This strategy is followed for computational purposes. The linearization helps us to solve efficiently for the rational expectations path of the economy, as well as to calculate optimal policy rules given a prespecified intertemporal quadratic loss function for the economy (However, we do not compute any optimal policy rules in this paper.)

To summarize, the model is an elaborated computable general equilibrium (CGE) models of the Japanese economy, with several features that set it apart

from standard CGE models. First, and most important, it is truly dynamic, with firms and households making dynamic savings and investment decisions based on rational expectations of the future economic environment. In contrast, most CGE models have static decision functions for savings and investment. Second, it gives special focus to the nexus of land in housing and agricultural production, which is the focus of our analysis.

Simulation Results

At this preliminary stage of investigating and calibrating the model, we present only two simulations. The experiment is a liberalization of food imports (as noted earlier, experiments involving land tax changes might be more relevant for the current policy discussions; we will pursue these other simulations in later work). We assume that domestic food prices are 50 percent above world levels, and are kept there by a fully prohibitive tariff. The tariff is then removed instantly and permanently in the first year of the simulation. We study two cases of the Blanchard model: $p = .01$ (expected time horizon = 100 years) and $p = .05$ (expected time horizon = 20 years).

Consider the longer time horizon first, as shown in Table 3. As soon as food imports are liberalized, the price of food in nominal Yen terms falls by 38 percent, while the Yen exchange rate depreciates by 13.4 percent. (The overall effect is a decline in $ prices of 50 percent). Land wealth falls by 38 percent of GNP, and total wealth falls by 29.6 percent of GNP. Since the change in consumption is $(d + p)$ times the change in wealth, with $d=.05$ and $p=.01$, we find a change in consumption of 1.78 percent of GNP. Because of the fall in land prices, value added in agriculture falls by 0.91 percent of GNP. As the housing capital stock rises, further encroaching on land utilization in

Table 3:
Trade liberalization (elimination of 50% tariff on food imports
Blanchard Consumers (ROW)

Japanese Economy					
GNP (output def)	-0.74	-0.93	-1.00	-1.04	-1.08
Consumption	-2.81	-2.20	-2.78	-2.03	-1.92
Investment:					
Equipment	-0.38	-0.35	-0.34	-0.33	-0.33
Structures	1.12	1.09	1.07	1.05	1.03
Housing	0.75	0.73	0.73	0.72	0.71
Government Exp.	0.00	0.00	0.00	0.00	0.00
Exports:					
Goods	1.75	1.73	1.73	1.73	1.72
Services	0.00	0.00	-0.00	-0.02	-0.03
Imports:					
Goods	1.78	1.93	2.05	2.16	2.24
Services	0.00	0.00	0.00	0.00	0.00
Current account	-0.03	-0.20	-0.33	-0.45	-0.55
Savings Ratio	1.48	1.28	1.14	1.00	0.82
Investment Ratio	1.51	1.49	1.47	1.45	1.42
Interest rate nom.	0.04	0.05	0.03	0.02	0.00
Exchange rate	13.09	13.13	13.18	13.21	13.23
Price of food	-36.91	-36.87	-36.82	-36.79	-36.75
Price of land	-40.72	-40.44	-39.86	-39.16	-38.35
wealth:					
human wealth	-2.69	-3.18	-3.50	-1.73	-0.91
Land	-37.33	-37.26	-36.79	-36.18	-35.49
Other wealth	3.22	3.64	3.94	4.18	4.30
Total wealth	-36.76	-36.73	-35.35	-33.80	-32.20
Sector VA:					
Agriculture	-0.91	-1.22	-1.48	-1.70	-1.87
Manufacturing	0.25	0.32	0.35	0.37	0.39
Services	0.05	0.19	0.24	0.28	0.33
Durables	0.13	0.24	0.27	0.28	0.30
Construction	0.45	0.49	0.51	0.52	0.54
Total	-0.03	0.07	-0.03	-0.10	-0.15

Notes to tables:

1) All variables unless otherwise stated are recorded as deviations from baseline measured in percentage units of GNP.Nominal values have been deflated by the gross output deflator.All prices and exchange rates are recorded as percentage deviation from baseline.Interest rates show deviations of percentage values.Value added is shown as deviation from baseline of actual quantities in percentage units of GNP.

agriculture, the agricultural output falls further, reaching a decline of 1.84 percent of GNP by the fifth year.

The decline in consumption causes savings to rise, in this case by 1.11 percent of GNP. At the same time, though, there is a significant increase in structures investment, both in housing and in non-residential structures. The overall investment ratio rises by 1.09 percent of GNP in the first year, and remains at 1.11 percent of GNP above baseline for the following few years. Note that the savings rate begins to fall in the second year, so that the rise in investment exceeds the rise in savings, thereby sending the current account into deficit. By the third year, the current account deficit is about 0.3 percent of GNP relative to the baseline, and by the fifth year the current account deficit is about 0.5 percent of GNP relative to the baseline.

