Capital Taxes, Labor Taxes and the Household

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Abstract

We study the impact of capital and labor taxation in an economy where couples bargain over the intrahousehold allocation. We present a life cycle model with heterogeneous individuals and incomplete financial markets. Drawing from the literature of the collective framework of household behavior, we model decision making within the couple as a contract under limited commitment. Lower capital taxation improves commitment and gives rise to insurance gains within married households. Our theory motivates these gains by the empirical observation that wealth, in contrast to labor income, is a commonly held resource within households. The effect of labor taxes on commitment is ambiguous.

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1 Introduction

There is considerable literature that investigates the effect of changes in the tax code on the economic behavior of families using the so called collective framework of the intra-household allocation (for example Apps and Rees (1988, 1999) and Donni (2003), among others). Within this framework the family is formed typically by two spouses, a male and a female. The couple allocate resources between its members according to a sharing rule which reflects the bargaining power of the two individuals. Changes in tax rates affect the sharing rule and the division of the surplus within the family.

Undoubtedly this body of work has highlighted important issues that governments need to be aware of when considering to change their policies. However, our objection to this literature is that the models are usually static and therefore not suitable to analyze how different tax schedules affect capital accumulation and, more generally, the intertemporal behavior of families. Our paper fills this gap. We present a dynamic model where households (couples) live for several periods and make savings and labor supply decisions. As in the collective model these economic decisions jointly maximize the households welfare, and are made according to a sharing rule which reflects the bargaining position of the male and the female spouse. The rule is initiated in the first period of the life cycle, and for every subsequent period it is updated to ensure that both spouses are better off in the marriage than as singles. Because in the model there is uncertainty about the labor income of individuals, when the labor income of one spouse increases, the sharing rule must allocate more resources to her. This implies that the couple has to give up some risk sharing to satisfy a participation constraint.

We study how this intrahousehold decision process is affected by shifts in the tax schedule focusing on changes in capital and labor taxation. Our results are as follows: First, changes in labor taxes have an ambiguous effect on intrahousehold risk sharing: On the one hand, higher labor taxes, reduce intrahousehold inequality in income and therefore improve the household’s insurance possibilities, but through a second channel they tighten the participation constraint, as they impoverish the household and make it more tempting to rebargain. Second lower capital taxes, are shown to always improve commitment and risk sharing within the household. Our analysis shows that as the household’s financial income increases, and a larger fraction of consumption is financed through wealth, the participation constraints are relaxed. Lower capital taxation encourages asset accumulation and leads to an improvement in risk sharing within the household. Our theory motivates this by the empirical observation that wealth, in contrast to labor income, is a commonly held resource within US households.

Our results are highlighted in section 2 using a simplified version of our theory (a two period model) that enables us to derive analytically the effect of the tax schedule on the intrahousehold allocation. In section 3 we setup a quantitative life cycle model, broadly similar to the models of Ligon, Thomas and Worrall (2000) and Mazzocco (2007) who study limited commitment problems in economies with savings. Our model features shocks to individual labor income, gender differences in life cycle productivity and incomplete financial markets. Though our basic results can be clearly stated using the simplified model in two periods, the quantitative analysis is important for two reasons: First, because it illustrates the properties of the intrahousehold allocation and rebargaining using a framework that is considered as the workhorse model in quantitative macroeconomics (the so called model of heterogeneous agents) and second, because it enables us to further investigate our results in an economy that features realistic heterogeneity. Moreover, studying the households limited commitment problem in more than two periods is impor-
tant, because the benefits from intrahousehold risk sharing and commitment accrue over longer horizons and change over the life cycle.

We calibrate our quantitative model to match several features of the cross section in the US data, focusing on moments that summarize its performance in terms of the intrahousehold allocation, such as hours worked for male and female spouses, the husbands share on total family income, and the correlation of shocks to the labor income within the household. Section 4 contains our main quantitative results. Taking US institutions as given, we consider a simple change in policy. We assume that the government eliminates capital taxation and instead finances its spending through higher distortive labor taxes. This simple policy change has been often studied in the literature and therefore serves as a benchmark that, using our model, enables us to describe quantitatively the effects of capital and labor taxes on the intrahousehold allocation. We find that there are gains in intrahousehold risk sharing and commitment. Household bargaining drops by roughly 25% both in the long run and in the transition towards the new steady state. Because of the improved commitment there is a significant reduction in individual consumption uncertainty and a welfare gain that is 50% as large as if perfect risk sharing possibilities were granted to the average household. However, when measured in terms of the standard measure of compensating variation, we find that these gains are typically small, corresponding to roughly 0.2% of average steady state consumption.

A final section concludes.

1.1 Literature Review

Our paper is related to several strands of the literature. First as discussed previously, there is a considerable literature on the collective model of intrahousehold decisions. To the best of our knowledge, we are the first to investigate the impact of changes in the tax code on the intertemporal behavior of families and the scope of intrahousehold risk sharing. Existing work on taxation within the collective framework uses static models mainly to investigate whether men and women should be taxed separately or, should face different tax schedules in light of the differences in the elasticity male and female labor supplies. For example Apps and Rees (1999) investigate revenue neutral reforms that increase the marginal tax rates of men and lower the tax rates of women in a model with home production. Apps and Rees (2011) ask whether the optimal Ramsey policy calls for lower marginal tax rates for women (see also Alesina, Ichino and Karabarbounis (2011)). Here, we do not attempt to address these issues. Our approach is to abstract from the complexities of the tax code and to summarize the institutions in a simple linear tax system. But since our model is dynamic, we add to the literature by formalizing how changes in linear taxes can affect the welfare and the risk sharing possibilities of families.

Moreover, there is a sizable literature on the optimality of the US tax code in models of heterogeneous and wealth accumulation. Early contributions in this literature include the work of Aiyagari (1995) and Imrohoroglu (1998) and more recent ones include the models of Domeij and Heathcote (2004), Conesa, Kitao and Krueger (2009) and Conesa and Krueger (2006). For its most part literature has relied on the so called bachelor household framework to document the effects of changes in the tax code. In this framework the household is most often represented by a single individual, typically a male. An exception is the recent work of Guner, Kaygusuz and Ventura (2012a,b) who consider dual earner

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1See for example Chiappori (1988, 1992), Blundell and Etheridge (2010) and especially the recent work of Mazzocchi, Ruiz and Yamaguchi (2007) and Gallipoli and Turner (2011) who present a dynamic extension of this model.
households and document considerable efficiency gains from (revenue neutral) reforms that replace joint filling with separate filling. These gains derive mostly from the response of female hours which in their model operates mostly at the extensive margin of labor supply. Our paper also presents a model where there is gender and marital status heterogeneity, but relative to Guner, Kaygusuz and Ventura (2012a,b) who consider a unitary model with no shocks to the labor income of individuals, our focus is on the effects of policy changes on the intrahousehold allocation and risk sharing in a non unitary model and in the presence of idiosyncratic income shocks.

Finally, the recent literature of dynamic optimal taxation in life cycle models with heterogeneity and incomplete markets, has documented large welfare gains from positive capital taxes (see for example Conesa, Kitao and Krueger (2009)). Our result that capital taxation has a negative impact on the intrahousehold allocation is not aimed at suggesting that these policy implications are reversed. For that matter we dont seek to characterize the optimal tax code but rather our point is a positive one: given the structure of decision making in US households there is an additional margin of the impact of capital and labor taxes that has been neglected from previous studies. More substantively we proffer that though the bachelor household model has been extensively used to characterize the distributional effects of policy changes on inequality and welfare between households, our model enables us to study the impact of policy changes within the household. Perhaps at a more speculative level, our analysis suggests that it is possible to have policy changes, such as reducing capital taxation, that exacerbate inequality between households but reduce inequality within households.

2 Intrahousehold Bargaining in two Periods

This section presents a simplified version of our theory. It investigates the optimal behavior of a couple that consists of a male and a female, lives for two periods, but faces the limited commitment problem only in the period two. We derive analytical results that establish the impact of the tax schedule on the intrahousehold decision process.

We assume that preferences of both the male and the female spouse, are represented by the following utility $u(c^g_t, l^g_t)$ where $c^g_t$ denotes consumption and $l^g_t$ is leisure in period $t = 1, 2$. The superscript $g$ denotes gender ($g \in \{m, f\}$ (male, female)). Moreover, we assume each household member enjoys a constant utility flow $\xi > 0$ each period from being married. If the marriage breaks up we set $\xi$ equal to zero.

Our analysis in this section, is derived in partial equilibrium. That is to say we state our results keeping the wage rate $w$ and the interest rate $r$ constant. Moreover, we assume that there is a government that levies capital and labor taxes denoted by $\tau_K$ and $\tau_N$ respectively. The household is born with level of wealth $a_0$, and accumulates wealth in period 1 to finance consumption in $t = 2$. The household’s members are assumed to be identical initially in terms of productivity (normalized to unity for simplicity) but in period two each individual experiences a shock in their productivity endowment, that alters their labor income potential. We let $\epsilon_g$ be the productivity for the household member of gender $g$ at $t = 2$.

The limited commitment problem emerges from the fact that differences in productivity across the two members affect the relative bargaining power within the household, and thus affect the intrahousehold allocation. To characterize this allocation we assign a weight to the welfare of each individual in the household. We let $\lambda_t$ be the share of the male spouse for $t = 1, 2$ and $1 - \lambda_t$ the analogous share of the female spouse. The fact
that $\lambda_t$ is time dependent reflects the lack of commitment in our model. We envisage that if in period two, the realized value of (say) $\epsilon_m$ is large enough, the male spouse may command a larger share of household resources, in which case there will be a renegotiation of the value of his share upwards. To be more precise, the couple inherits a sharing rule $\lambda_1$ from period 1. If the male spouse needs to be made better off then the sharing rule will settle to a new value $\lambda_2 > \lambda_1$. We assume, following Ligon, Thomas and Worrall (2000) and Mazzocco, Ruiz and Yamaguchi (2007), that this new value $\lambda_2$ must be such that the male spouse is as well off as they would be if the marriage was dissolved (essentially being a bachelor).² Analogously, if the female spouse has to be made better off then $\lambda_2 < \lambda_1$. If participation is not violated for either spouse then $\lambda_2 = \lambda_1$.

