HOUSING TAXATION IN A DYNAMIC GENERAL EQUILIBRIUM FRAMEWORK

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HOUSING TAXATION IN A DYNAMIC GENERAL EQUILIBRIUM FRAMEWORK (*)

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INCOME TAXATION IN A DYNAMIC GENERAL EQUILIBRIUM FRAMEWORK

ABSTRACT

This paper analyzes the efficiency and distribution effects of eliminating the deductibility of housing mortgage interest payments from the personal income tax base as well as the impact of taxation of imputed housing rental income. This analysis is pursued in the context of a dynamic general equilibrium model of the United States economy. This model emphasizes the different housing tenure situations and the changes in tenure status, the characteristics of housing as an investment good as well as a consumption good, and the importance of forward-looking behavior by households and industries and of government borrowing.

Simulation results suggest that both policy changes would lead to a decrease in the relative price of owning versus owning. Accordingly, households would turn to a more rental-intensive tenure choice and the size of the housing rental market would increase. On the other hand, the elimination of deductibility of mortgage interest payments would lead to higher costs of purchasing housing capital and depress the demand for new houses reflecting a tendency for more intensive utilization of savings in financial assets as opposed to housing assets. In turn, the taxation of imputed rents for home-owners would be capitalized in lower current housing prices and induce a more housing-intensive portfolio allocation. Finally, both policy changes would be efficient in the long-run, while efficiency-reducing in the short-run. This pattern is explained by the rigidities in the allocation of housing capital.


1. Introduction

This paper analyzes the efficiency and distribution effects of some of the main features of housing taxation in the context of a dynamic general equilibrium model of the United States economy. The tax treatment of the housing markets is of paramount importance in many respects. In fact, the stock of housing is estimated to be about one-third of the total capital stock in the U.S. In addition, purchase of housing is the most important investment decision most households make and a major destination for private savings.

This paper focuses on both the deductibility from the personal income tax base of mortgage interest on housing loans and on the taxation of imputed net housing rental income of owner-occupants. Before the Tax Reform Act of 1986 (TRA86) the full value of all interest payments, including consumers' interest as well as mortgage interest payments for both homeowners and owners of rental housing, were deductible from personal taxable income. The Tax Reform Act of 1986 brought with it substantial restrictions on interest deductibility: only mortgage interest payments on housing are currently deductible and deductibility only applies to two homes per household. On the other hand, the Tax Reform did not bring about any change in the treatment of imputed rents: the federal tax code does not require owner-occupants to report as income the net value of the services from their homes. If these homes were rented out the net rental income would be taxable.

The idea of repealing or reducing the mortgage interest deduction and/or introduce the taxation of imputed rents has gained some clout in the political arena in the recent past. Concern over big government deficits and the possibility of automatic deficit reduction mechanisms along the lines of the Gramm-Rudman-Hollings Act of 1986 has led politicians and economists alike in search of ways to increase tax revenues and ultimately to reduce deficits. The tax revenue
potential of these policy changes is attested by the fact that, mortgage interest deductibility is estimated to yield a tax revenue loss of $35 billion by 1990, and the non-taxation of imputed rents will then represent a revenue loss of about $20 billion.

Changes in the tax treatment of housing may also be desirable on efficiency grounds. The deductibility of mortgage interest payments decreases the users' cost of housing, capital, and disbursements decisions by inducing more ownership as opposed to rental. Also, deductibility makes investment in physical assets more attractive relative to investment in financial assets. On the other hand, the taxation of imputed rents would eliminate the differential treatment of owner occupancy versus ownership for rental purposes. In addition, the taxation of imputed housing rents would improve the inter-asset allocation by equally taxing the returns to housing and financial assets.

As desirable as they may be from the points of view of boosting tax revenues or enhancing economic efficiency, restrictions on the deductibility of mortgage interest payments and the taxation of imputed rents, are viewed with great apprehension by both current homeowners and prospective home buyers as well as the housing industry. The policy changes are perceived by households as ultimately leading to an increase in the costs of housing services and lower well-being and wealth accumulation. On the other hand, depressed demand would have a negative effect on the housing construction industry.

The treatment of housing taxation has been the objective of many important studies. Peterka (1984) uses an asset price approach in a static partial equilibrium framework to examine the effect of tax provision for the deductibility of the mortgage interest on housing prices. He concludes that most of the 30% increase in real housing structure prices during the inflationary late 1970s can be explained by the deductibility of mortgage interest. In particular, the effects of mortgage interest deductibility dominate the effects of taxation of imputed rents. Summers (1985) extends Peterka's asset price approach to investigate the interaction between corporate assets and housing assets in a simplified general equilibrium framework. He shows that much of the increase in the value of owner-occupied housing and decrease in the value of the stock
market can be explained by the nonneutral effect of inflation on the tax system. In turn, Rosen (1979) empirically examines in the context of a static partial equilibrium framework, the effects of the current income tax treatment of owner-occupied housing on the joint decisions of housing demand and tenure choice. Hendershott (1986) investigates in a static situation the impact of changes in tax regimes in the 1980's and/or expected inflation on interest rates and the allocation of real capital. The allocation of a fixed private capital stock depends on the rental costs for the capital components, the price elasticities of demand with respect to the rental costs, and the elasticities of homeownership with respect to the cost of owning versus renting.

More recently, Stenrod (1982) has developed a cohort life-cycle model which incorporates housing capital and also tenure decisions together with a simplified specification of production and government behavior in a static general equilibrium model. The model is used to study the effect of tax policy change on capital allocation between housing and non-housing sectors, and the relative proportion of owned and rental housing capital. Also, Hamilton and Whalley (1985) have developed a sequenced general equilibrium model to analyze the effects of taxation of imputed rents. However, they do not consider debt issuance and mortgage deductibility as a tax issue and renting versus ownership decisions. In addition, Coulter (1989) in the context of a dynamic general equilibrium model has examined the effects of the changes in the corporate income tax introduced by TRA86 on the performance of housing and other industries in the short and long run. However, tenure choices and government borrowing are ignored.