Unlike the theoretical model, there is no one-time boom in housing or structures. Because the construction industry is only about 10 percent of GNP, the rise in structures investment of about 1.4 percent of GNP is a significant increase in output in the industry, which strains its capacity, causing the investment boom to be spread out for several years.

Finally, notice the sectoral distribution of output in the years following the shock. Naturally, the agricultural sector is the big loser, with a very sharp drop in output. All other sectors show some increase in output, with construction showing the biggest gain in value added originating.

The simulation in Table 4 carries out the same exercise but with shorter-lived households. We expect from the theoretical discussion that the wealth effect of the land decline will hit consumption harder in this case, with the result that the rise in savings should be larger. In fact, there is now a 1.7 percent of GNP increase in the savings rate in the year of the shock, which

Table 4:
Trade Liberalization (Elimination of 50% Tariff on Food)
Blanchard Consumers (σ=1.0)

Japanese Economy					
GNP (output def)	-1.08	-1.23	-1.37	-1.47	-1.55
Consumption	-3.11	-3.13	-3.08	-2.99	-2.76
Investment:					
Equipment	-0.30	-0.28	-0.27	-0.27	-0.26
Structures	1.10	1.09	1.07	1.06	1.04
Housing	0.66	0.65	0.66	0.66	0.67
Government Exp.	0.00	0.00	0.00	0.00	0.00
Exports:					
Goods	2.15	2.09	2.07	2.04	2.02
Services	0.00	0.03	0.06	0.07	0.08
Imports:					
Goods	1.55	1.71	1.84	1.95	2.04
Services	0.00	0.00	0.00	0.00	0.00
Current account	0.60	0.42	0.29	0.17	0.06
Savings Ratio	2.10	1.90	1.77	1.64	1.52
Investment Ratio	1.50	1.48	1.47	1.47	1.45
Interest rate nom.	-0.16	-0.15	-0.16	-0.17	-0.18
Exchange rate	16.04	15.88	15.73	15.56	15.39
Price of food	-33.96	-34.12	-34.27	-34.44	-34.61
Price of land	-37.46	-37.43	-37.04	-36.50	-35.86
Wealth:					
Human Wealth	-0.71	-1.63	-1.67	-1.58	-1.44
Land	-34.55	-34.73	-34.39	-33.91	-33.33
Other Wealth	4.14	5.08	5.89	6.58	7.15
Total Wealth	-31.12	-31.28	-30.18	-28.91	-27.61
Sector VA:					
Agriculture	-0.84	-1.14	-1.40	-1.61	-1.78
Manufacturing	0.26	0.32	0.35	0.37	0.38
Services	-0.05	0.05	0.10	0.14	0.19
Durables	0.20	0.32	0.35	0.36	0.37
Construction	0.44	0.47	0.50	0.52	0.53
Total	0.01	0.06	-0.03	-0.11	-0.15

now significantly exceeds the investment buildup. The current account thereby moves into surplus. Note, importantly, that the size of the investment boom is very close to the earlier simulation. The Blanchard parameter p does not importantly affect the speed or size of the investment buildup, only the size of the decline in consumption following the fall in land prices.

Section 6. Conclusions and Extensions

The taking-off point for this paper is the current Japanese policy goal of stimulating domestic demand. That policy aim has several motivations: (1) to counteract contractionary effects of a shift in the U.S. policy mix towards fiscal contraction and monetary ease; (2) to reduce Japan's trade surplus in order to reduce protectionist pressures in the rest of the world; and (3) to rectify distortions in the Japanese economy that give advantage to foreign investment over domestic housing investment. We argued in Section 2 of this paper the Keynesian case (argument 1) for a policy-led demand expansion is rather weak empirically and theoretically. The shift in the U.S. policy mix is unlikely to have highly deflationary consequences for the Japanese economy; indeed the changes could well be expansionary. We also noted, however, that even with a substantial shift in the U.S. policy mix, Japan's external surpluses were likely to remain large. Therefore, if there is indeed a pressing case for reducing those surpluses, further policy actions would likely be necessary. We pointed out two actions that would almost surely be effective, though perhaps at high cost: a return to the large budget deficits of the late 1970s, and a return to capital controls. The unattractiveness of these measures has led policymakers to consider additional ways to spur

private investment, particularly housing investment.