The household contract is represented as a joint program, given these weights. We let $M_1(a_0, \lambda_1)$ be the value function that characterizes this joint maximization problem in period 1 and $M_2(a_1, \lambda_2, \epsilon)$ the analogous function for $t = 2$. Notice that the latter has $\epsilon$ as an argument which now represents the vector of idiosyncratic productivities in period 2. To characterize the households program we solve backwards. Given the wealth endowment and the levels of productivity, $M_2(a_1, \lambda_2, \epsilon)$ is a solution to:

\begin{equation}
M_2(a_1, \lambda_2, \epsilon) = \max_{c^m_2, l^m_2} \lambda_2 u(c^m_2, l^m_2) + (1 - \lambda_2)u(c^f_2, l^f_2) + \xi \tag{1}
\end{equation}

subject to:

\begin{equation}
\sum_g c^g_2 = \sum_g(1 - l^g_2)w(1 - \tau_N)\epsilon_g + a_1(1 + r(1 - \tau_K)) \tag{2}
\end{equation}

Standard results imply that the optimal allocation satisfies $\lambda_2 u_c(c^m_2, l^m_2) = (1 - \lambda_2)u_c(c^f_2, l^f_2)$ and $w(c^m_2, l^m_2) = w(1 - \tau_N)\epsilon_g$. To introduce formally the notion that the household contract may be bargained, we let $S_g(D_g(a_1), \epsilon_g)$ be the utility of the household member of gender $g$ if the marriage breaks up, where $D_g(a_1)$ is a division of family wealth in the event of divorce with the property $\sum_g D_g(a_1) \leq a_1$. The participation constraints that need to be satisfied are:

\begin{equation}
u(c^g_2, l^g_2) + \xi \geq S_g(D_g(a_1), \epsilon_g) \quad g \in \{m, f\} \tag{3}\end{equation}

The renegotiation of the marital contract takes the following form:

\begin{equation}
\lambda_2 \in \operatorname{arg\,min}_{\lambda^*} |\lambda^* - \lambda_1| \text{ such that } V_g(a_1, \lambda^*, \epsilon) \geq S_g(D_g(a_1), \epsilon_g) \quad g \in \{m, f\} \tag{4}\end{equation}

where $V_g$ is the level of utility of the household member of gender $g$ that derives as a solution to program 1 if the weight is equal to a generic value $\lambda^*$. Equation 4 says that the share is updated in those states where the participation constraint is violated, and is otherwise constant. Whenever there is a change in $\lambda_2$ relative to $\lambda_1$, this change is the minimum required to satisfy participation for both spouses. Notice that the case where the participation constraints never bind corresponds to a full commitment allocation. Relative to this case, under limited commitment, the couple needs to partially give up risk sharing in order to satisfy the participation constraints.

Given the above discussion, we can represent the households program in period 1 as follows:

\begin{equation}M_1(a_1, \lambda_1) = \max_{c^m_1, l^m_1} \lambda_1 u(c^m_1, l^m_1) + (1 - \lambda_1)u(c^f_1, l^f_1) + \xi + \beta \int M_2(a_1, \lambda_2, \epsilon)dF(\epsilon_m, \epsilon_f) \tag{5}\end{equation}

² See also Gallipoli and Turner (2011) and Voena (2012).
subject to:

\[ \sum_{g} c_{2}^{g} + a_{1} = \sum_{g} (1 - l_{2}^{g})w(1 - \tau_{N}) + a_{0}(1 + r(1 - \tau_{K})) \]

where \( \beta \) is the discount factor of the household, and \( F(\epsilon_{m}, \epsilon_{f}) \) represents the joint cdf of productivity shocks in the family. Note that given the individuals are identical in the first period we can, without loss of generality, set \( \lambda_{1} = \frac{1}{2}. \)\(^3\)

One final comment is in order: to determine the outside options for the male and the female spouse, we assume as Mazzocco (2007) does, that divorce leads to an equal division of assets and therefore set \( D_{m}(a_{1}) = D_{f}(a_{1}) = \frac{a_{1}}{2}. \) This assumption also appears to be empirically relevant; according to Mazzocco, divorce settlements in the US on average lead to a 50-50 split in family wealth.\(^4\) We therefore follow the empirical evidence, but in section 2.2 we illustrate that our results go through under different specifications for divorce outcomes and divisions of assets.

### 2.1 The Effect of Taxes on Household Decision Making

We illustrate how capital and labor taxes affect the properties of the sharing rule in period two. Our starting point is to assume that \( u(c_{2}, l_{2}^{g}) = \eta \log c_{2}^{g} + (1 - \eta) \log l_{2}^{g}. \) With this parametrization of preferences a share of one half translates into equal consumption between male and female spouses. If, on the other hand, \( \lambda_{2} \neq \frac{1}{2}, \) then under limited commitment the consumption levels diverge, giving rise to within household inequality. Our goal here is to trace the effect of different policies on risk sharing in that sense.

We solve the model backwards. Assume that we are in period 2, and that given the sharing rule, the household decides how to split consumption and hours in the family. Let \( A_{c} = (1 + r(1 - \tau_{K}))a_{1} \) be the level of wealth of the household brought forward from period one. It is trivial to show that the optimal consumption is \( c_{2}^{m} = \lambda_{2} \eta(A_{c} + \sum_{g} w(1 - \tau_{N})\epsilon_{g}) \) and \( c_{2}^{f} = (1 - \lambda_{2}) \eta(A_{c} + \sum_{g} w(1 - \tau_{N})\epsilon_{g}). \) Similarly, the optimal choice of leisure for the male and female spouses is given by: \( l_{2}^{m} = \lambda_{2}(1 - \eta) \frac{A_{c} + \sum_{g} w(1 - \tau_{N})\epsilon_{g}}{\epsilon_{m}w(1 - \tau_{N})} \) and \( l_{2}^{f} = (1 - \lambda_{2})(1 - \eta) \frac{A_{c} + \sum_{g} w(1 - \tau_{N})\epsilon_{g}}{\epsilon_{f}w(1 - \tau_{N})}. \)

**Participation Constraints.** To respect the participation constraint of each household member, the allocation rule \( \lambda_{2} \) must satisfy the following conditions:

\[
\eta \log \lambda_{2} \eta(A_{c} + \sum_{g} w(1 - \tau_{N})\epsilon_{g}) + (1 - \eta) \log \lambda_{2} \eta \frac{(A_{c} + \sum_{g} w(1 - \tau_{N})\epsilon_{g})}{\epsilon_{m}w(1 - \tau_{N})} + \xi \geq 0
\]

\[\eta \log \frac{A_{c}}{2} + w(1 - \tau_{N})\epsilon_{m} + (1 - \eta) \log \eta \frac{A_{c}}{2} + w(1 - \tau_{N})\epsilon_{m}}{\epsilon_{m}w(1 - \tau_{N})} \]

\( ^{3} \)In section 3 we formalize on the initial sharing rule assuming that the couple solves a Nash bargaining problem. For identical individuals the solution to this program would obviously be \( \lambda_{1} = \frac{1}{2}. \)

\( ^{4} \)Specifically in those states that have a ‘common property law’ assets are indeed divided equally between the spouses after a divorce. In the so called ‘equitable property’ states assets are divided ‘fairly’, meaning that courts take into account a variety of factors, including the contributions of each party, but also future earnings and living standards.
which guarantees that the male spouse is better off in the marriage than as a single and,
\[
\eta \log(1 - \lambda) \eta(A_c + \sum_g w(1 - \tau_N)\epsilon_g) + (1 - \eta) \log \lambda \eta \frac{(A_c + \sum_g w(1 - \tau_N)\epsilon_g)}{\epsilon_f w(1 - \tau_N)} + \xi \geq 0
\]
(8)
\[
\eta \log \eta\frac{A_c}{2} + w(1 - \tau_N)\epsilon_f) + (1 - \eta) \log \eta \frac{(A_c/2 + w(1 - \tau_N)\epsilon_f)}{\epsilon_f w(1 - \tau_N)}
\]
which represents the analogous condition for the female spouse. Solving equations 7 and 8 for \(\lambda_2\) defines the following bounds:
\[
\lambda_2 \in \left\{ e^{-\xi} \frac{A_c/2 + \epsilon_m w(1 - \tau_N)}{A_c + \sum_g \epsilon_g w(1 - \tau_N)}, 1 - e^{-\xi} \frac{A_c/2 + \epsilon_f w(1 - \tau_N)}{A_c + \sum_g \epsilon_g w(1 - \tau_N)} \right\}
\]
(9)
Notice that with \(\xi = 0\) the level of utility for each household member is identical to what they would get as singles. In this case, the spouses cannot commit to any allocation other than the one that divides the assets equally and gives to each of them their own labor income. Being together is no different than being single when \(\xi = 0\). However, if \(\xi > 0\), expression 9 gives a region where the initial allocation is not rebargained. For instance, for each value of \(\epsilon_f\) and financial income \(A_c\), there is a unique threshold \(\epsilon_m(A_c, \epsilon_f)\) such that if \(\epsilon_m < \epsilon_m(A_c, \epsilon_f)\), the contract updates \(\lambda_2\) to be equal to the upper bound of 9. In words, if male productivity in period 2 is low, the sharing rule has to be rebargained. The new weight \(\lambda_2\) is equal to the upper bound of 9 because the upper bound is lower than a half, thus making the participation constraint of the female spouse bind. Similarly, there is an analogous \(\tau_m(A_c, \epsilon_f)\) such that for an \(\epsilon_m\) above this threshold the new contract gives \(\lambda_2\) equal to the lower bound of 9. Henceforth, we refer to the lower bound in 9 as \(\lambda_2^L\) and to the upper bound as \(\lambda_2^U\).