The above contributions have not considered the full dimension of intertemporal housing decisions. In particular, some ignore savings decisions and the purchase of housing capital assets by households, others the nature of housing as a consumption good as well as an investment good, and the timing of tenure conversion from renting to owning. In a different tradition, intertemporal housing decisions have been emphasized in a partial equilibrium context. Ranny (1981) and Wheelen (1985) develop a life-cycle model of housing to investigate the effect of inflation on housing demand, paying attention to liquidity constraints. Henderson and Ioannides (1983) develop a model of tenure choice and housing demand, which focuses on the characteristics
of housing as an investment good as well as a consumption good. Extending the model developed by Artle and Verdi (1978), Pleut (1987) develops a life-cycle model of timing of tenure conversion from renting to owning, also emphasizing the characteristics of housing as an investment good as well as a consumption good. It is concluded that within a static framework, the decisions of tenure choice and housing demand depend on the relative cost of renting versus owning, whereas intertemporal decisions of tenure choice and housing demand depend not only on the relative cost of renting versus owning but also on expectations of housing prices and the expected return on other assets. In turn, Nakajima and Pereira (1989) examine the impact of housing appreciation and mortgage interest rates on homeowner mobility in a model that emphasizes the characteristics of housing as an investment good as well as a consumption good.

This paper brings together the developments in these two traditions: the general equilibrium literature on the effects of housing taxation and the partial equilibrium urban economics literature on intertemporal housing decisions. This paper develops a dynamic general equilibrium model of the U.S. economy. This model emphasizes the specific provisions of housing taxation, the different tenure situations and changes in tenure status, and the characteristics of housing as both an investment good and a consumption good, together with the importance of forward-looking investment behavior, and the rigidities in the allocation of capital, optimal savings decisions, and government borrowing decisions.

Simulation results suggest that both policy changes would lead to a decrease in the relative prices of renting versus owning. Accordingly, households would turn to a more rental-intensive tenure choice and the size of the housing rental market would increase. On the other hand, the elimination of deductibility of mortgage interest payments would lead to higher costs of purchasing housing capital and depress the demand for new houses, reflecting a tendency for more intensive allocation of savings in financial assets as opposed to housing assets. In turn, the taxation of imputed rent for homeowners would be capitalized in lower current housing prices and induce a more-housing-intensive portfolio allocation. Finally, both policy changes would be efficient in
the long-run, while efficiency-reducing in the short-run. This pattern is explained by the rigidities in the allocation of housing capital.

This paper is organized as follows. Section 2 develops the dynamic general equilibrium model. It discusses the foundations of economic behavior as well as the nature of economic equilibrium. Section 3 presents the design of the policy experiments and the empirical evidence on the elimination of mortgage interest deductibility and taxation of imputed rent under different policy scenarios. Finally, Section 4 summarizes the results and provides some concluding remarks.

2. A Dynamic General Equilibrium Model of the U.S.

The model developed in this paper extends Pereira's (1988a, 1988b) model to include a detailed modeling of the housing sector. First, the distinction between non-residential capital good and residential capital good is emphasized. Non-residential capital good is used as a production input, while residential capital good is used by households. Secondly, housing is seen as an investment good as well as a consumption good for households. This formulation sheds light on the fact that residential capital stock produces housing services, and at the same time, plays a role in the allocation of savings as a physical asset in addition to the financial assets. Thirdly, a rental market for housing services is established. Part of residential capital stock is owner-occupied. For each household the difference between housing capital ownership and demand for housing services reflects the net position in the rental market.

2.1 A General Overview

In this model the U.S. economy is characterized by an incomplete, sequential market structure. All current markets are open, but there are no future markets. At any time, several markets are open for different consumption goods, residential capital, non-residential capital.
labor and financial assets. In this economy there are three types of agents: consumer groups, industries, and government. Agents face a dynamic environment. Economic behavior of every agent in this economy is derived from an intertemporal specification of the agents’ objectives and constraints. The economic problem for each is solved using control theory techniques – Pontryagin’s Maximum Principle – to obtain the optimal demand functions.

The model considers three industrial sectors: sector one produces non-capital goods; sector two includes capital goods such as transportation and machinery; and sector three produces residential capital. Industries maximize the present value of the net cash flow in a technology with quadratic adjustment costs, to determine endogenously optimal supplies and optimal demands for the different production inputs. In particular, investment decisions are forward-looking. Real investment is financed by retained earnings and issuance of new debt and equity according to exogenously defined rules.

Government engages in several economic activities. First, it collects taxes – on the use of labor by the different industries, on both corporate and personal income including capital gains, and on sales – according to an exogenously given tax regime. The taxation system in the model reflects the situation in the United States after the Tax Reform Act of 1986. Secondly, it transfers discretionary lump-sum amounts to the private sector. Finally, it purchases consumption goods and primary inputs to accomplish general government activities through the production of a public good. Government intertemporal behavior is obtained from the maximization of a social welfare function defined over the domain of the public good. General government activities are constrained by a recursive set of budget constraints so that government is allowed to run yearly deficits. Government engages in the sale of public bonds to finance such imbalances.

The model considers three income classes: lower class with yearly income below six thousand of 1973 dollars; middle class with income between six and fifteen thousand of 1973 dollars; and upper class with income above fifteen thousand of 1973 dollars. Optimal household behavior follows a intertemporal utility maximization model generating endogenous savings and labor-leisure decisions. Household savings are invested in both housing and financial assets –
public and private bonds, and equity. In the absence of uncertainty, the composition of the financial asset portfolio is a matter of indifference for the households. Financial portfolio decisions accommodate the composition of the demand for the funds households are supplying.

The concept of Temporary Walrasian Equilibrium is adopted to capture the incomplete and sequential aspects of real world trading, and the limitations of foresight into the future which we want to capture in this model. All current markets are assumed to clear, hence the Walrasian nature of equilibrium. Also, equilibrium in the short-run is parametric on the expectations of future prices held by the different agents as well as future taxation parameters, hence the temporary nature of equilibrium. The link between adjacent periods is endogenously provided by the recursive transitions of the stock variables in the economy.

In several fundamental directions, the model in this paper departs from most of the numerical general equilibrium literature for tax policy evaluation (see Shoven-Whalley (1984) and Pereira-Shoven (1988) for detailed surveys of this literature). First, it provides a comprehensive modeling of dynamic economic behavior. In particular, government deficits are optimally determined and investment decisions are forward-looking and are the result of optimizing behavior. Secondly, it encompasses an endogenous sequential equilibrium structure founded on dynamic economic behavior with flexible expectations. Thirdly, the model provides a detailed consideration of financial assets, public and private. Fourth, it provides an in-depth modeling of the housing sector and housing taxation.