These possible measures, involving changes in land-use policy, are the focus of sections 3 and 4 of the paper. Several kinds of policy measures were considered: (1) trade liberalization in foodstuffs; (2) changes in zoning ordinances; and (3) changes in the tax treatment of agricultural and housing real estate. We introduced a theoretical model to study the interactions of land, savings, and investment. The purpose of this model was to emphasize a number of linkages which are particular to Japan, and could have important implications for the effects of policy upon the Japanese economy. The key point from this discussion is that these policies have effects both on investment and savings, often with indeterminate signs. In general, policies that reduce agricultural land values tend to raise savings, the external surplus, and the net foreign investment position, while at the same time such policies tend to raise housing invesment, thereby lowering the external surplus and the net foreign investment position. In the models that we studied, the housing effect is necessarily short-lived. In the long run, the savings effects dominate. Most of the policies considered that would contribute to a short run housing boom would also lead to current account surpluses in the longer term, and an actual increase in the economy's net foreign asset position. We emphasize that these results are derived from a highly stylized model of the Japanese economy, and that more definitive results could only be obtained by carefully examining the other important linkages which we have discussed above, but have not chosen to focus on in this paper.

A multi-sectoral simulation model was then introduced, to begin the process of quantifying some of these effects. We stressed the rudimentary nature of

the empirical estimates, but presented them both to give an order of magnitude and to encourage further empirical investigation of these issues. We noted that the size of the current account effects from the policy changes depends importantly on the nature of intertemporal consumption behavior. The more short-lived are the horizons of households, the more likely it is that a reduction of land prices would produce a rise in the external surplus, rather than the fall that is goal of the policy.

Let us conclude with several observations about the research agenda in this area. In our view, it will be fruitful to proceed with a more careful quantification and specification of a model like that presented in Section 4. Most importantly, we need to broaden the scope of our theoretical work in order to determine the relative importance of the various tax and trade policies in maintaining the high price of land. In empirical work, much more information must be included about the patterns of land use in Japan, and the technical tradeoffs between alternative uses of land. Even rudimentary information such as the average ratios of land to fixed capital in various uses should be investigated more fully. Also, the response of that ratio to relative price changes should be examined econometrically.

It should be possible to test directly for the effects of land prices on the cost of housing and on the demand for housing. Moreover, the links of land prices to agricultural policies could also be studied fruitfully. The extraordinary premium of rice prices above world market levels is a relatively recent phenomenon, dating back to the late 1960s, when the regulations involving price maintenance for rice were changed. From the early 1960s to the late 1960s the premium of the domestic price of rice over the import price of rice rose from about 20 percent to more than 100 percent.[22] It should be

possible to study the effect of this policy change on contemporaneous land prices and land use patterns. Another area where quantification is importantly needed is on the effects of tax policies on land allocation decisions. Little seems to be known rigorously about the overall effective tax rates on the different uses of land.

The model has so far neglected various potentially important linkages of housing investment with other forms of spending, that could significantly affect the quantitative estimates. Various kinds of consumer durables expenditures, such as on furniture and household appliances, are complementary with housing investment. It is widely believed that Japan's relatively low stock of housing relative to income is matched by a low supply of other consumer durables relative to income. Indeed, an important reason for the difference in U.S. and Japanese household savings rates is the fact that American households save a much larger share of income in the form of consumer durables (which typically gets counted as part of consumption rather than savings). To the extent that a decrease in land prices stimulates housing demand, it is likely that it would also stimulate the demand for other consumer durables, thereby increasing the liklihood in the short run of a significant reduction in the external surplus. Similarly, one presumes that many forms of public investment spending (e.g. on sewage and roads) should also rise in tandem with a housing boom. These complementarity effects in private demand can be investigated through empirical estimation of consumer demand systems.

A further major area for empirical investigation is the fiscal implications of the land-use policies. The current policies of high internal price support for food, for example, have large direct budgetary consequences. A reduction

of such price supports would not only lower internal land prices but also free up government resources for public investment spending. (In our theoretical model, we assumed that reduction in subsidies s were matched by reductions in taxes T; alternatively we could have allowed for reductions in s to finance increases in public sector investment). Similarly, land sales by the government would probably reap enormous revenues, that could also provide the fiscal base for higher public investment spending.

An important theoretical area that should be investigated further involves the welfare and distributional implications of alternative policy changes. One of the motivations for many of the proposed changes in land-use policy is the current market distortion against housing investment. How large are the welfare costs of such distortions, and how would the welfare of different generations and different sectors be affected by elimination of those distortions?

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Table 2. Value of Land and Structures in Japan and the United States, end-1984, $ billion (calculated at Y251 = $1)

	Japan	United States
Value of Land	3690	2896
-- as percent of GNP	317	79
-- as percent of net worth	54	24
Value of Farm land as percent of total land	19	18
Value of Residential Structures	616	3308
-- as percent of GNP	53	90
-- as percent of net worth	9	27
Value of Non-Residential Structures	594	1902
-- as percent of GNP	51	52
-- as percent of net worth	9	16
Percent of Non-Farm Land Value in Total Value of Structures	71 [a]	31
Memo Items:		
GNP	1160	3662
Net Worth	6827	12091

a For Japan, the measure is the ratio of the value of "land under buildings" divided by the sum of the land value and the net fixed capital stock in structures. For the U.S., the measure is the value of non-farm land divided by the sum of the value of non-farm land and the net fixed capital stock in structures.