**Labor Taxes.** Given the intrahousehold allocation, we can derive the effect of changes in the level of labor taxes \(\tau_N\) and capital taxes \(\tau_K\). First consider that labor taxes fall, i.e. \((1 - \tau_N)\) increases. Abstracting from movements in wages and interest rates, we can write:
\[
\frac{d\lambda_2^L}{d(1 - \tau_N)} = e^{-\xi} A_c (A_c + \sum_g \epsilon_g w(1 - \tau_N)w)^2\epsilon_m w - \sum_g \epsilon_g w\frac{w}{2}
\]
(10)
\[
\frac{d\lambda_2^U}{d(1 - \tau_N)} = e^{-\xi} A_c (A_c + \sum g \epsilon_g w(1 - \tau_N)w)^2\sum g \epsilon_g w - \epsilon_f w
\]
(11)
Consider the case where \(\epsilon_m > \tau_m(A_c, \epsilon_f)\). In this case, it must be that \(\lambda_2 = \lambda_2^L > \frac{1}{2}\), i.e. the male spouse’s weight needs to increase (the lower bound in 9 binds). The partial derivative 10 is positive, meaning that a reduction in the level of labor taxes increases \(\lambda_2^L\) and, therefore, makes the change in \(\lambda_2\) relative to \(\lambda_1\) even greater. A fall in the tax rate reduces risk sharing within the household because in those states where the male labor income is high, the husband’s consumption share increases even more than if labor taxation is high. The intuition is that changes in labor income are the root of the limited commitment problem. Lower tax rates exacerbate intrahousehold income inequality and therefore exacerbate the limited commitment problem.\(^5\) We summarize the result in the following proposition:

\(^5\)Obviously from 10 (and 11), this effect goes through if the household has positive wealth at the beginning of period 2. If \(A_c\) equals zero, then the derivatives are zero and changes in the tax schedule have no impact on the intrahousehold allocation.
Proposition 1. Holding wages and interest rates constant, a reduction in labor income taxes reduces insurance within the household under log-log separable preferences. The household sharing rule and thus the intrahousehold allocation become more responsive to changes in the idiosyncratic labor productivity of the male and the female spouse.

Note that if $\epsilon_f >> \epsilon_m$ the upper bound $\lambda^U_2$ will bind. In that case, the female spouse must be made better off and a reduction in $\tau_N$ will decrease $\lambda^U_2$ hence making the fall in the male share larger. ⁶

Capital Taxes. We derive the impact of wealth and capital taxation on the participation constraints. The relevant partial derivatives are those of $\lambda^U_2$ or $\lambda^U_2$ with respect to $A_c$, given by the following expressions:

\[
\frac{d\lambda^U_2}{dA_c} = e^{-\xi}(1 - \tau_N)\frac{\sum_g \epsilon_g w}{(A_c + \sum_g \epsilon_g (1 - \tau_N)w)^2} - \epsilon_m w
\]

\[
\frac{d\lambda^U_2}{dA_c} = e^{-\xi}(1 - \tau_N)\frac{\epsilon_f w - \sum_g \epsilon_g w}{(A_c + \sum_g \epsilon_g (1 - \tau_N)w)^2}
\]

Notice that if $\epsilon_m > \epsilon_f$ (male participation constraint may bind), 12 and 13 satisfy $\frac{d\lambda^U_2}{dA_c} < 0$ and $\frac{d\lambda^U_2}{dA_c} > 0$. ⁷ They imply that a rise in asset income has a beneficial effect on household risk sharing. When capital taxes drop, more risk sharing comes from two sources: First, the household enjoys a higher return given its stock of assets because the quantity $1 + r(1 - \tau_K)$ increases absent any effect on the interest rate. Second, the level of wealth increases as the household wants to save more in response to the higher return. The next proposition summarizes the effect of lower capital taxation on household insurance:

Proposition 2. Lower capital taxes improve insurance under log-log preferences. The household sharing rule and thus intrahousehold allocation are less responsive to changes in labor income tax.

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⑥It is worth noting that general equilibrium effects that are left out from 10 and 11 typically operate in the opposite direction. To see this, note that in the short run, with the economy’s capital being fixed, a fall in labor taxes will affect wages and interest rates through hours worked. Since hours will increase in response to the fall in distortionary taxation, the wage rate $w$ will decrease and the interest rate $r$ will rise (under a Cobb-Douglas production technology). Consequently, the above expressions have to be multiplied by $1 + \frac{dw}{d(1-\tau_N)} \frac{(1-\tau_N)}{w}$. Moreover, an additional term that reflects the effect of higher financial income on the constraint set has to be included. This term is given by $\frac{d\tau(1-\tau_N)\alpha}{d(1-\tau_N)} > 0$ times the partial derivatives of $\lambda^U_2$ or $\lambda^U_2$ with respect to $A_c$.

We can show that $\frac{d\lambda^U_2}{dA_c} > 0$ and $\frac{d\lambda^U_2}{dA_c} > 0$ is the case where $\epsilon_m > \epsilon_f$ (male participation constraint is relevant). In words, when labor taxes fall, the rise in the interest rate will increase the importance of financial income to the households budget and relax the limited commitment constraints. This effect, however, will grow weaker as the economy builds up a higher capital stock after the fall in the labor income tax rate.

Finally, notice that the magnitude of the term $\frac{dw}{d(1-\tau_N)} \frac{(1-\tau_N)}{w}$ has to be implausible to invalidate proposition 1. For example, assume that the technology is off the form $K^\alpha N^{1-\alpha}$, that gives a wage rate $w = (1 - \alpha)K^\alpha N^{-\alpha}$. Moreover, note that we can write the term $\frac{dw}{d(1-\tau_N)} \frac{(1-\tau_N)}{w}$ as $\frac{d\tau}{dN} \frac{dN}{d(1-\tau_N)} \frac{(1-\tau_N)}{w}$.

Let $\epsilon_N$ be the elasticity of $N$ with respect to $(1 - \tau_N)$, it follows that $\frac{d\tau}{dN} \frac{dN}{d(1-\tau_N)} \frac{(1-\tau_N)}{w} = -\alpha \epsilon_N$. If we assume that $\alpha$ (the capital share in value added) is roughly one third, the elasticity has to be above three to reverse the sign of the term $1 + \frac{dw}{d(1-\tau_N)} \frac{(1-\tau_N)}{w}$. This seems to be implausibly high given that most empirical estimates place the elasticity of labor supply below unity.

⑦The signs are opposite when $\epsilon_f > \epsilon_m$. 

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Note that as the previous discussion indicates, lowering capital taxation may induce changes on the intrahousehold allocation both when the change in policy takes place in which case savings may be held fixed, as well as in the longer term i.e. when capital is build up in response to the higher returns. Moreover, it is important to emphasize that the changes in intrahousehold insurance that we are interested in, do not stem from the standard role of assets as means of buffering shocks to the family income (e.g. precautionary savings). They are related to the division of resources in the household, and the notion that wealth in contrast to labor income, is a common resource for the household.

In the Appendix we investigate the impact of limited commitment on household savings. We establish that more or less commitment has an ambiguous effect on the demand for assets, meaning that household savings could both increase or decrease under household bargaining. This in turn implies that wealth accumulation which will respond to the changes in intrahousehold insurance that we are interested in, do not stem from the changes on the intrahousehold allocation both when the change in policy takes place in the shorter term (the term \(1 - \tau_N\)) and also the first term in \(16\) eventually switches sign. When the overall partial derivative is negative, the fall in labor taxation exacerbates inequality within the family and reduces welfare by reducing insurance. This is the result we established under log-log separable utility. What non-separability brings to the equation is the leading term in \(16\) that yields the non-monotonicity that makes the effect of changes in labor income taxation ambiguous.

To understand what this term captures, note that when wealth is low, a rise in the tax rate reduces inequality in terms of labor incomes, but it also impoverishes the household.

**Non-Separable Preferences.** We derive the impact of changes in taxation assuming that individual utility is given by \(u(c_l^g, l_f^g) = \frac{((\eta^g)^{\eta}(\lambda^g)^{1-\eta})^{1-\gamma}}{1-\gamma} \) with \(\gamma > 1\). Using simple algebra, we can write the participation constraints for male and female spouses as follows:

\[
(14) \quad \left( \frac{A_c + \sum_g w(1 - \tau_N)\epsilon_g}{(1 + f(\lambda_2, \epsilon))((w(1 - \tau_N)\epsilon_m)^{1-\eta})^{1-\gamma}} \right)^{1-\eta} \geq \frac{\chi}{1-\gamma} + \xi \geq \left( \frac{\frac{A_c}{2} + w(1 - \tau_N)\epsilon_m}{(w(1 - \tau_N)\epsilon_m)^{1-\eta}} \right)^{1-\eta} \frac{\chi}{1-\gamma}
\]

\[
(15) \quad \left( \frac{f(\lambda_2, \epsilon)}{1 + f(\lambda_2, \epsilon)} \frac{A_c + \sum_g w(1 - \tau_N)\epsilon_g}{(w(1 - \tau_N)\epsilon_f)^{1-\eta}} \right)^{1-\eta} \geq \frac{\chi}{1-\gamma} + \xi \geq \left( \frac{\frac{A_c}{2} + w(1 - \tau_N)\epsilon_f}{(w(1 - \tau_N)\epsilon_f)^{1-\eta}} \right)^{1-\eta} \frac{\chi}{1-\gamma}
\]

where \(\chi = (\eta^g(1 - \eta)^{1-\eta})^{1-\gamma}\) and \(f(\lambda_2, \epsilon) = \frac{\lambda_2}{1 - \lambda_2} (\frac{\epsilon_f}{\epsilon_m})^{(1-\eta)(1-\gamma)}\). Notice that with nonseparable utility, the family member that works the most must be compensated with a higher consumption share, and thus the sharing rule depends on the relative endowments (the term \(\frac{\epsilon_f}{\epsilon_m}\)). We show in the Appendix that the effect of a rise in \(1 - \tau_N\) on \(\lambda_2^f\) is determined by the sign of the following expression:

\[
(16) \quad (1 - \gamma) \left[ \tilde{\xi} \left( \frac{A_c(1 - \eta)}{1 - \tau_N} - \eta \sum_g w(1 - \tau_N)\epsilon_g \right) \kappa_1(A_c, \epsilon) + (A_c w(\epsilon_m - \frac{\sum_g \epsilon_g}{2})) \kappa_2(A_c, \epsilon) \right]
\]

where \(\kappa_1 = \frac{(w(1 - \tau_N)\epsilon_m(1-\eta)(1-\gamma))}{(A_c + \sum_g w(1 - \tau_N)\epsilon_g)^{2-\gamma}} > 0\), \(\kappa_2 = \frac{(A_c w(\epsilon_m - \frac{\sum_g \epsilon_g}{2}))}{(A_c + \sum_g w(1 - \tau_N)\epsilon_g)^{2-\gamma}} > 0\) and \(\tilde{\xi} = -\frac{\xi(1-\gamma)}{\eta^g(1 - \eta)^{1-\gamma}} > 0\).