2.2 Household Behavior

Intertemporal preferences of households in consumer group \( i \) defined at every \( z \) over current and future consumption plans are represented by a time-separable felicity function of the form:

\[
I_{zt\lambda t}(1+\delta_t)^{-(t-z)}U_t(L^z_{zt}, L_{zt}, \kappa_{zt}, \ldots, \kappa_{zt}, \delta_{zt})
\]
where \( \lambda_i \) is the time-invariant, subjective rate of discount for class \( i \), and \( U_j(\cdot) \) is a well-behaved, time invariant utility function defined over the space of the \( J \) output goods \( y_j \), leisure \( t_{it} \), and consumption of housing services \( H_{it} \). Leisure is given by \( L^* - L_{it} \), where \( L^* \) is the total available time of consumer \( i \) and \( L_{it} \) is labor supply.

It is assumed that, since the production of housing services is capital-intensive, residential capital \( H_{it} \), provides one unit of housing services without either labor input or intermediate goods.

\[
H_{it} = f(H_{it}) = H_{it}
\]

Residential capital consists of both owned-residential capital, \( HK_{it} \), and rented-residential capital, \( HK_{Ri} \). If \( HK_{Ri} \) is positive, income group \( i \) is a net renter, while if \( HK_{Ri} \) is negative, income group \( i \) is a net owner.

Consumer's behavior is constrained by a recursive set of budget constraints relating the intertemporal patterns of income, spending and savings. At \( t \), consumer group \( i \) receives labor income, \( \pi_{it}L_{it} \), lump-sum transfers from the government, \( T_{it} \), and if consumer \( i \) is an owner, rental income \( R_{it}HK_{Ri} \). Also, consumer \( i \) receives wealth generated income, which includes return on private and public bonds, dividends and capital gains on equity and housing:

\[
(1 - \sum_j e_{jt}) t_i + \sum_j e_{jt} \left( D_{it} + \frac{1}{2} E_{it} \right) F_{it} + \sum_j \left( \frac{1}{2} P_{it} - P_{it-1} \right) E_{it} + \left( P_{HKi} - P_{HK_{it}-1} \right) HK_{it}
\]

where \( e_{jt} \) is the share at \( t \) of equity \( j \) in total financial wealth of individual \( i \), and \( 1 - \sum e_{jt} \), represents the fraction of public and private debt.

Labor and wealth income are taxable according to a progressive income tax schedule. Lump-sum transfers from the government are considered tax-exempt. Capital gains on equity and residential capital for renter-occupied housing units are taxed at a rate, \( CGT_{EH} \) and \( CGT_{HR} \), respectively. Accordingly, disposable income for consumer \( i \) at \( t \) is given by:

\[
b_{it} + (1 - T_{it}) \left( \pi_{it}L_{it} - \mu R_{it}HK_{Ri} \right) \left( 1 - \sum_j e_{jt} \right) t_i + \sum_j e_{jt} \left( D_{it} + \frac{1}{2} E_{it} \right) F_{it} + \sum_j \left( \frac{1}{2} P_{it} - P_{it-1} \right) E_{it} + \left( P_{HKi} - P_{HK_{it}-1} \right) HK_{it} + \mu \left( CGT_{HR}HK_{HR} \right).
\]
where $b_{ij}$ is negative to reflect the fact that marginal tax rates exceed average tax rates and $T_{ij}$ is the marginal income tax rate for group $i$. Moreover, $u$ is equal to one (zero) if income group $i$ is a net owner (a renter) of housing capital.

At each $t$, $p_{ij}w_{ij}$ represents pre-tax expenditure of group $i$ in commodity $j$. Purchase of good $j$ is subject to an ad valorem sales tax. Therefore, the total after-tax expenditure of the $i$-th group in consumption goods is $\sum_j (1 + T_{ij}) p_{ij}w_{ij}$. In turn, $R_iHK_{Rit}$ represents expenditure on rental housing consumption at $t$, if income group $i$ is a renter.

Adjusting housing capital stock toward its optimal level is costly. Also, housing capital is not fully mobile across households. These features are captured by household-specific cost functions defined over gross capital stock accumulation. This cost function for residential capital stock includes acquisition and adjustment costs:

(5) $TC_i(H_{it}) = p_{Ht}(H_{it} + C_{Ht}(H_{it}))$,

where $C_{Ht}(H_{it})$ represents the adjustment cost of residential capital stock for household $i$, and $p_{Ht}$ indicates the price of residential capital investment good. The adjustment cost function is assumed to be non-negative, monotonic increasing, and strictly convex. Furthermore, it is assumed that an exogenous fraction of total investment costs $d$, is paid for immediately, while the remainder is debt-financed.

The evolution of residential capital stock through time is given by:

(6) $H_{it} = HK_{Rit} + (1 - \beta_{Ht})HK_{Rit}$,

where $\beta_{Ht}$ is the depreciation rate of residential capital stock owned by consumer $i$.

Depreciation allowances on residential capital stock for renter-occupied housing units, $DA_{Rt}$, are tax deductible. Let $\beta_{Ht}$ and $HK_{Rit}$ be the depreciation rate for tax purposes and residential capital stock for tax purposes, respectively. Also, property taxes $\gamma_{Ht}HK_{Ht}HK_{Rit}$, where $\gamma_{Ht}$ is the property tax rate are deductible at the federal level.

Mortgage payments consist of both interest payment on housing debt $HD_{it}$ and principal retirement $(1/T^*) HD_{it}$, where $T^*$ represents mortgage maturity. The evolution of housing debt is given by:
(7) $HD_{it+1} - HD_{it} = r_t HD_{it} \{ [r_t HD_{it} \{ (1/T^*) HD_{it} \} ] + (1 - d) D_{HH} [H_{it+1} + C_{it}(H_{it})] \} = -(1/T^*) HD_{it} - (1 - d) D_{HH} [H_{it+1} + C_{it}(H_{it})]$

(8) $HD_{it} = HD_{it}^*$

Therefore, the total after-tax expenditure of consumer $i$ is:

(9) $\Sigma [ (1 + T^*)] D_{ij} W_{ijt} + (1 - \mu) R_{it} K_{H(R)t} + (1 - T^*) (r_t HD_{it} + \delta H_{it} H_{it+1} H_{it})$

Since the equation of motion for physical wealth for every $t$ can be written as:

(10) $FW_{it+1} = FW_{it} + (1/T^*) HD_{it} + D_{HH} [H_{it+1} + C_{it}(H_{it})]$

the equation of motion for financial wealth for every $t$ can be written as follows:

(11) $FW_{it+1} = FW_{it} + (1/T^*) (D_{HH} [H_{it+1} + C_{it}(H_{it})] F_{it}) + \mu (D_{HH} [H_{it+1} + C_{it}(H_{it})] F_{it})$