Sources: For Japan, "Closing Stocks of Assets and Liabilities by Institutional Sector (1982-1984)", Statistical Yearbook of Japan, 1985, p. 563. For the U.S., "Balance Sheets for the U.S. Economy, 1947-86, Board of Governors of the Federal Reserve System, May 1987; and "Summary of Fixed Reproducible Tangible Wealth Series, 1925-86", in Survey of Current Business, November 1987, p. 36

1. See for example M. Yoshitomi (1986).

2. Bergsten and Cline contended in late 1985 that "Japan, as the second largest economy in the world and perhaps the major beneficiary of an open trading system, must alter its fiscal policy substantially and go the extra mile to deal with the criticisms so widely leveled against its trade policies." See Bergsten, C. F. and W. R. Cline, "The United States - Japan Economic Problem", Institute for International Economics, No. 13, October 1985, p. 129. More recently, Marris has argued for a Japanese fiscal expansion: "Europe and Japan have not yet taken expansionary fiscal policy action on the scale needed to offset the inevitable negative drag on their growth as the US trade deficit is eliminated." In Marris, S., "Deficits and the Dollar Revisited", Institute of International Economics, August 1987, p. 39.

3. The role of structural policy measures, especially in the area of land use, has been a major point of emphasis in several important commissions in Japan, including the Okita Advisory Committee for External Economic Relations, April 1985, and the two reports of the Maekawa Commission.

4. According to OECD estimates, the 1987 fiscal expansion amounted to approximately a 0.3 percent of GNP rise in the structural deficit in Japan. Some commentators have attributed Japan's recent rise in domestic demand to this modest stimulus. In our view, more of the explanation lies in: (1) falling real interest rates; (2) rising household wealth; (3) the terms of trade improvement in Japan following the 1986 decline in oil prices, which only recently have been passed on to consumers.

5. This calculation is based on the assumption that Japan pegs the money supply, and not the interest rate. The U.S. policy mix causes Japanese short-term interest rates to fall. If Japan instead pegged the interest rate, it might choose to reduce the money supply in response to the U.S. policy measures, and this could turn the mildly stimulative effect into a mildly contractionary effect.

6. The U.S. number probably overstates the land share of value, since the 31 percent is estimated as the total value of non-farm land in the U.S. divided by the sum of this value plus the value of net structures. Some of the land counted in this ratio probably includes land that is not associated with structures. The 35 percent estimate is taken from a study of Hayashi, Ito, and Slemrod (1987), who cite a 1982 survey of the ministry of construction.

7. Cited in The Economist, "Japan Survey", December 5, 1987, p. 31

8. To the extent that land and government bonds are highly substitutable financial assets in private portfolios, and to the extent that government purcahses of land have little affect upon the price of land, a bond-financed purchase of land would have little effect on aggregate demand.

9. The price of housing land in Tokyo rose by about 95% in 1987, prompting protests at the Bank of Japan's low interest rate policies, which were accused of fueling land speculation. In all of Japan, land prices rose only by about 7%, however. (Data from The Economist, December 5, 1987)

10. See the Economist, "Japan Survey," December 5, 1987.

11. From personal correspondence with Mitsuhiro Fukao, Bank of Japan. The majority of the remaining land (67% of total area) is covered by forests.

12. Roughly 10% of the labor force is reported to be employed in agriculture, a much higher number than in other OECD countries, though part of the discrepancy is due to the large number of Japanese whom report they are part-time farmers in order to take advantage of certain fiscal benefits.

13. The interim report of the Maekawa Commission made the following observations: "2.4.1 The Enhancement of housing and social stock crucially hinges upon the solution of land problems; in particular, the promotion of land supply is indispensable. 2.4.2 there is an urgent need to undertake far-reaching measures in large urban areas in order to ensure the promotion of the orderly supply of housing land and the stability of land prices. 2.4.3 In so doing, it is necessary to implement specific policies with special attention to: a. the redistribution of space (e.g. easing regulations and restrictions regarding the landfill reclamation of public waters, promoting the conversion of paddy land to other uses in urbanization promotion areas, and reviewing zoning regulations), b. the intensive use of land (e.g. easing regulations regarding on total floor space and promoting urban redevelopment work to meet the need for more offices and other commercial sites), c. the greater use of unused or under utilized sites (e.g. promoting the more efficient use of government- and corporate-owned sites and encouraging the conversion of abandoned plant sites to housing sites), d. the utilization of new modalities of housing land supply (e.g. formulas allowing joint-use with the landowner, including land trust formulas and tenancy formulas), e. the utilization of tax policy to promote the supply of housing land (e.g. strengthening the application of taxation on agricultural land in urbanization promotion areas to more approximate tax rates on residential land), and f. the stabilization of land prices (e.g. utilizing the National Land Use Planning Act and levying higher tax rates on very short-term real estate trading).
Quoted from the Interim Report, Special Committee on Economic Restructuring (Chairman: Haruo Maekawa), December 1, 1986.