In \(16\), if \(A_c = 0\) then only the leading term is different from zero and in fact it is positive. In this case, we can show that an increase in \(1 - \tau_N\) will increase intrahousehold risk sharing against uncertain labor income, or to put it differently, it will reduce the response of the sharing rule to variations in income. When \(A_c > 0\), the second term is added and also the first term in \(16\) eventually switches sign. When the overall partial derivative is negative, the fall in labor taxation exacerbates inequality within the family and reduces welfare by reducing insurance. This is the result we established under log-log separable utility. What non-separability brings to the equation is the leading term in \(16\) that yields the non-monotonicity that makes the effect of changes in labor income taxation ambiguous.
When utility is curved, the reduction in household income translates into a substantial increase in the marginal utility of consumption. Given $\epsilon_m$ and $\epsilon_f$ the participation constraints tighten. There is, therefore, a powerful income effect that in the case of log utility was balanced by the larger equity in household resources. In the Appendix, we show that a similar result applies to the upper bound $\lambda_U^2$. We also establish that the effect of lower capital taxation is unambiguous; it always improves the household’s insurance possibilities.

**Proposition 3.** Assume that utility is nonseparable in consumption and leisure. Lowering labor income taxes reduces intrahousehold inequality when household wealth is low. In contrast, when the household is wealthy, reducing labor taxation has a detrimental effect on intrahousehold insurance. Lower capital taxes always improve the households insurance.

**Proof:** See Appendix.

In our quantitative analysis in section 4, following previous work in the optimal tax code literature (see for example Imrohoroglu (1998), Conesa, Kitao and Krueger (2009) and Conesa and Krueger (2006)) we deal only with the case of nonseparable utility. However we think that it is important to disentangle the channels through which preferences affect our results and therefore we also consider here a commonly used specification of separable preferences. Moreover, note that since the change in policy in section 4 is one that eliminates capital taxation and raises labor income taxes, our results under non separable utility illustrate that it may or may not relax the households limited commitment problem. To the extent that the policy change does not affect overall household resources by much, shifting the burden of taxation from wealth to labor income will enhance commitment. Clearly wealthier households are more likely to benefit from this channel. But very young and very old households that are typically wealth poor, may not.

### 2.2 Implications and Alternative Approaches

Equations 14 and 15 in the previous paragraph defined the updating rule of the household weight $\lambda$. According to the household contract, the weight jumps if and only if there is a violation of the participation constraint and if not, it stays constant over time. Rewriting equation 14 we can express the updating rule when the husbands participation constraint binds as follows:

$$
\frac{\lambda_2}{1-\lambda_2} = (\frac{\epsilon_m}{\epsilon_f})^{(1-\gamma)(1-\gamma)} (-\frac{\xi_m}{\lambda} + \frac{\epsilon_m}{\lambda} (1-\gamma)) (1-\gamma) + \frac{A_e + \sum_g \epsilon_g w (1-\tau_N) w^{1-\gamma}}{A_e + \sum_g \epsilon_g (1-\tau_N) w^{1-\gamma}} (\frac{1}{\gamma - 1 - 1})^{-\gamma}.
$$

We think that it is important to generalize our findings, by briefly explaining what 17 would look like if we included in our model the following features: 1. Preference heterogeneity, 2. Nash Bargaining each period and 3. Different costs of divorce and a different division of the household’s wealth in the event of divorce.

To address preference heterogeneity, we keep our parameterization of the individual utility function as non-separable but assume that male and female spouses value consumption and leisure differently through the parameters $\eta_m \neq \eta_f$. It can be shown that

---

8Unfortunately it is not possible to derive closed form solutions in the form of 17 when $\gamma_m \neq \gamma_f$. We have however solved such a model numerically and found that our results generalize.
in that case the updating rule takes the following form:

$$\frac{\lambda_2}{1 - \lambda_2} = \kappa_3 \left( \frac{\epsilon_m(1 - \eta_m)(1 - \gamma)}{\epsilon_f(1 - \eta_f)(1 - \gamma)} \right) \left[ (\frac{\xi}{\chi} \epsilon_m(1 - \eta_m)(1 - \gamma)(1 - \gamma) + (\frac{A_c}{A_c} + \epsilon_m w(1 - \tau_N)(1 - \gamma))^{\frac{\gamma}{\gamma - 1} - 1} \right]$$

where $$\kappa_3 = (\frac{w}{\eta_m})^{1 - \gamma} \left( \frac{\eta_m}{1 - \eta_m} \right)^{(1 - \eta_m)(1 - \gamma)(1 - \eta_f)(1 - \gamma)}$$. Notice that 18 is different from 17 only in the leading term. In both equations the leading terms are positive and the crucial expression that determines sign of the effect of wealth and the tax rates is the bracketed subsequent term. Therefore under preference heterogeneity wealth continues to have the same impact on household commitment. Moreover it can be established that the implications of changes in capital and labor taxes on commitment are essentially the same.

Under Nash Bargaining the household contract no longer has the property that it keeps individual weights constant over a region of the state space where the participation constraint does not bind. In the Nash bargaining equilibrium the sharing rule is rebargained each period and $$\lambda_2$$ is a function of assets, $$\epsilon_m$$ and $$\epsilon_f$$ and solves the following equation:

$$\lambda_2(a, \epsilon) \in \arg \max_{\lambda_2} \left\{ \left( \frac{A_c + \sum_g w(1 - \tau_N)\epsilon_g}{(1 + f(\lambda_2, \epsilon))((w(1 - \tau_N)\epsilon_m)^{1 - \eta})} \right)^{1 - \gamma} \frac{\chi}{1 - \gamma} + \xi - \left( \frac{A_c + \sum_g w(1 - \tau_N)\epsilon_g}{(w(1 - \tau_N)\epsilon_m)^{1 - \eta}} \right)^{1 - \gamma} \frac{\chi}{1 - \gamma} \right\}$$

From 19 we can derive the impact of wealth on the equilibrium allocation that solves the Nash bargaining program. For the sake of brevity we leave it to the Appendix to show that as wealth increases the surplus for the household increases and the equilibrium weight gets closer to 1/2. Shocks to individual income have a smaller impact on the weight the higher the stock of wealth. The analysis of the previous section that derives the impact of the tax schedule on the household sharing rule is therefore applicable to this model.9

Finally, assume that instead of an equal division of assets in the case of divorce we have a rule of the form $$A_c \geq D_m(A_c) + D_f(A_c)$$. As in Regalia and Ríos-Rull (2001) this specification allows for divorce costs to be proportional to the wealth stock but also for male and female shares to be different. Under this rule we can establish that the sign of the effect of wealth on rebargaining, when the male spouse’s participation constraint binds, is determined by:

$$\frac{(\gamma - 1)^2 \xi (\epsilon_m(1 - \eta_m)(1 - \gamma))}{\chi (A_c + \sum \epsilon_i)^{1 - \gamma}} + (1 - \gamma) \kappa_4 [D_m' A_c - D_m(A_c) + w(1 - \tau_N)(D_m' \sum \epsilon_g - \epsilon_m)]$$

where $$\kappa_4 = (\frac{D_m(A_c) + \epsilon_m w(1 - \tau_N)}{(\sum \epsilon_g w(1 - \tau_N) + A_c)^{2 - \gamma}})$$

The first term captures more commitment when wealth increases. The second term has the same impact if positive. To simplify, let $$\theta_m$$ be the

---

9Notice that given that $$\lambda_2(a, \epsilon)$$ is a function of the state vector under Nash bargaining, the equilibrium under Nash bargaining is a Markov perfect equilibrium whereby wealth and current productivity are sufficient to summarize the household’s contract. In contrast, under our benchmark contract the entire history of shocks matters for the allocation (even beyond the current stock of wealth and productivity). Ours is a model where the weight is constant over a part of the state space, and in this region perfect risk sharing applies. Nash bargaining is therefore less efficient because it leads to more frequent renegotiations over the intrahousehold allocation.
male spouses share on wealth in the event of divorce. Then the second term in 20 becomes 
\((1 - \gamma)\kappa[w(1 - \tau_N)(\theta_m \sum \epsilon_g - \epsilon_m)]\). This is positive surely 
over the relevant region if \(\theta_m \leq \frac{1}{2}\), because 20 is pertinent only when \(\epsilon_m > \epsilon_f\), i.e. when the male 
spouse needs to be made better off. Moreover, even if this condition is violated, i.e. when 
\((\theta_m > \frac{\epsilon_m}{\sum \epsilon_g})\), \(\theta_m\) still needs to be large enough to 
compensate for the first term in 20. As discussed previously, the relevant empirical 
evidence suggests that US courts in principle on average split equally the common 
marital property (assets). In this respect the weight \(\theta_m\) could be large, but 
only as a realization of a stochastic \(\theta_m\) that the couple draws after the divorce is 
final. Notice that if we had made \(\theta_m\) stochastic, then for risk averse individuals 
divorcing would be even less attractive the higher wealth is. We conclude this paragraph 
by noting that under reasonable alternative assumptions our model’s implications 
continue to hold.

3 Quantitative Model

This section presents our quantitative life cycle model. We consider an economy populated 
by a continuum of individuals, equally many males and females. Gender is indexed by 
g \(\in\{m, f\}\) and age by \(j \in\{1, 2, ..., J\}\). Individuals survive from age \(j\) to \(j + 1\) with 
probability \(\psi_j\). At each date a new cohort of individuals enters the economy; we assume 
that the population grows exogenously at rate \(\theta\).