(12) $FW_{it+1} = FW^*$

Therefore, the total savings (financial and physical) for consumer $i$ at $t$ are given by:

(13) $TW_{it+1} - TW_{it} = \Sigma [ B_{ij} (1 - B_{ij}) + \delta B_{ij t} ] + (1/T^*) HD_{it} + D_{HH} [H_{it+1} + C_{it}(H_{it})]$

Savings represent optimal intertemporal transfers of wealth to finance future consumption. Financial wealth $FW_{it+1}$ is to be invested in a menu of financial assets: private bonds, equity, government bonds, and housing capital. Financial assets are perceived by consumers as perfect substitutes, because all the assets are expected to yield the same after-tax rate of return. Accordingly, the asset composition of the financial portfolio is a matter of indifference for consumers. The actual composition of the portfolio holdings is determined by the market equilibrium conditions. Furthermore, the portfolio composition will be the same for all consumer groups. Each group $i$ will own, at $t$, a fraction of the market portfolio which corresponds to its share of the total wealth owned by consumers at $t$.
2.3 Production Behavior

Production technology at each $t$ is represented by a time invariant Leontief structure of the form:

$$u_{jt} = \min\left( f_j(L_{jt}, K_{jt}), u_{j,t-1}/a_{j,1}, \ldots, u_{j,t-1}/a_{j,J} \right)$$

The value-added production function $f_j(L_{jt}, K_{jt})$ is twice continuously differentiable, strictly increasing in every input, and concave.

We further assume that adjusting capital stock towards its optimal level is costly and capital is not perfectly mobile. These ideas are captured by sector-specific cost functions defined over gross capital stock accumulation. The cost functions can be interpreted to include both acquisition and adjustment costs.

$$C_j(l_{jt}) = \frac{a_j}{a_{j,j}}(l_{jt} - C_j(l_{jt})),$$

where $C_j(l_{jt})$, the adjustment cost function for non-residential capital investment good is twice continuously differentiable, non-negative, monotonic increasing and strictly convex.

The evolution of non-residential capital stock through time is given by:

$$l_{jt} = K_{jt+1} - (1 - g_{jt})K_{jt},$$

where $g_{jt}$ is the sector-specific depreciation rate of non-residential capital stock installed in sector $j$ at period $t$. The equation of motion for non-residential capital reflects the idea that, in the short run, capital stock is fixed, i.e., the capital stock in existence at $t$ is not a decision variable at $t$, but it is determined by optimal decisions in previous periods. However, at $t$, investment decisions will be made determining the capital stock at $t+1$. In the long run, capital stock is variable.

Each sector of production $j$ faces ad valorem taxes on the use of labor services, which represent the employer's portion of Social Security taxes. Therefore, if $T_{LL}$ is the tax rate, assumed constant across sectors of production, the cost for sector $j$ of one unit of labor is given by $(1 + T_{LL})P_{LL}$. 
As a consequence of its decisions at period $t$, the sector $j$, including non-residential capital investment industry, realizes gross profits $\Pi_{jt}$ — payment of capital services plus economic profits, i.e., sales revenues minus non-investment expenditures:

$$\Pi_{jt} = \left[ p_{jt} - \Sigma \alpha f(\Sigma \rho_j \pi_j) \right] y_{jt} - (1 + T_{L_j}) d_{L_j} L_{jt}. $$

Sector $j$ is subject to an ad valorem corporate tax on $\Pi_{jt}$. The after-tax gross profits are $(1 - T_{cjt}) \Pi_{jt}$, where $T_{cjt}$ is the sector-specific corporate tax rate at $t$. Also, interest payments are deductible from the corporate tax base so that the net interest paid on outstanding bonds is $(1 - T_{cjt}) r_t B_{jt}$. In turn, depreciation allowances $D_A_{jt}$, are to be deducted from the corporate tax base.

Let $B^*_{jt}$ and $K^*_{jt}$ be the depreciation rate for tax purposes and non-residential capital stock for tax purposes, respectively. The after-tax gross profits are increased by $T_{cjt} B^*_{jt} K^*_{jt}$.

Industry $j$'s net cash flow at $t$, $NCF_{jt}$, can be written as:

$$NCF_{jt} = (1 - T_{cjt}) \left[ p_{jt} - \Sigma \alpha f(\Sigma \rho_j \pi_j) \right] f_j(K_{jt}, L_{jt}) - (1 + T_{L_j}) d_{L_j} L_{jt} - D_{t} \left[ 1 + C_j y_{jt} \right]$$

The producer's dynamic behavior is determined by the maximization of the present value of net discounted cash flow subject to strictly convex adjustment costs, and the equation of motion for the capital stock.

Real investment activities and the payment of interest on outstanding debt at $t$ are financed through retained earnings, $RE_{jt}$, and external funds $FD_{jt} = FL_{jt} - FL_{jt}$. Therefore, production sector $j$ is financially constrained in the following way:

$$FD_{jt} = p_{jt} f_j(K_{jt}, L_{jt}) + (1 - T_{cjt}) W_t B_{jt} + (1 - C_{tj}) f_j(E_{jt} - D_{jt})$$

$$- RE_{jt} - T_{cjt} B^*_{jt} K^*_{jt}$$

Dividend-retention policies are exogenously given. Corporate dividend-retention policies are represented by parameter $B_{\Pi_{jt}}$, the fraction of the after-tax gross profits generated at $t$ which is retained by industry $j$. The remainder, $(1 - B_{\Pi_{jt}})$, represents the distributed portion of earnings. Total dividends at $t$, $(1 - B_{\Pi_{jt}})(1 - T_{cjt}) \Pi_{jt}$, are distributed among the $t$-th period shareholders.

External funds totalling $FD_{jt}$ are obtained by issuing additional equity $E_{jt+1}$ at price $P_{e_{jt+1}}$ and additional fixed-price bonds $A_{B_{jt}}$. Issuance of new bonds and equity is governed by
exogenous continuous corporate financing rules represented in this model by parameter $E_{st}$, the fraction of new equity in the total demand for external funds.