14. One interesting preliminary attempt to quantify the potential effects of the Maekawa Commission recommendations is Takenaka and Ishii (1987). This otherwise informative study does not, however, attempt to explain the precise economic channels through which the Maekawa recommendations would operate.

15. It is useful to make a small point about the political economy of land use in Japan. There are important and well known political explanations for the current land use policies in place. The ruling Liberal Democratic Party is has long derived important support from rural areas, which are disproportionately represented in the Japanese Diet. Agricultural groups

contribute heavily to political campaigns, and spend considerable sums in political lobbying. Many of the policy changes that we will consider would be difficult to carry out politically. Our focus in this paper is on the economic implications of various possible policy changes, and not on the liklihood of their implementation.

16. Throughout the paper we assume that individuals are able to "pierce the corporate and fiscal veil". Given that a large amount of land in Tokyo, and elsewhere in Japan, is owned by the corporate and public sector, we are assuming that the fall in these land values will be reflected in stock prices and future tax liabilities, and individuals will fully perceive these changes in total wealth.

17. See Matsuyama, K. "Current Account Dynamics in a Finite Horizon Model," Journal of International Economics, November 1987, pp. 299-314, for further details on the open-economy version of the Blanchard model.

18. In a simple economy where expenditure shares remain constant, i.e. a case where consumer demand functions are Cobb-Douglas, and where the liquidity constraint requires that agents pay a fixed proportion of the total cost of a house as a down payment, then the steady-state expenditure on housing would not change as long as steady-state income did not change. If the policy considered had no effect upon the nature of the liquidity constraint in the housing market, than, in a model such as ours, the steady-state level of aggregate wealth in the economy would be unaffected.

19. We assume throughout the text that the equilibrium is an interior solution where some land is used in the agricultural sector so that the marginal product land is determined by the price of food.

20. This is because $rB + p_H * H + p_F * F = r[B + (p_H/r)*H + (p_F/r) * F] = r * NE$, while $Q = (r+p)*E$.

21. Note that from (16) and (21):

$$\dot{K} = [\, u * s_H * (d+p)] \, (\dot{K} + \dot{B}) / [\, u + v * q_F \,] \, .$$

Therefore, we see that:

$$\dot{K} = n * \dot{B} \quad \text{where} \quad n = [u*s_H*(d+p)]/[u+v*q_F - u*s_H*(d+p)]$$

It is easy to show that the denominator in the RHS of the expression for n is positive. Therefore, since the change in W is equal to sum of the changes in K and B, we have:

$$\dot{K} = [n/(1+n)] \, \dot{W}$$

$$B = [1/(1+n)]\ W$$

22. For an excellent discussion of the politics and economics of Japanese rice policies historically until 1980, see the studies by Hayami (1972), and Otsuka and Hayami (1985).

Appendix 1

Japan Multi-Sectoral Model

The simulation model described here is a dynamic, muti-sectoral CGE model of the Japanese economy. The structure of the model is similar to the McKibbon-Sachs global model: all agents are rational and decisions are made with perfect foresight based upon intertemporal maximization of utility and profit functions. A major advantage of this model over other CGE models is that resources are allocated among sectors by forward-looking, profit-maximizing firms. Thus it is well suited for the analysis of the impact of various types of tax policy changes upon the Japanese economy.

There are five produced goods, including two types of capital inputs, and five consumption goods. The consumption goods are purchased by individuals, the government, and foreigners. Capital goods are used for investment and are exported. Two non-produced goods, energy and raw materials, are imported along with other producer inputs and consumption goods.