\(^{10}\)Notice that in the two period setup for \(\xi > 0\) it is not possible to obtain a region where couples prefer 
to divorce. To put it differently, it is always possible in the second period, to implement an allocation 
that gives to the male and the female spouses exactly the same level of utility that they would get if they 
separated (this property, however, does not hold in the multiperiod setup of the next section). In order 
to introduce (endogenous) divorce in this model we would have to consider an environment where the 
couple draws a new value of \(\xi\) in period 2 (as in Voena (2012)). In the Appendix we make the following 
point: We argue that though couples divorce when the realization of \(\xi\) is negative, a stochastic \(\xi\) (if 
positive) will nonetheless impact the intrahousehold allocation. For instance if \(\xi\) is low enough the couple 
will rebargain more frequently in response to the realized values of \(\epsilon_m\) and \(\epsilon_f\). We show that more 
wealth can mitigate the impact of shocks to \(\xi\) in a way that reduces fluctuations in the sharing rule 
\(\lambda_2\). Therefore higher wealth improves commitment even when the source of rebargaining is shocks that 
produce endogenous divorce.

\(^{11}\)For the sake of completeness we briefly comment on how our model’s implications would be affected if 
we allowed divorce settlements to depend on the income of the male and the female spouses such as in the 
case of alimony. First, note that alimony payments are more likely to concern a permanent component 
of individual productivity rather than a transitory shock such as the \(\epsilon\) endowment considered in this 
section. In our quantitative model we allow for a fixed effect component to labor income and a life cycle 
component of male and female productivity implicit to which is the gender pay gap. We argue that by 
and large these predictable components of individual productivity are factored in the initial allocation in 
the first period, and do not lead to renegotiations of the marital contract. Household rebargaining (or its 
most part) stems from the time varying transitory shocks which are similar to the shocks considered in 
this section.

Second, note that when wealth is a state variable, as it is in our model, past realizations of temporary 
shocks do affect the outside options of individuals through wealth accumulation. Families that have 
experienced a stream of good shocks in productivity, are likely to have accumulated more wealth. Given 
an our formalization of how wealth is divided in the event of separation it is therefore obvious that in the 
multiperiod model of the next section, outside options, through wealth, are influenced by the history of 
individual labor income and are thus (partially) contingent on the realization of shocks. If one of the 
spouses experiences a stream of high productivity shocks, he (she) contributes more to wealth accumu-
lation and in the event of a separation, the division of common marital property favors the other spouse. 
Notice also that for couples with enough wealth, modelling such transfers through the division of wealth 
or modelling them as per period lump sum payments is essentially the same.
The life cycle of individuals comprises of the following three stages: Marriage (matching), work and retirement. Since our model does not endogenize family formation, we simplify the first stage by letting matching take place in a pre-labor-market period of life labeled age zero. A fraction $\mu$ of individuals will find partners at this stage and form households as couples, and the remaining agents will remain bachelors.\(^{12}\) Marital status does not change over time. After date zero individuals work for $j_{R} - 1$ periods –conditional on survival– and then retire at date $j_{R}$. At age $J$, they die with probability one.

Agents are risk averse and derive utility from consumption $c$ and leisure $l$. Per-period utility is denoted by $u(c, l)$. We follow the convention in the literature of representing male and female preferences by the same utility function. Finally individuals and households discount future utility flows at a constant factor $\beta$.

### 3.1 Endowments

Agents in the economy differ in terms of their labor productivity along three dimensions: a deterministic (life cycle) component $L_{g}(j)$, a fixed effect $\alpha_{g}$ and an idiosyncratic labor productivity shock $\epsilon_{g}$. When entering the labor market, each agent draws a realization of $\alpha_{g}$, the value of which remains constant throughout her working life. We assume that there are $N$ possible realizations $\{\alpha_{1,g}, \alpha_{2,g}, ... \alpha_{N,g}\}$ for each gender. We also assume that the assignment of an agent to a realization is made according to some probabilities $p_{S}^{g}$ when the agent is single, and according to probabilities $p_{M}^{g}$ when the individual is married. Notice that $p_{M}^{g}$ is the joint distribution of the two spouses across all possible values of $\alpha_{m}$ and $\alpha_{f}$.

Idiosyncratic productivity $\epsilon_{g}$ changes stochastically over time according to a first order Markov process. We let $\pi_{g}(\epsilon'_{g}|\epsilon_{g})$ be the conditional pdf for this process. The analogous object for couples is denoted by $\pi(\epsilon'_{e}|\epsilon)$, where $\epsilon$ in the case of a couple household is the vector of productivities of its members.

### 3.2 Markets and Technology

We assume that the production technology can be represented with a Cobb-Douglas function of the form:

\[
Y = K^{\alpha}(AN)^{1-\alpha}
\]

where $K$ denotes the economy’s aggregate capital stock, and $N$ is the aggregate labor input, and $A$ is the level of labor-augmenting technology. The resource constraint is given by $K' = (1 - \delta)K + Y - G - C$, where by convention, primes denote the next model period. $C$ is aggregate consumption in the economy, $G$ is government spending and $\delta$ is the depreciation rate of the aggregate capital stock. Factor prices are determined in competitive markets. Wages, measured in efficiency units, are equal to the marginal product of labor, and the return to capital is its marginal product net of depreciation. We denote these objects by $w$ and $r$ respectively.

Financial markets are incomplete. There are no state contingent securities. By trading claims on the aggregate capital stock, agents can self insure. In keeping with the literature, we assume that these trades are subject to an ad hoc borrowing constraint $\pi$. The value for the constraint is set to zero, such that our economy rules out borrowing altogether.

\(^{12}\)Note that though our focus is on the behavior of couples we include single households in the model to get a realistic response of aggregate prices to the change in the tax schedule.
Moreover, there are no annuity markets and households leave accidental bequests which we denote by $B$. Bequests are distributed uniformly across individuals in the economy.

### 3.3 Government

The government engages in two activities. First, it levies taxes on consumption $\tau_C$, on financial income $\tau_K$, and on labor income $\tau_N$ to finance a level of expenditures $G$. We rule out government debt so that the government runs a balanced budget each period.

Second, it runs a Pay-as-you-Go social security system, which is financed through a proportional tax on the earnings of the working population. We denote by $\tau_{SS}$ the social security tax, and by $SS(g, \alpha_g)$ the transfer that a retired individual receives from the government. Notice that transfers depend on gender $g$, and the wage fixed effect $\alpha_g$. Our aim is to capture the current US social security system in a parsimonious way. $SS(g, \alpha_i,g)$ depends on gender because life cycle productivity $L_g(j)$ differs across men and women in the economy.

### 3.4 Value Functions

**Bachelor Households.** We first consider the program of a bachelor of gender $g$ and age $j$. We let $S_g(a, X, j)$ be the lifetime utility for this agent when her (his) stock of wealth is $a$, her permanent productivity is $\alpha_g$, her idiosyncratic time varying productivity is $\epsilon_g$. To save on notation, we summarize the fixed effect and the time varying component of productivity in a vector $X$. This agent must choose consumption $c$ and hours worked $n$ (if not retired, i.e. $j < j_R$) to maximize her utility subject to the budget and the borrowing constraints. She solves the following functional equation:

\[
S_g(a, X, j) = \max_{a', l \geq a, l} u(c, l) + \beta \psi_j \int S_g(a', X', j + 1) d\pi_g(X'|X) \tag{22}
\]

Subject to:

\[
a' + (1 + \tau_C)c = (a + B)(1 + r(1 - \tau_K)) + w\epsilon_g\alpha_i,gL_g(j)(1 - \tau_N - \tau_{SS})n \quad \text{if } j < j_R
\]

\[
a' + (1 + \tau_C)c = (a + B)(1 + r(1 - \tau_K)) + SS(g, \alpha_g) \quad \text{if } j \geq j_R
\]

**Couples.** In this paragraph, we describe the program of the couple. As previously in section 2, we model decision making within the household as a contract under limited commitment following the work of Mazzocco, Ruiz and Yamaguchi (2007), Gallipoli and Turner (2011) and Voena (2012). The participation constraints are again such that individuals must be at any point in time better off in the marriage than as singles implying that the household needs to partially give up risk sharing in order to satisfy them. We denote the male share $\lambda$ and equivalently, $1 - \lambda$ represents the female spouse’s share. Given the households contract these shares will change over time to satisfy participation. Moreover, in the model of this section we assume that they are initiated at the matching stage, whereby the household solves a Nash bargaining game.

As in Cubeddu and Ríos-Rull (1997), Regalia and Ríos-Rull (2001) and Mazzocco (2007), among others, we consider wealth as a commonly held resource in the family. This assumption is a considerable simplification of the households program because it reduces the number of state variables (we only have to keep track of the households total wealth), and it implies that individual Euler equations do not have to be introduced as additional constraints to the household’s program. More importantly, it is a reasonable assumption.
to make for the behavior of US households. According to the empirical evidence in Mazzocco (2007), in all US states, with the exception of the state of Mississippi, all income earned in the marriage, and wealth acquired with this income, are considered common marital property. We take this to mean that only aggregate family wealth matters for the household’s decision making. Moreover, note that because in the model individuals are born with zero assets and couples are born married and stay married forever, all wealth that is accumulated over the life cycle is indeed common property.