Perfect capital markets are assumed such that the price of equity at $t$, $P_{E_{jt}}$, is the present discounted value of the future expected stream of dividends per share $DiV_{st}/E_{st}$:

$$D_{st} = r_s [P_{st} (1 + r_s)^{-1}] DiV_{st}/E_{st}$$

2.4 Government Behavior

Government engages in different economic activities. First, it collects taxes. Secondly, it transfers discretionary lump-sum amounts to the private sector. Thirdly, it purchases consumption goods, non-residential capital, and labor to accomplish general government activities through the production of a public good. Finally, since general government activities are constrained by a recursive set of budget constraints, and it is allowed to run yearly deficits, the government is also to enlarge in the sale of public bonds to finance such imbalances.

The government raises revenue by levying taxes on the private sector. It is assumed that the government knows exactly how to compute the tax revenue it is going to collect at $t$. It is as if the government knows the closed form net demands of all the agents in the economy and therefore the tax base. The government can also infer future tax revenues which are relevant for current decisions from future price expectations.

The tax system and tax policies are institutionally given as the outcomes of a process not captured by the model. Seven classes of taxes are considered in this model as described in the preceding sections. The total revenues they generate at $t$ are accumulated as follows:

1. ad valorem labor tax on labor services used by the different industries ($j=1,\ldots,J;j=1$) and government, representing Social Security taxes, unemployment insurance, and workmen's compensation and which generates revenue $LT_{t}$:

$$LT_{t} = \sum_{j} T_{L_{t}} D_{L_{t}} L_{t} + T_{L_{t}} D_{L_{t}} L_{t} D_{t} + T_{L_{t}} D_{L_{t}} L_{t} D_{t} + T_{L_{t}} D_{L_{t}} L_{t} D_{t}$$
It should be noted that government is seen as paying to itself taxes on the use of labor. Consequently, the income effects of such tax cancel out. However, the price effects measure the opportunity cost to government of hiring labor. Notice also that marginal labor tax rates in the private and public sectors are different, reflecting better pension plans for government employees.

2. ad valorem corporate income tax on industry $j = 1, \ldots, J; I$ and HI generates revenue $CT_t$.

net of interest deductibility and depreciation allowances:

$$
CT_t = \sum_j T_{cjt} \left( D_{jt} - \sum_i P_{jt} R_{it} \right) y_{jt}^{S_{jt}} \cdot (1 + T_{lt}) P_{lt} L_{jt}^{D_{jt}} - r_{wi} B_{ji} - S_{jt} K_{ji} \\
+ T_{cHt} \left( D_{Ht} - \sum_i P_{Ht} R_{ht} \right) y_{Ht}^{S_{Ht}} \cdot (1 - d) P_{Ht} E_{i}^t (HID_{Ht} + C_{Ht}(HID_{Ht})) + \sum_i (r_i + (1 / T)) \cdot HD_{it} \\
- (1 + T_{lt}) P_{lt} L_{jt}^{D_{jt}} - r_{Ht} (S_{Ht} - B_{jt} H_{Ht} K_{Ht})
$$

3. ad valorem sales tax generates revenue $ST_t$:

$$
ST_t = \sum_j [T_{j} D_{jt} P_{jt} y_{jt}^{D_{jt}}]
$$

4. a progressive personal income tax represented by a linear function for each $i$.

generates revenue $IT_t$:

$$
IT_t = \sum_i \left[ - t_i H_i + t_i E_i^t (D_{it} - P_{it} R_{it} H_{Kt} K_{Rt}) + (1 - \Sigma_j \Sigma_j D_{jt} E_{jt} (D_{jt} P_{jt} R_{jt} E_{jt}) F_{Wt} \right]
$$

5. capital gains taxes:

$$
CGT_t = \sum_j CGT_{jt} \left( D_{jt} (P_{jt} - P_{jt-1}) E_{jt} \right) + \sum_j CGT_{jt} (P_{jt} - P_{jt-1}) E_{jt}
$$

6. property taxes:

$$
PT_t = \sum_i PH_{Kt} K_{Rt} H_{Kt} H_{Rt}
$$

7. deductibilities of mortgage interest and property taxes and depreciation allowances:

$$
D_t = \sum_i \left[ \tilde{t}_i (D_{it} R_{it} + C_{it} (H_{Kt} K_{Rt} H_{Kt})) + B_{jt} H_{Ht} H_{Kt} H_{Rt}\right]
$$

On the other hand, total lump-sum redistributive transfer payments, i.e., transfers to the private sector/consumer groups at $t$ (Social Security, food stamps, AFDC, etc.), are exogenously given and represented by $Tr_t = \sum_j Tr_{jt}$.

Government behavior is constrained by an intertemporal balanced budget condition. The discounted sum of all the government expenditures on commodities, labor and new capital
investment can not exceed the discounted sum of all its revenues, i.e., tax revenues net of transfers. The intertemporally recursive specification of the budget constraint can be written for each 2 = 1 T , in the form:

\[ LG_t = (1 + r_t)LG_t + T_t + \sum_j D_{jt} (y_{jt} + \gamma (1 + T_{gt} )) + D_{lt} L_{gt} + D_{lt} L_{gt} - T_{gt} , \]

with conditions:

\[ LG_0 = LG^*_0 \]
\[ LG_T = 0 \]

Government deficits and surpluses, which represent changes in government liabilities, are accommodated by open market operations in the bond market.

Optimal government spending is derived from the constrained maximization of a social welfare function over the domain of an aggregate public good. Such public good is produced using capital, labor, and intermediate inputs according to a well-behaved production function. This public good is not subject to market pricing. Accordingly, its production is financed via tax revenues and borrowing. This optimization objective is consistent with our modeling of consumers' behavior in which the public good does not enter the set of budget constraints, and is not a decision variable. This is equivalent to having the public good enter additively in time to the private utility functions. Thus, the marginal rates of substitution between private goods do not depend on the level of availability of the public good. The government is then assumed to act empathetically according to a constrained social utility maximizing problem.

The social welfare function over the domain of the aggregate public good can be expressed indirectly in terms of a well-behaved, time invariant utility function defined at every t over the J commodities, and labor and capital services, \( U_t (K_{yt}, L_{yt}, y_{jt}, \ldots, y_{jmt}) \). The intertemporal government preferences at 2 are characterized by a additively separable intertemporal utility/felicity function of the form:

\[ \sum_{z=1}^{T} (1 + r_t)^{-z} \gamma (x_{zt}, L_{zt}, y_{jt}, \ldots, y_{jmt}) \]

where \( \gamma \) is the time invariant subjective rate of discount for the government.
3. Simulation Results

Policy evaluations are carried out by contrasting a base case reflecting the current tax treatment of housing services and several counterfactual equilibria reflecting alternative policy scenarios. In what follows, we will consider the elimination of the mortgage interest payments from the personal income tax base, and the taxation of net imputed housing rents for owner-occupants. First, we consider the short-run effects of both policies. Secondly, we discuss the short-run effects under different equal yield assumptions. Thirdly, the intertemporal effects of these policies are emphasized. Finally, the policy implications of the simulation results are analyzed.