Private consumption is determined by a representative agent's maximization of a utility function. Intertemporal consumption is allocated according to standard additively separable utility functions with the utility level each period given by a log utility function. This implies that total consumption each period will equal the consumer's rate of time preference (plus an adjustment for mortality) multiplied by total wealth. The within-period allocataion of consumption among goods is determined by a Cobb-Douglas utility function. There are five goods and services bought by consumers: services, food, housing, other durables and other non-durables. The two consumer durables, housing and other durables, are assumed to provide service flows in proportion to the existing capital stocks. In both cases the goods are rented each period, and there are no adjustment costs to households in changing their rentals. Investment demand for housing, structures and equipment is determined from Tobin's q-equations in the supply-side of the model as described below. The government purchases goods and services directly from each producing sector, and may also hire labour and import goods. Government expenditures are assumed to be a fixed, exogenous share of Japanese GNP. All imported goods apart from food are assumed to be imperfect substitutes with

domestic goods, and import shares of total consumption expenditures are determined using Cobb-Douglas utility functions. The demand for exports by foreigners is determined by demand equations with unitary price elasticites, and foreign expenditures on the Japanese good are assumed to be fixed in foreign currency.

The supply-side of the model is structured similarly to an input-output table with each sector linked to other sectors through the purchases of intermediate inputs and capital. There are five producing sectors: food, manufacturing, services, durables and construction. Each sector purchases manufactures and services as intermediate inputs, and uses durables and the construction good in order to install equipment and build structures. Intermediate inputs can also be imported as imperfect substitutes from abroad. The value of import shares are calculated from the production functions. All production functions have a nested Cobb-Douglas form, and each sector uses three non-produced inputs: labour, raw materials and energy. The agricultural sector, as discussed below, also uses land as a non-produced input. We assume there are adjustment costs to capital accumulation, in order to derive investment demand equations. This implies that there will be short-run supply constraints in each industry.

The construction of housing and structures receives special treatment in this model. Housing is assumed to be built using fixed proportions of land and the construction good. The arbitrage condition for housing construction requires that the cost of the input of land and the construction good identically matches the discounted value of future rents on housing. The rental price of a house is determined by inverting the consumer's demand equation, and construction is assumed to occur with a one-period lag. Supply constraints upon the production of housing occur due to the upward sloping short-run supply curve in the construction industry. Structures are also assumed to combine a fixed proportion of land per unit of the construction good. Investment in structures in each industry is determined using q equations which equate the present discounted values of the marginal product of structures with the discounted cost of the required rents on land and payment for the construction good. It is important to recognize that for both industries, the rise in investment after a fall in land prices will be directly related to the marginal input of land required with each additional unit of structures or housing.

Wealth in this model consists of net human wealth (the present discounted value of wages minus lump-sum taxes), equity in firms, the stock of housing, the stock of consumer durables, government bonds, the value of land and net foreign assets. All assets in the model are perfect substitutes and arbitrage equations determine their current values. Financial capital is assumed to be perfectly mobile across countries and the exchange rate adjusts so as to satisfy the interest arbitrage equation. The world rate of interest is exogenous.

In order to close the model, prices in each sector adjust so that aggregate supply equals aggregate demand. The world price of imported inputs are assumed to be fixed in dollars, and the yen prices adjust with the yen-dollar exchange rate. The supply of labour is exogenous, and contracts for nominal wages are signed such that the labour market clears, in expectation, one period ahead. Labour supply is perfectly elastic in the current period at the current nominal wage, so that contemporaneous unanticipated shocks will affect current employment (though employment after the first year will not affected). The rental price of land is determined as the marginal product of land in agriculture. The land usage in agriculture is determined by subtracting land usage in housing from total land available. All stock and wealth variables in the model are adjusted for current flows. The domestic nominal interest rate is determined by inverting a Goldfield money demand equation and setting the money supply as exogenous. In this version of the model, all government spending is financed through bond issue and lump-sum taxes.

The equations of the model are non-linear. In order to solve the model we first linearize each equation around steady-state values of the variables, and then using the techniques described in Oudiz and Sachs (1985) we solve for the unique stable manifold. The conditions for stability of models can be checked numerically. In practice we have found no difficulty with instability.

The initial parameterization of this version of the model was calculated using Japanese input-output tables and financial data from the Japanese Statisctical Yearbook :1985. Modifications to the input output tables were made in order to accomodate the structure of intermediate inputs in our model. Most notably, producer durables, and food are assumed to not be used as intermediate inputs in production. Likewise the addition of land as an input

to housing and agriculture required that we adjust value added in the relevant sectors accordingly. Each consumption good was assumed to be composed only of the good from the relevant producing sector. Thus, for example, consumption of services was set equal to the total consumption expenditures on the services industry as reported in the input-output table. The input-output table, the allocation of consumption expenditures and wealth values are shown in Tables A1-A3. Appendix 2 briefly outlines the behavioural equations and permits the reader to examine the initial paramterization of some of the key equations.

The model is specified with an exogenous rate of Harrod neutral technical progress and can accommadate a risk premium on all assets. In order to mimic the Blanchard model we chose a discount rate for consumption equal to 5%, and a probabiltiy of death equal to either 0.01 or 0.05 depending upon the simulation.