In order to determine the outside options for the male and the female spouse, we continue to assume as in the analysis of section 2 that divorce leads to an equal division of assets. As discussed previously this assumption is in line with the empirical evidence presented in Mazzocco (2007). Let $M(a, X, \lambda, j)$ be the value function of a household of age $j$ (in our economy households are formed by agents of the same cohort), where $X$ summarizes the productive endowments of its members, and as before $a$ is the level of wealth of the household. Moreover, $\xi$ is again the (constant) benefit that accrues to each spouse in the marriage. The program of the couple can be written as:

$$
M(a, X, \lambda, j) = \max \lambda u(c^m, l^m) + (1 - \lambda)u(c^f, l^f) + \xi + \beta \psi_j \int M(a', X', \lambda + 1)d\pi(X'|X)
$$

Subject to:

$$
l^g + n^g \leq 1 \text{ for } g \in \{m, f\}
$$

$$
a' + (1 + \tau_C)(c^m + c^f) = (a + 2B)(1 + r(1 - \tau_K)) + w(\sum g L_g(j)\alpha_i \epsilon_{i,g} n^g(1 - \tau_N - \tau_{SS})) \text{ if } j < j_R
$$

$$
a' + (1 + \tau_C)(c^m + c^f) = (a + 2B)(1 + r(1 - \tau_K)) + \sum g SS(g, \alpha_i, g) \text{ if } j \geq j_R
$$

Notice that in 23, the couple draws a new value $\lambda'$ in the next period. As discussed previously, this updating occurs if there is a violation of participation. If, for example, under a new realization of the state vector $X'$ the husband is better off as a single than under the contract $\lambda$, his share in household resources must increase to reflect his improved bargaining position. Analogously, $\lambda$ decreases if the female spouse has to be made better off. Formally, let $V_g(a, X, \lambda, j)$ be the expected lifetime utility of the household member of gender $g$ under the optimal policies that solve equation 23. It is determined by the following functional equation:

$$
V_g(a, X, \lambda, j) = u_g(c^g, l^g) + \xi + \beta \psi_j \int V_g(a', X', \lambda, j + 1)d\pi(X'|X)
$$

The updating rule for $\lambda$ in the model of this section (which generalizes the analogous object defined in the previous section) is as follows:

$$
\lambda' \in \arg \min_{\lambda'} |\lambda' - \lambda| \text{ such that } V_g(a', X', \lambda', j + 1) \geq S_g(a', X_g', j + 1)
$$

where $X_g$ is a vector formed by elements of $X$ that are relevant to household member $g$ if he or she were to be single.
Finally, the value of $\lambda$ is initiated at the matching stage of the life cycle, as a solution to the following Nash bargaining problem:

$$\lambda_1 \in \arg \max_{\lambda} \left[ V_m(a, X, \lambda, 1) - S_m\left(\frac{a}{2}, X, \lambda, 1\right) + \bar{\xi}_m \right] - S_f\left(\frac{a}{2}, X, \lambda, 1\right) + \bar{\xi}_f]$$

Two final comments are in order. First, notice that the Nash sharing rule determines the initial intrahousehold allocation under the influence of two additional gender specific utility gains $\bar{\xi}_g$ for $g \in \{m, f\}$. These gains at the matching stage determine the magnitude of income transfers from one spouse to the other. For example, if $\bar{\xi}_m > \bar{\xi}_f$ then the household contract will give an initial allocation with large transfers from the male to the female spouse thus leading to a big inequality in hours within the family. We will choose values for $\bar{\xi}_m$ and $\bar{\xi}_f$ to target the division of hours in the family as in the US data.

Second, although the marriage gain $\xi$ is constant over the life cycle and, therefore, has no direct effect on the optimality conditions in 23, it does affect the extent to which the two spouses can commit to the allocation that they bargain for in period 1. If $\xi$ is sufficiently large, the marital surplus is sufficiently large so that updating of the weight $\lambda$ never occurs. In this case, there exists an initial weight $\lambda_1$ such that the household can commit to never update the sharing rule, and perfect risk sharing within the household will obtain. For smaller values of the utility gain the household contract is one of limited commitment, meaning that the participation constraints will occasionally bind (see Ligon, Thomas and Worrall (2000); Attanasio and Ríos-Rull (2000)). In our numerical analysis, we choose the value of $\xi$ to be the lowest possible such that there is no divorce in equilibrium. In other words we maximize the frequency of rebargaining within the household subject to having a positive surplus for all marriages. Note that in making this assumption we are nevertheless overestimating commitment; since couples do divorce, a lower value of $\xi$ that would enable us to target the empirical divorce rates, would lead to even more frequent changes in the intrahousehold allocation. Therefore our quantitative results about the impact of the tax schedule on the intrahousehold allocation are conservative if anything.

We characterize the competitive equilibrium in section A.3 in the Appendix.

### 3.5 Calibration and Model Evaluation

**Preferences and Demographics.** The demographic parameters have been set so that the model has a stationary demographic structure that matches the age distribution in the US economy. We assume that individuals are born at age 25 and live at most until age 95. Retirement is at age 65. The survival probabilities are taken from Arias (2010), based on the US National Vital Statistics Reports and correspond to probabilities concerning the entire population (pooling men and women). The model period is set to five years. This means that there are fifteen periods in the model and the retirement age $j_R = 10$. Although we make this assumption for computational reasons, in what follows we report annual values for the parameters. We set the fraction of households that are married $\mu$ equal to 52% which is the corresponding statistic in the PSID data over all age groups. With this choice roughly 69% of all individuals in our economy are married. Population growth is assumed to be constant $\theta = 0.012$.

---

13 As noted previously in the multiperiod model of this section positive values of $\xi$ are consistent with equilibrium divorce. This was not the case under the two period model presented previously (see Appendix for further details).
Per period utility for each household member is of the following form:

\[ u(c, l) = \left[ (\theta l^{1-\eta} - 1)^{1-\gamma} - 1 \right] / 1 - \gamma \]

We calibrate the preference parameters as follows: first, in keeping with previous studies on the optimal tax code, we follow Conesa, Kitao and Krueger (2009) and Fuster, Imrohoroglu and Imrohoroglu (2008), and set \( \gamma = 4 \). We also choose a value of \( \eta = 0.38 \) so that our model produces, in the steady state, average hours worked of one third. With these numbers the intertemporal elasticity of substitution, \( (1 - \eta(1 - \gamma))^{-1} \), is equal to 0.4673.

For married couples we have to determine the utility gains \( \xi_m \) and \( \xi_f \) at the Nash bargaining stage and the flow gain \( \xi \) that couples enjoy at each period. As discussed earlier, these parameters govern the following two aspects of the intrahousehold allocation. First, \( \xi_m \) and \( \xi_f \) determine the transfers from one spouse to another, and along with differences in the age productivity profiles \( L_j(g) \), they determine inequality in hours within the household. We pick numbers for these parameters to match average hours worked for married men and women as in the US data; according to the PSID married males worked 2104 hours in 2006, married females 1420 hours, single males 1743 hours and single females 1593 hours. We map these numbers into model units and we normalize the work time to be one third of the time endowment on average in our economy.

Second, the constant gain \( \xi \) determines the ability of the household to commit to an allocation that is chosen at the matching stage. The smaller \( \xi \) is, the more the household members will be tempted to renege on this allocation and the more frequent rebargaining will occur in every period. As discussed previously, we chose a very low value for \( \xi \) so that in the model rebargaining is frequent but divorce never occurs. To motivate this choice we noted that in the data couples do divorce and therefore, if we were to allow for separations, lower values of \( \xi \) would be appropriate. Moreover, because divorce is a type of renegotiation of the household contract and a breakdown of commitment, our model misses on an important channel that is affected by changes in the tax code. That is to say our quantitative results of the impact of capital and labor taxes on household risk sharing

\[14\] Based on empirical evidence by Attanasio and Weber (1995) and Meghir and Weber (1996), which suggests that individual preferences are not separable in consumption and leisure, Mazzocco, Ruiz and Yamaguchi (2007) argue that a value of \( \gamma \) greater than unity is appropriate. Note that given our results in section 2 a separable utility in consumption and leisure (\( \gamma = 1 \)) would imply that both higher labor taxes and lower capital taxes, improve intrahousehold commitment. Therefore our calibration is conservative in this sense.

\[15\] Average hours are reported in the PSID 2007 survey and correspond to the previous year work time.

\[16\] Our results are not sensitive to the calibration of the initial bargaining position. It is worth noting however that \( \xi_m \) and \( \xi_f \) are not the only parameters that affect the initial sharing rule, but also the constant gain \( \xi \). The higher is \( \xi \) and the closer is the model to the full commitment allocation (see the previous discussion), the closer are the initial shares to \( \frac{1}{2} \) by the properties of Nash bargaining. Our approach is to utilize \( \xi \) to maximize rebargaining in the family (so a low value is targeted ) and use \( \xi_m \) and \( \xi_f \) in order to target the division of hours as in the data. This gives us \( \xi_m > 0 \) and \( \xi_f < 0 \); nevertheless the female (initial) share \( 1 - \lambda \) is underestimated under the limited commitment contract and is roughly 0.45 on average. To put this differently, absent intrahousehold transfers the share would have been even lower and female hours even higher in the model (possibly matching those of single females). If on the other hand the household contract was complete, transfers from males to females would be higher and married females would work too little relative to the targets in the data.

Note that a model that contains home hours as well as market hours would possibly enable us to set \( \xi_m \) and \( \xi_f \) equal to zero, because overall hours in the household would reflect specialization in home and market production rather than initial differences in the sharing rule. This is an important extension that we leave to future work.
are in fact conservative relative to what we would get had we included (endogenous) divorces to the model.  

**Technology and Endowments.** The technology parameters are chosen as follows. In the model we allow technology $A_t$ to grow at a rate equal to 1.4% per year. Moreover, we set the capital share in value added $\alpha$ equal to 0.36 and we choose the depreciation rate of capital $\delta$ to match an investment to output ratio of 21% in the steady state. This gives us an annual value for this parameter of 5.26%. The subjective discount factor $\beta$ is calibrated so that the economy in the steady state produces the capital output ratio of 2.7. This procedure yields a value of 1.003.