3.1 Short-Run Simulation Results

Elimination of Mortgage Interest Deductibility

The first set of experiments consist of the simple elimination of the deductibility of housing mortgage payments from the personal income tax base. These simulation results are summarized in Table 3.

The treatment of mortgage interest affects directly the cost of the installed housing capital as well as the price of new housing capital. The key factor behind the changes introduced by the elimination of mortgage interest deductibility are the changes in the relative price of renting versus owning induced by the general equilibrium adjustments of the economy. The tenure decision on an additional unit of housing services depends crucially on the relative price of renting versus buying - price of housing investment good.

The elimination of the mortgage interest deductibility reduces the relative price of renting versus owning by about 7%, it is relatively more costly to buy. As a consequence, elimination brings a clear shift from owning to renting. The low and medium income household groups are now renting more. The lowest income group is now renting 85.5% of the housing services it
demands as opposed to 85.5% before. The medium income group is now renting 6.2% of its housing services, up from 5.8%. In turn, the highest income group who is a net provider of rental services is now renting out a higher proportion of its housing capital stock to make up for the increase in the demand for rental housing services. Globally speaking, the rental market increases by about 1.5% as a consequence of the change in relative prices of renting to owning induced by the elimination of mortgage interest deductibility.

The adjustment toward a more renting intensive utilization of housing services, allows the lower income group, which relies essentially on rental services to satisfy its housing demand, to increase marginally their current utility by resorting to a less expensive tenure option. However, middle and high income classes suffer utility losses. In fact, since mortgage interest deductibility is not assumed to be grandfathered for current owners, these income groups will face increased users' cost of installed housing capital.

The elimination of mortgage interest deductibility increases the cost of financing purchases of new housing units, thereby increasing the relative cost of acquisition of housing assets relative to the cost of financial assets. This is reflected in changes in the portfolio allocation. The middle and high income groups which own about 95% of the housing stock, experience together with a reduction in their housing wealth, an increase in their financial wealth. This is made possible by increased housing rental income due to a more renting-intensive tenure choice. In turn, the low income group experiences a decrease in both their financial and physical wealth due to the increase in the cost of acquisition of assets. However, as we have seen, this income group experiences an increase in utility. This pattern reflects the change in the relative price of consumption now versus consumption in the future.

All the income groups experience a reduction in housing investment as a consequence of increased price of investment in housing capital induced by the elimination of mortgage interest deductibility. The housing investment market is thereby negatively affected - it drops by about 1.5%. In turn, the changes in the housing investment market induce a slight decrease of .34% in the GNP adjusted to include the value of leisure.
Finally, the elimination of mortgage interest deductibility is accompanied by a tax revenue increase of about 3.2%. This figure is consistent with previous estimates in the literature (see Rosen (1985)).

**Taxation of Imputed Rental Income**

The second set of experiments in this paper consist of the taxation of net imputed housing rental income. Simulation results are also summarized in Table 3. The results of taxation of imputed rents go in the same general direction as the results on the elimination of mortgage deductibility. In particular, the relative price of renting versus owning is decreased which induces a more rental-intensive tenure choice and a global increase in the size of the rental market. The lowest income class experiences a slight increase in utility, together with a decrease in both financial and housing wealth. The lower income groups experience a decrease in housing investment. Finally, tax revenues increase by about 2.4%, which however is somewhat below previous estimates in the literature (see Rosen (1985)).

The taxation of imputed rents affects directly the relative price of different assets - housing and financial - as lower future rates of return on the housing asset are capitalized into lower housing asset prices. Accordingly, the highest income group adopts a more housing intensive portfolio allocation of savings: its financial wealth is reduced while its physical wealth is increased. This is not pure substitution effects in the sense that the level of housing investment is also increased.

Notice that the highest income group is in a very special position. In fact, this group which provides most of the housing rental services in the economy is now relatively better off, since their rental income has been taxed all along. They are going to benefit from lower asset prices without substantial changes in the returns to their housing assets. By contrast, for the middle income group which is a net renter of housing services, there will be a reduction in the (imputed) return to the housing assets. This explains why the middle income group, unlike the highest income group, shifts into a more financial-intensive portfolio.
3.2 Equal Yield Experiments

In the next set of experiments, the link between the base case and the counterfactual simulations is provided by the concept of equal yield: base case and counterfactual equilibria are such that the size of government is kept constant in a meaningful way. This is usually interpreted as government maintaining the same level of public utility in both the base case and the revised cases. Given the presence of government deficits, the optimal level of expenditure necessary to achieve base case public utility can be financed by either changes in the tax revenues with constant base case deficits - tax-financed equal yield, or by changes in deficits with constant base case tax revenues - bond-financed equal yield. (See Pereira (1988c) for a detailed discussion of these issues.) By concentrating on equal yield alternatives, our analysis will require the computation of replacement rates, i.e., the computation of the changes in some specific tax rates necessary to neutralize in a specific way the tax changes under consideration. Under personal income tax replacement, the compensation comes from increased marginal personal income tax.

Simulation results of the elimination of mortgage deductibility and taxation of imputed rents under the different equal yield alternatives are summarized in Tables 4–5. Most of the equal yield results are qualitatively similar to the previous experiments. However, all the effects are dampened. This is explained by the fact that under equal yield, policy changes are designed so that the size of the government is kept constant in a relevant way.

The information contained in the different equilibria is synthesized in a scalar efficiency indicator which is the dynamic generalization of the Hicksian Equivalent Variation. This efficiency indicator is designed to accommodate inter-temporal comparisons of equilibrium paths when perfect foresight is not necessarily assumed and future markets are not open. The elimination of mortgage interest deductibility is shown to have negative global efficiency effects of .138% and .564% of the GNP adjusted to include the value of leisure under bond-financed and tax-financed equal yield, respectively. In fact, the move towards eliminating mortgage deductibility is
inefficient on a priori grounds: since interest received is taxable interest paid should be non-
taxable. Eliminating mortgage interest deductibility would reinforce the negative effects of the
elimination under the Tax Reform Act of 1986 of consumer interest deductibility. On the other
hand, the inefficiencies associated to the elimination of mortgage interest deductibility are greater
under tax-financed. In fact, bond-financed keeps tax revenues constant while tax-financed induces
an increase in tax revenues. The difference is due to the additional distortions generated by the
increase in the marginal tax rates under tax-financed equal yield.