Table A1: Japanese Input-Output Data

	Food	Manuf	Servi	Durab	Const	House	Total
Food	0	0	0	0	0	0	0
Manufactures	.001	.268	.109	.042	.067	0	.498
Services	.002	.098	.219	.017	.041	0	.399
Durables	0	0	0	0	0	0	0
Construction	0	0	0	0	0	0	0
Raw materials	.001	.006	.003	.002	.002	0	.014
Energy	.002	.037	.006	.010	.013	0	.068
Total intermediate	.039	.409	.337	.071	.123	0	.979
Wage bill	.027	.119	.336	.079	.079	0	.640
Capital: Equipment	.020	.013	.035	.007	.007	0	.082
Structures	.000	.016	.042	.009	.009	.053	.129
Land	.020	.014	.036	.007	.007	.067	.151
Value added	.067	.162	.449	.102	.102	.120	1.002

	Consumption	Invest.	Govt.	Exports	Imports	GDP
Food	.100	0	0	0	-.030	.07
Manufactures	.058	0	.002	.046	-.016	.09
Services	.300	0	.102	.028	-.010	.42
Durables	.016	.065	.013	.068	-.010	.15
Construction	0	.140	.080	0	0	.22
Housing	.120	0	0	0	0	.12
Raw Mat + Energy	0	0	0	0	-.082	-.08

Table A2: Division of Private Consumption Expenditures

	% of GNP	Share
Consumption Expenditures:		
Food	10.0	16.8
Housing	12.0	20.2
Services	30.0	50.4
Other consumer non-durables	5.8	9.7
Consumer durables	1.7	2.9
Total	59.5	100.0

Table A3: Initial Values of Asset Variables

Wealth		
Human (p=.01)	754.5	62.3
Financial:		
Capital	88.7	7.3
Housing	68.4	5.6
Land	300.2	24.7
Foreign Assets and Govt bonds	0.0	0.0
Consumer Durables	3.2	0.2
Total Financial	457.5	37.7
Total	1212.0	100.0

APPENDIX 2

Outline of Simulation Model Specification and Parameterization

The following is an outline of the behavioural equations of the simulation model discussed in the text. The purpose of this section is to permit the reader to examine the parametization and specification of key equations. A discussion of the remaining equations and the general framework of the model is given in Appendix 1.

Consumers

Total consumption in terms of the deflator is given by:

$$C = (d + p)(H + W)$$

where
- C: real consumption expenditures
- H: human wealth
- W: non-human wealth
- d: consumer's rate of time preference
- p: probability of death.

Total consumption is allocated amongst the various consumption goods via the following set of nested CES utility functions which are maximized subject to the given budget constraint:

$$C = \max_{F,NF} [\alpha_1 F^{B_1} + (1-\alpha_1)NF^{B_1}]^{1/B_1} \quad \text{st: } P_F F + P_{NF} NF = P_C C$$

$$NF = \max_{CD,OD} [\alpha_2 CD^{B_2} + (1-\alpha_2)ND^{B_2}]^{1/B_2} \quad \text{st: } P_{CD} CD + P_{ND} ND = P_{NF} N_F$$

$$CD = \max_{H,OD} [\alpha_3 H^{B_3} + (1-\alpha_3)OD^{B_3}]^{1/B_3} \quad \text{st: } P_H H + P_{OD} OD = P_{CD} CD$$

$$ND = \max_{S,DND} [\alpha_4 S^{B_4} + (1-\alpha_4)OND^{B_4}]^{1/B_4} \quad \text{st: } P_S S + P_{OND} OND = P_{ND} ND .$$

where
- F: consumption of food
- NF: index of non-food consumption
- CD: index of durables consumption
- ND: index of non-durables consumption
- H: housing stock proxying for housing services
- OD: other durables stock proxying for other durables services
- S: index of consumption of services
- OND: index of consumption of other non-durables
- P: the relevant price index or rental cost

Division of Consumption Between Imports and Domestic Goods

Consumption of tradeable goods is allocated between domestically produced and imported versions via the following Cobb-Douglas function:

$$C_i = \max_{D_i, M_i} D_i^{r_i} M_i^{1-r_i}$$

$$\text{subject to } P_i^D D_i + P_i^M M_i = P_i^C C_i$$

where i = 1 services
2 other non-durables
3 other durables

C_i: consumption of good i as derived above

D_i, M_i: consumption of domestically produced and imported version resp.

P_i^D, P_i: price of domestically produced and imported version resp.