Individual wages in the model are the product of three components; the gender specific life cycle profile, the fixed effect, and the temporary idiosyncratic productivity shock. Following the bulk of the literature, we take the life cycle profiles $L_g(j)$ from Hansen (1993). Moreover, our principle to calibrate the fixed effect component and the distribution of the idiosyncratic shocks $\epsilon$ is to reproduce the life cycle cross sectional variance of family earnings as they are documented in Storesletten, Telmer and Yaron (2004). For the fixed effect, we choose two values $\alpha_1, \alpha_2$ which we assume are common across gender and marital status. We follow Conesa and Krueger (2006) and assume that $\alpha_1 = e^{-\sigma_\alpha}$ and $\alpha_2 = e^{\sigma_\alpha}$ where $\sigma_\alpha$ governs the variance of the process. For bachelor agents we calibrate the fractions $p_S^g$ to 1/2. For couples, we calibrate the joint probabilities $p^M$ so that our economy reproduces the degree of marital sorting in earnings ability that has been documented in the US data; for instance Hyslop (2001) estimates a 0.5 correlation of fixed effects within the family in his PSID sample. To match this correlation, we set $p^M = 0.375$ for households where $\sigma_m = \alpha_f$ (i.e. spouses have the same fixed effect) and $p^M = 0.125$ otherwise.

We choose $\sigma_\alpha$ so that the model is consistent with the empirical evidence on the cross sectional variance of household income at age 25, reported in Storesletten, Telmer and Yaron (2004). The idiosyncratic component $\epsilon$ is assumed to be a first order autoregressive process that we discretize as a Markov process using standard techniques. We choose the persistence of this process and the variance of the innovation to $\epsilon$ to make the model produce a linear rise in the cross-sectional variance of the logarithm of income with age and a value of 0.9 at age 65. Finally, we allow for shocks to $\epsilon$ to be contemporaneously correlated within the family and set the correlation equal to 0.15 (see Hyslop (2001)).

**Government.** In order to parameterize the steady state tax code, we proceed as follows. The level of government expenditures $G$ is chosen so that in the balanced growth path, the government consumes 21% of output. This spending is financed by the tax levies on consumption, capital and labor income. We follow Fuster, Imrohoroglu and Imrohoroglu (2008) and fix the consumption tax $\tau_C$ to 0.05, and we set the steady capital income tax $\tau_K$ to 0.35. The value of $\tau_N$ is chosen so that the government runs a balanced budget. In the initial steady state the model gives us a value of roughly 15% for this parameter. In our numerical experiment, we eliminate capital income taxation and adjust labor income taxes, while holding the level of expenditures constant to their steady state value.

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17 We previously made the point that under a stochastic $\xi$ as in Voena (2012), our model would give rise to equilibrium divorces. However, changes in the value of $\xi$ would impact the sharing rule by tightening the participation constraints for some households, without leading to separations. In the Appendix we utilize the model of section 2 to show that the tax schedule has a similar impact to rebargaining that is due to these types of shocks.

18 In order to represent our economy in the computer, we have to make the standard normalizations as in Aiyagari and McGrattan (1998).

19 Our calibration targets are taken from Fuster, Imrohoroglu and Imrohoroglu (2008).
Our principle to calibrate the social security benefit system is the following: First, as explained previously, we consider the individual as the unit to which benefits are distributed and not the household. Second, we try to capture in a parsimonious way, with the functional $SS(g, a_g)$, the fact that social security in the US contains a redistributive component. For instance, in 2004 individuals received 90% of the first 7,300 of their total social security entitlement, 32% for earnings between 7,300 and 44,000, and 15% for earnings above 44,000. We calibrate $SS(g, a_g)$ so that the model economy gives roughly the same redistribution of income in retirement in terms of median lifetime earnings as in the US economy. To give an idea of the numbers, we calculate in the model that men of the highest earning ability (fixed effect) get roughly 1.5 times as much as men of the lowest ability, whereas their lifetime earnings are twice as high. Furthermore, women with the lowest ability receive in benefits roughly 67% of what poor men receive, and women of high ability get slightly (3%) more than poor men. We fix the social security tax rate at 12.5% and solve for the average level of benefits. In the computational experiment, we keep the tax rate constant across environments and vary the level of benefits.

<table>
<thead>
<tr>
<th>Table 1: Calibrated Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>$\mu$ fraction married households</td>
</tr>
<tr>
<td>$\theta$ annual population growth</td>
</tr>
<tr>
<td>$\hat{A}$ annual productivity growth</td>
</tr>
<tr>
<td>$\alpha$ capital share</td>
</tr>
<tr>
<td>$\delta$ annual depreciation rate</td>
</tr>
<tr>
<td>$\beta$ discount factor</td>
</tr>
<tr>
<td>$\gamma$ preference parameter</td>
</tr>
<tr>
<td>$\eta$ preference parameter</td>
</tr>
<tr>
<td>$\tau_C$ consumption tax</td>
</tr>
<tr>
<td>$\tau_K$ capital income tax</td>
</tr>
<tr>
<td>$\tau_{SS}$ social security tax</td>
</tr>
<tr>
<td>$\tau_N$ labor income tax</td>
</tr>
</tbody>
</table>

Note: For growth rates ($\hat{A}$, $\theta$, $\delta$) the reported values are annual, but we solve on 5-yearly frequency.

**Model Performance.** In table 2 we summarize relevant cross sectional observations in the model and in the data. Because our focus is on the behavior of couples we investigate our models performance in matching a set of cross sectional moments that refer to married households. In the first row we look at between married household wealth inequality. According to the results in the table the model produces a wealth Gini coefficient of 0.61 whereas in the data the analogous quantity is in the order of 0.64. Note that given the structure of the PSID we cannot disentangle which part of a households net worth in the data is accumulated in the marriage and which part was brought in the marriage by one of the spouses. On the other hand in the model all wealth is common marital property. In this respect the data Gini coefficient may in fact slightly overestimate the between married household inequality in wealth.

In the second row of the table we report the Gini index for between household income inequality. This statistic reflects the sum of male and female labor income (total family labor income) and therefore refers to the income distribution for US couples. The model matches the data counterpart very accurately generating a Gini coefficient of 0.35 vs. 0.33 in the data. Rows 3 to 5 summarize inequality in income and wages within the household.
The third row reports the average fraction of male to female labor income, the fourth row the mean difference between the log male income minus the log of female income, and the fifth column reports the analogous difference for wages. In all of the statistics the model matches the US data very well. In particular on average married men earn 64% of total family income in the US; the model produces a value of 68%. The average of the difference of the logs of income (wages) is 0.68 (0.68) in the model and it is 0.64 (0.65) in the data.

As discussed earlier we have targeted average hours worked for married men and married women as in the US data. In the last two rows of the table we investigate how well the model performs in matching male and female participation to the labor market. Note that in spite of the fact that there is no explicit extensive margin in our model, individuals may nonetheless choose zero hours in which case the optimal allocation is at a corner solution. In the data columns we report the fraction of working age households that in a five year interval in the PSID have positive hours. This fraction is 89.4% in the data for married women and it is 97% for married men. The model generates numbers for these statistics of 89.6% and 98.7%. Therefore on average it can match very accurately non-participation.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini Wealth</td>
<td>0.64</td>
<td>0.61</td>
</tr>
<tr>
<td>Gini Income</td>
<td>0.35</td>
<td>0.33</td>
</tr>
<tr>
<td>Male to Total Household Income</td>
<td>0.68</td>
<td>0.64</td>
</tr>
<tr>
<td>Log Income Ratio</td>
<td>0.68</td>
<td>0.65</td>
</tr>
<tr>
<td>Log Wage Ratio</td>
<td>0.31</td>
<td>0.33</td>
</tr>
<tr>
<td>Female Participation</td>
<td>89.6%</td>
<td>89.4%</td>
</tr>
<tr>
<td>Male Participation</td>
<td>98.7%</td>
<td>97.0%</td>
</tr>
</tbody>
</table>

One final comment is in order. Though we have assumed that male and female preferences are homogeneous, the model can generate differences in labor supply elasticities by gender following an argument that is similar to Alesina, Ichino and Karabarbounis (2011). To see this consider the following formula for the elasticity derived from a log linear approximation of the labor supply optimality condition; 

\[ e^g_w = \frac{I_g}{1-I_g} \]

where \( I_g \) denotes the average leisure of gender \( g \) in the model. Evaluated at the mean male and female leisure the implied value of the male elasticity is 1.43 and the female elasticity is nearly twice the size. A more appropriate approach is to generate data from the model and estimate the first order condition for hours. We did this and our estimates were that the female elasticity in the model is 1.67 and the analogous quantity for married men is 1.3. Therefore the model gives rise to a more elastic female labor supply.

4 Results

This section contains our main quantitative results. We evaluate how a reform that sets capital taxation permanently equal to zero and raises labor taxes affects the economy, in terms of aggregates, welfare and the intrahousehold allocation. In order to fully investigate the impact of this change in the tax schedule on economic outcomes, we consider both the long run and the short run effects, meaning both the behavior of the economy in the final steady state as well as in the first period of the transition.
4.1 Long run and Short run Effects on Aggregates

In figure 1 we plot the response of aggregate capital (top left), aggregate output (top right), benefits (bottom left) and returns (bottom right). Period zero stands for the old steady state, before the reform. In period one there is an unanticipated permanent shift in the tax schedule. The figure shows the path of the variables from the initial period until the new steady state is reached, after 30 model periods (each period counts for five years of calendar time).²⁰

![Figure 1: Responses of Capital, Output, Benefits and Returns to the Reform](image)

Note: The figure plots the response of aggregate capital (top left), aggregate output (top right), retirement benefits (bottom left) and rate of returns (bottom right), where the solid line shows the gross return and the dashed line the return net of capital taxation.

Notice that aggregate capital is predetermined and therefore does not change when the reform takes place. But when capital taxation is abolished individuals are more willing to save due to the rise of the after tax return on savings. We represent the net return with the dashed line in the bottom right panel. It increases by roughly 41% on impact and even in the long run is considerably higher than in the initial steady state. The solid line in the plot which represents the gross return indicates that the build up of capital lowers the gross return to savings by 11% in the final steady state. Aggregate capital is 6% higher after 30 model periods.