The efficiency effects of the taxation of imputed rent are also negative. They are −.18% and
.587% of the GNP adjusted to include the value of leisure under bond-financed and tax-financed
equal yield, respectively. The taxation of imputed rents improves the inter-asset allocation of
savings by postulating equal tax treatment of the returns on the financial assets and the returns on
housing assets. However, from the standpoint of an ideal consumption taxation of returns on wealth
accumulation, distorts the intertemporal consumption/savings decisions. The negative efficiency
results in this paper suggest that, in the short-run, the increase in intertemporal distortions from
taxation of imputed housing rents is more important than the improvement in the inter-asset
allocation through equal tax treatment. Notice that this short-run result contradicts Hamilton and

3.3 Simulation Results: Long-Run Effects

The long-run effects of the elimination of interest mortgage deductibility and the taxation
of imputed rents are depicted in Figures 1-4. With the elimination of interest mortgage
deductibility, the relative price of renting versus owning housing services increases throughout
time. By contrast the sustained taxation of net imputed rents gradually decreases this relative
price. Accordingly, the intertemporal pattern of results differ for the two experiments. Under the
elimination of mortgage deductibility, the size of the rental market tends to be reduced through time.
until eventually returning to the original levels. However, under taxation of imputed rents the size of the rental market increases consistently.

The reductions in housing investment and housing capital accumulation for the lower income groups, and the increase for the higher income groups are reinforced through time. This pattern is induced by the adjustment costs dynamics. It takes time for the effects of policy changes on investment behavior to come up. Also, the allocation of savings is increasingly financial intensive as the elimination of inter-asset distortions is sustained.

No major changes occur in the future in terms of the additional tax revenues to be collected by the government as a consequence of these policy changes. However, in the case of mortgage elimination, there is a clear downward trend, while in the case of taxation of imputed rents this trend is upward. This is consistent with the pattern of change in the relative price of renting versus owning as reported above.

A striking feature of the intertemporal efficiency results is the fact that the short-run efficiency losses associated with both policies are dampened in the long-run to a point that the nature of the results is reversed. Ultimately, both policies lead to positive albeit small intertemporal efficiency gains: .2% of GNP for elimination of mortgage interest deductibility and .13% for the taxation of imputed rents. This result suggests that, in the long-run, the increase in intertemporal distortions from taxation of imputed housing rents is less important than the improvement in the inter-asset allocation through equal tax treatment. The intertemporal pattern of efficiency gains is explained by the nature of forward-looking behavior under rigidities in the capital allocation. Adjustments in the optimal level of housing capital for households are costly and take time to occur. Therefore, adjustments in the allocation of savings between financial and housing assets also take time to occur.

Ultimately, the efficiency impact of taxation of net imputed rents in this paper agrees with the direction of the results reported in Hamilton-Whalley (1985). However, the intertemporal efficiency gains reported here are about one-third the corresponding results in Hamilton-Whalley (1985). Several differences between the two models explain the differences in
the size of the effects as well as the intertemporal pattern detected in this paper. In particular, the rich dynamic structure with rigidities in the capital allocation, the modelling of government deficits and of intertemporal labor supply decisions, and the inclusion of housing debt and housing tenure are features of the model in this paper that are not shared by Hamilton-Whalley (1985).

4. Policy Implications and Final Remarks

This paper analyzes the efficiency and distribution effects of eliminating the deductibility of housing mortgage interest payments from the personal income tax base as well as the impact of taxation of imputed housing rental income. This analysis is pursued in the context of a dynamic general equilibrium model of the United States economy. This model emphasizes the different housing tenure situations and the changes in tenure status, the characteristics of housing as an investment good as well as a consumption good, and the importance of forward-looking behavior by households and industries, and of government borrowing.

Simulation results suggest that both policy changes would lead to a decrease in the relative price of renting versus owning. Accordingly, households would turn to a more rental-intensive tenure choice and the size of the housing rental market would increase. On the other hand, the elimination of deductibility of mortgage interest payments would lead to higher costs of purchasing housing capital and depress the demand for new houses, reflecting a tendency for more intensive allocation of savings in financial assets as opposed to housing assets. In turn, the taxation of imputed rents for homeowners would be capitalized in lower current housing prices and induce a more housing-intensive portfolio allocation. Finally, both policy changes would be efficient in the long-run, while efficiency-reducing in the short-run. This pattern is explained by the rigidities in the allocation of housing capital.

Globally speaking, simulation results lend credibility to the tax revenue potential of these policy changes in housing taxation but casts some doubts on the fears of households and the construction industry. The expectation that the elimination of mortgage interest deductibility will
increase tax revenues seems to be well founded. In fact, tax revenues are projected to increase by
even more than the amount directly recovered with the elimination of mortgage interest
deductibility. The same applies for taxation of imputed rents. On the other hand, the intertemporal
pattern of tax revenues showing a downward trend in the case of mortgage interest elimination and
an upward trend in the case of taxation of imputed rents, suggests that tax revenue collection is
maximized by an appropriate intertemporal combination of the two policies.

On the other hand, the concerns of households seem to be only partially founded. In fact,
all income groups experience either a increase in current utility (low income group) or an
increase in the accumulation of financial wealth (middle income group) or physical wealth
accumulation (high income group). In particular, the high income group that under progressivity
of the personal income tax structure would seem to lose more from the elimination of these tax
shelters is not dramatically affected: a decrease in current utility is compensated by an increase
in either financial or physical wealth, and therefore future consumption.

The size of the housing market is decreased by the elimination of mortgage deductibility.
Also, net profits would diminish and capital accumulation would slow down. However, these
negative effects for the housing industry are relatively small. They are dampened by the changes
in the relative price of renting versus owning and the subsequent increase in the size rental
market. This increase partially offsets the slowdown in housing capital ownership for strictly
consumption motives. On the other hand, taxation of imputed rents actually induces an increase in
the housing investment market, due to the reallocation of savings in favor of a more housing-
intensive portfolio. Accordingly the concerns of the housing industry are only partially founded.

The fact that the reductions in housing investment and housing capital accumulation for the
lower income groups, and the increase for the higher income groups are reinforced through time
suggests that the policy changes will have lower average effects in the short-run than in the long-
run. This is also the case with the efficiency effects: the efficiency benefits of the policy changes
will appear only in the long-run.
The general policy implication of this paper is that changing the tax treatment of housing may not be necessarily a bad idea. Also, the taxation of net imputed rents may cause less problems and generate less opposition than the elimination of mortgage interest deductibility.