Production Functions

$$Y_i = a_i L_i^{\theta_{i1}} KS_i^{\theta_{i2}} KE_i^{\theta_{i3}} M_i^{\theta_{i4}} S_i^{\theta_{i5}} RM_i^{\theta_{i6}} E_i^{\theta_{i7}} LD_i^{\theta_{i8}}$$

i = 1: agriculture
2: services
3: manufacturing
4: producer durables
5: structures

Y: production in sector i
L: labour input in sector i
KS: capital stock - structures - in sector i
KE: capital stock - equipment - in sector i
M: inputs of manufactured good in sector i
S: inputs of services in sector i
RM: inputs of raw materials in sector i
E: inputs of energy in sector i
LD: inputs of land in sector i.
a: constant term

$$\sum_{j=1}^{8} \theta_{ij} = 1 \qquad \theta_{ij} \geq 0 \qquad \forall\ i,j$$

Factor inputs are determined by setting the marginal product of each input equal to the cost of the input. Note that land used for structures is implicitly included in the value share parameter θ_{i2}.

Investment and Tobin's Q Equations

Investment in each sector is determined by Tobin's q equations where:

$$qs_i = \left[\sum_{j=t}^{\infty} \left(\frac{\partial Y_i}{\partial KS_i}\frac{P_i}{DEF}\right)_j ((1+r)(1+\delta_j))^{-(j-t)}\right]\frac{DEF_t}{PKS_t}$$

$$\dot{KS}_i = (\delta_s + \frac{(qs_i - 1)}{AS})KS_i$$

Likewise for qe_i and $\dot{KE}_i$.

where qs_i, qe_i: Tobin's q for structures and equipment resp.

$\delta s, \delta e$: rate of economic depreciation of structures and equipment

AS, AE: adjustment cost parameters for structures and equipment

KE, KS: gross investment in structures and equipment

r : the real interest rate (time dependent in simulations)

Imports of Intermediate Inputs:

Intermediate inputs of manufacturers, services and producer durables may be imported or purchased from domestic producers. These are allocated between imports and domestic goods by maximizing 2-level Cobb-Douglas functions which determine the an input index, subject to the given budget constraint:

$$S_i = DS^{r_5} MS^{r_5} \qquad \text{st } P_{DS}DS + P_{MS}MS = P_S S_i$$

$$M_i = DM^{r_6} MM^{1-r_6} \qquad \text{st } P_{DM}DM + P_{MM}MM = P_M M_i$$

$$\dot{KE}_i = DE^{r_7} ME^{1-r_7} \qquad \text{st } P_{DE}DE + P_{ME}ME = P_P\dot{KE}$$

where: DS,DM,DE: domestically produced services, manufactures, and producer durables
MS,MM,ME: imported produced services, manufactures, durables
P_{DS}, P_{DN}, P_{DE}: price of domesticity produced version
P_{MS}, P_{MM}, P_{ME}: price of imported version

Structures and Housing:

As discussed in the text, we have assumed that each unit of structures and housing require one unit of the construction good plus a fixed amount of land. The initial paramterization may be expressed in value terms, and we have chosen the value shares at the margin of land in the total cost of one unit of structures and housing as θ_S, θ_H respectively.

Parameter Values

Consumers:

$\alpha_1 = 0.187$ $B_1 = 0$ $r_1 = 0.885$

$\alpha_2 = 0.129$ $B_2 = 0$ $r_2 = 0.746$

$\alpha_3 = 0.784$ $B_3 = 0$ $r_3 = 0.569$

$\alpha_4 = 0.838$ $B_4 = 0$

Production functions:

$\theta_{11} = .19$ $\theta_{12} = .14$ $\theta_{13} = .14$ $\theta_{14} = .01$

$\theta_{15} = .01$ $\theta_{16} = .01$ $\theta_{17} = .01$ $\theta_{18} = .48$

$\theta_{21} = .44$ $\theta_{22} = .08$ $\theta_{23} = .04$ $\theta_{24} = .14$

$\theta_{25} = .28$ $\theta_{26} = .00$ $\theta_{27} = .01$ $\theta_{28} = 0$

$\theta_{31} = .21$ $\theta_{32} = .04$ $\theta_{33} = .02$ $\theta_{34} = .48$

$\theta_{35} = .17$ $\theta_{36} = .01$ $\theta_{37} = .06$ $\theta_{38} = 0$

$\theta_{41} = .46$ $\theta_{42} = .08$ $\theta_{43} = .04$ $\theta_{44} = .25$

$\theta_{45} = .10$ $\theta_{46} = .01$ $\theta_{47} = .06$ $\theta_{48} = 0$

$\theta_{51} = .36$ $\theta_{52} = .06$ $\theta_{53} = .03$ $\theta_{54} = .30$

$\theta_{55} = .18$ $\theta_{56} = .01$ $\theta_{57} = .06$ $\theta_{58} = 0$

Other Parameters:

$r_5 = .987$ AS = 8 $\delta_S = .04$

$r_6 = .965$ AE = 8 $\delta_E = .14$

$\theta_S = .35$

$\theta_H = .35$