The single most important extension of the model and the issue in this paper would be the analysis of the effects of different expected housing inflation, and changes in mortgage interest rates on the global evaluation of the elimination of mortgage interest deductibility, and on the taxation of imputed rents. In fact, the decisions of tenure choice and housing demand depends not only on the relative cost of renting versus owning but also on the expectations of future housing prices, interest rates and the expected returns on other assets.
REFERENCES


APPENDIX I

MODEL NOTATION

1. General Notation

Time
- current time: $z$
- terminal time: $T$
- future time: $z < t < T$
- mortgage maturity: $t^*$

Agents
- consumers: $g_{i=1,...,C}$
- producers of consumption goods: $i = 1, ..., J$
- producers of non-residential capital: $j = 1$
- producers of residential capital: $j = H$
- government: $g$

Prices
- consumption good $j$: $P_{j,t}$
- rental housing consumption: $R_t$
- vector of consumption goods: $P_t$
- non-residential investment: $P_{H,t}$
- residential investment: $P_{H,t}$
- labor: $P_{L,t}$
- interest rate: $r_t$
- price of equity $j$: $P_{j,t}$

Commodities
- consumption of good $j$ by $i$: $Y_{j,t}$
- consumption of rental housing by $i$: $H_{i,t}$
- consumption of owner-occupied housing by $i$: $O_{i,t}$
- labor supplied by $i$: $L_{i,t}$
- leisure of $i$: $l_t$
- residential capital owned by $i$: $R_{K,H,i,t}$
- residential capital used for rental units: $R_{K,R,i,t}$
- total residential investment cost by $i$: $T_{C,H,i,t}$
- adjustment costs by $i$: $C_{j,t}(.)$
- total available time of $i$: $L^*_i$

- consumption good $j$: $Y_{j,t}$
- total non-residential investment cost by $j$: $T_{C,j,t}$
- adjustment costs of non-residential capital by $j$: $C_{j,t}(.)$
- use of input $f$ by $j$: $U_{j,t}$
- non-residential capital stock in sector $j$: $K_{j,t}$
- non-residential investment by industry $j$: $l_{j,t}$
- total demand for non-residential investment by $j$: $l_{j,t} + C_{j,t}(.)$
labor used by industry j  \( l_{jt} \)
non-residential investment good  \( I_t \)
housing investment good  \( H_t \)
use of good j by g  \( u_{tgt} \)

non-residential capital stock demanded by g  \( K_{gt} \)
non-residential investment by g  \( I_{gt} \)
labor demanded by g  \( L_{gt} \)

Financial / Physical Flows and Assets

financial wealth by i  \( FW_{it} \)
physical wealth by i  \( PW_{it} \)
total wealth by i  \( W_{it} \)
financial savings by i  \( S_i \)
housing debt by i  \( d \)
fraction of downpayment  \( B_{ijt} \)
j-th industry bonds owned by i  \( E_{ijt} \)
j-th industry equity owned by i  \( D_{ijt} \)
dividends from j received by i  \( B_{igt} \)
government bonds owned by i  \( s_{it} \)
i's share of the market portfolio  \( e_{it} \)
share of debt in i's portfolio  \( 1 - \Sigma j e_{ijt} \)
share of equity in i's portfolio  \( e_{ijt} \)
j-th's net cash flow  \( NCF_{jt} \)
j-th industry bonds  \( B_{jt} \)
j-th industry capital equity  \( E_{jt} \)
sector j liabilities  \( F_{jt} \)
dividends distributed by j  \( D_{jt} \)
retained earnings by j  \( R_{jt} \)
new funds demanded by j  \( B_{jt} \)
government bonds  \( L_{jt} \)
government liabilities  \( F_{gt} \)
new funds demanded by g  \( L_{ft} \)
labor tax revenue  \( CT_t \)
corporate tax  \( CT_t \)
capital gain tax  \( CCGT_t \)
income tax  \( IT_t \)
residential property tax  \( PT_t \)
deductibility of mortgage interest and property tax  \( D_t \)
sales tax  \( ST_t \)
total taxes  \( TT_t \)
transfers  \( Tr_t \)
### Structural Parameters

**Preference and Technology Parameters**
- Group i's discount rate: $a_i$
- Residential investment adjustment costs parameter: $b_{MH}$
- I-th's residential capital depreciation rate: $S_{Mt}$
- Non-residential investment adjustment costs parameter: $b_{j}$
- J-th's non-residential capital depreciation rate: $S_{jtt}$
- Dividend retention parameter: $S_{jtt}$
- New debt/equity parameter: $a_{gp}$
- Government discount rate: $S_{gt}$
- G's non-housing capital depreciation rate: $S_{gt}$

**Tax Parameters**
- Income tax rate: $T_{it}$
- Income tax rate intercept: $b_{it}$
- Capital gains tax on equity: $COTE_{it}$
- Capital gains tax on rental housing: $COTE_{it}$
- Property tax: $g_{tt}$
- I's depreciation allowances: $d_{MH}$
- I's depreciation for tax purposes: $S_{Mtt}$
- Transfers received by i: $T_{fit}$
- Sales tax rate: $T_{jtt}$
- Labor tax rate: $T_{jtt}$
- J's corporate tax rate: $D_{jt}$
- J's depreciation allowances for non-residential stock: $S_{jtt}$
- J's non-residential capital depreciation for tax purposes: $S_{jtt}$
TABLE 1
BASE CASE PARAMETER VALUES AND STOCKS FOR EACH INDUSTRY

<table>
<thead>
<tr>
<th></th>
<th>SECTOR 1</th>
<th>SECTOR 2</th>
<th>SECTOR 3</th>
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<td>Depreciation Rate (Tax)</td>
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TABLE 2
BASE CASE PARAMETER VALUES AND STOCKS FOR HOUSEHOLDS AND GOVERNMENT

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<td>Share of housing con.</td>
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<td>low income</td>
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INCOME TAX UNDER EQUAL YIELD
(BASE CASE=1.0000)

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FIGURE 1
INTERTEMPORAL CHANGES IN RELATIVE PRICES (BASE CASE = 1.0)

FIGURE 2
INTERTEMPORAL CHANGES IN SIZES OF RENTAL HOUSING MARKET (BASE CASE = 1.0)