Notice that when the reform takes place there is a considerable drop in aggregate output that derives from the response of hours to the change in the tax schedule. In table 3 we report the behavior of hours and labor taxes in rows 2 and 3. Notice that aggregate hours fall by roughly 8.5% initially. Labor taxes increase by 201% in period 1 and by 193% in the final steady state. The reason for this pattern is that higher capital eventually increases wages and individual labor income which in our model is the tax

²⁰Our approach to solve for the equilibrium of the model is to guess a time path of prices and quantities (interest rates, tax rates and benefits), compute the optimal decision rules of households that face this time path, and simulate the model starting from the ergodic distribution of the initial steady state. Thus, the solution characterizes the dynamic adjustment of the economy from the first period in which the reform is implemented to the new long run steady state.
base. Therefore a lower labor tax is needed to balance the governments budget in the long run than in the first period of the transition. Moreover, due to the joint behavior of aggregate capital and aggregate hours, output falls by 5.25% initially and then rises until the steady state. After thirty periods aggregate output is 1.6% lower than it was before the reform.

Table 3: Responses of Aggregate Variables to the Reform

<table>
<thead>
<tr>
<th>Quantity</th>
<th>First Period</th>
<th>Long Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>100.00%</td>
<td>108.7%</td>
</tr>
<tr>
<td>Hours</td>
<td>91.52%</td>
<td>92.04%</td>
</tr>
<tr>
<td>Labor Taxes</td>
<td>201.72%</td>
<td>192.80%</td>
</tr>
<tr>
<td>Output</td>
<td>94.75%</td>
<td>98.40%</td>
</tr>
<tr>
<td>Benefits</td>
<td>94.75%</td>
<td>98.38%</td>
</tr>
<tr>
<td>Net Return</td>
<td>141.65%</td>
<td>132.01%</td>
</tr>
<tr>
<td>Gross Return</td>
<td>92.07%</td>
<td>85.81%</td>
</tr>
</tbody>
</table>

Note: The table expresses aggregate variables in the first period of the transition and the final steady state, as a percentage of the variables in the original steady state.

Table 4: Responses of Variables to the Reform

<table>
<thead>
<tr>
<th>Quantity</th>
<th>First Period</th>
<th>Long Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \pi^C )</td>
<td>100.00%</td>
<td>109.48%</td>
</tr>
<tr>
<td>( \pi^{Sm} )</td>
<td>100%</td>
<td>107.10%</td>
</tr>
<tr>
<td>( \pi^{Sf} )</td>
<td>100%</td>
<td>106.12%</td>
</tr>
<tr>
<td>( \pi^{Cm} )</td>
<td>92.47%</td>
<td>92.67%</td>
</tr>
<tr>
<td>( \pi^{Cf} )</td>
<td>91.21%</td>
<td>91.75%</td>
</tr>
<tr>
<td>( \pi^{Sm} )</td>
<td>92.02%</td>
<td>92.64%</td>
</tr>
<tr>
<td>( \pi^{Sf} )</td>
<td>88.86%</td>
<td>90.21%</td>
</tr>
</tbody>
</table>

Note: The table expresses aggregate variables in the first period of the transition and the final steady state, as a percentage of the variables in the original steady state. \( \pi \) denotes average hours. The superscripts indicate individual and household type. \( C_f \) and \( C_m \) are married females and males and \( S_f \) and \( S_m \) are single females and males respectively.

In table 4 we disaggregate the responses of wealth and hours into household types. Notice that the largest increase in wealth accumulation is experienced by couples (9.48% relative to the initial steady state). Single households experience a more modest increase in assets. For single male households the increase is in the order of 6.12% and for single females it is 7.1%. We return to this prediction of our model at a later section. Rows 4 to 7 of table 4 report hours for married and single individuals. The largest drop in hours is experienced by single females in the economy (roughly 10% in the final steady state). Married males reduce their work time by roughly 7.3% and married females by 8.25%. Finally, though we leave it out of the table, our findings suggest that in response to the reform there is a change in the non-participation pattern. We find that the fraction of married women that do not work increases to roughly 17% when the reform takes place, as opposed to 10.4% in the original steady state. Therefore the drop in hours for married females represents partly a withdrawal from the labor force. For men, the reduction in hours occurs almost entirely at the intensive margin.
4.2 The Intrahousehold Allocation

The top left panel of figure 2 illustrates the behavior of the male share \( \lambda \) over the life cycle in the initial steady state for a generic household. This couple starts with mean productivity in the first period, and at age 40 the female spouse’s productivity drops by about one third, triggering a rise in the male spouses share. The share \( \lambda \) increases from a half to roughly 0.66, which represents a considerable renegotiation of the marital contract. From age 40 until the end of the household’s life, the share remains constant.

To understand this pattern note that though households experience shocks from the second period of their working lives, it is shocks that occur later, that are more likely to make participation constraints bind. Very early shocks are less permanent to the household and therefore are less likely to lead one of the two spouses to renege. On the other hand, by the time the household is at the middle of its working life it probably has accumulated enough assets to be able to ward off changes in productivity without any change in \( \lambda \). Therefore in the model households rebargaining relatively rarely (twice or three times over the life cycle). Rebargaining may occur in retirement even though income is constant, but only for households where the weight of one of the spouses is too high due to a sequence of very good shocks; as wealth is typically run down in retirement, the less favored spouse seeks to rebargain.

Figure 2: Evolution of the Male Share

Note: The figure gives an example of the behavior of the male share over the life cycle. The top left shows the share in the initial steady state. The top right shows the change in the share that is due to shocks to the households labor income. The bottom left compares the initial steady state (solid line), final (dashed line) and first period of the transition (crossed line). The bottom right panel shows this comparison for a different household.

In the top right panel of figure 2 we investigate the influence of shocks vs. the life cycle productivity component on the evolution of the weight. This graph represents the difference of the actual weight, from the path generated for a household where no shock occurs throughout its working life. There are two noteworthy features. First as the graph shows the bulk of the adjustment at age 40 is due to changes in idiosyncratic productivity rather than (changes in) life cycle prices. Second, note that in our calibration which
follows the empirical results in Hansen (1993), the life cycle pattern of wages varies across gender. The productivity path of men rises steeply with age, it peaks at age 45-50 with a ratio of the maximum to initial productivity is 1.22. In contrast female productivity is roughly constant over the life cycle. According to figure 2, these differences in the life cycle paths (along with the permanent components of individual productivity i.e. the fixed effect) are factored in the sharing rule at age 25. At age 35 according to our results, there is only a modest increase in the male share of roughly 2 percentage points.

The bottom left panel of the figure represents with the dashed line the path of $\lambda$ in the final steady state and with the crossed line the analogous path in the transition. The solid line represents the initial steady state (same as in the top left panel). Notice first that after the reform the newborn couple at age 25, draws a starting value of the weight that is different from the value in the initial steady state. The reform therefore has a differential impact to male and female spouses and redistributes the bargaining power within the household. We will return to this model feature in the next section. Second, note that in the new steady state with zero capital taxation the household is better placed to commit to the initial allocation and changes in the share are less. This effect is consistent, with the results of Section 2.1 that eliminating capital taxes induces the household to save, and higher wealth improves the household’s risk sharing possibilities. Indeed for the path plotted in the figure the rise in $\lambda$ at age 40 is roughly 8 percentage points in the final steady state, where as it is more than 12 percentage points before the reform. Moreover, note that in considering the first period of the transition, we consider the behavior of $\lambda$ for a couple that is born right when the change in policy takes place. When the couple is of age 40, it has lived for three periods under the new tax regime. Hence this family has had enough time to accumulate wealth in response to the drop in capital taxes. The bottom right panel of the figure repeats the plot for a different household and shows a similar influence of the new tax code on the sharing rule.

Household rebargaining. In order to further investigate, the impact of the reform on intrahousehold commitment, we consider in table 5 the frequency with which participation constraints bind, before and after the change in policy. The statistic reported in the table counts the number of times that a change in the weight $\lambda$ takes place in a panel of families that is representative of the population. According to the results of the table, on average 15.35% of households in the old steady state rebargain. Moreover, consistent with our previous results, most renegotiations occur at young ages (25-45). When the change in policy takes place the frequency of rebargaining drops by about 3.2 percentage points in the new steady state, where as it is more than 12 percentage points before the reform. Moreover, note that in considering the first period of the transition, we consider the behavior of $\lambda$ for a couple that is born right when the change in policy takes place. When the couple is of age 40, it has lived for three periods under the new tax regime. Hence this family has had enough time to accumulate wealth in response to the drop in capital taxes. The bottom right panel of the figure repeats the plot for a different household and shows a similar influence of the new tax code on the sharing rule.

Note that the frequency of rebargaining is a good proxy for the magnitude of the change in $\lambda$ in the model. For instance we find that in the initial steady state the average magnitude of the updates of $\lambda$ is in the order of 7.61 percentage points, whereas in the final

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21This prediction is due to two features of the model. First the change in the tax code produces a drop in retirement (social security) income. As explained previously less income makes reneging on the marital contract more tempting. Second, because households also experience a drop in disposable income in their working life, the incentive to save for retirement, under the new tax schedule, is reduced. Therefore for some very old households in the final steady state the model predicts less savings and consequently participation constraints that bind more frequently.
steady state it is 5.51 percentage points. It is therefore evident that when the tax code changes there is a drop in both the frequency of rebargaining and in the size of the change in $\lambda$ when rebargaining occurs. Households therefore experience gains in commitment along both of these dimensions.

Finally, the last two columns of table present the implications of a partial equilibrium analysis. In the column labeled ‘Only $\tau_K$’ we consider setting the capital tax equal to zero, and keeping all other quantities, taxes, wages, interest rates etc to the original steady state values. The column labeled ‘Only $\tau_N$’ refers to a model where the labor tax increases to the final steady state value and all other aggregates are kept constant. In section 2.1, we established that increasing labor taxation may, or may not, lead to more frequently binding participation constraints. On the one hand, as after-tax income inequality within the household is reduced, rebargaining will probably occur less often. On the other hand, when total household labor income is lower, the temptation to renege on the contract increases. The results shown in column 5 demonstrate that overall the first channel dominates. Therefore both the reduction in $\tau_K$ and the rise in $\tau_N$ improve commitment, though obviously the effect from capital taxation is more powerful.

Consumption volatility effects of improved commitment. When shocks to individual labor income occur, individual consumption is affected more if the household sharing rule changes. In the case where $\lambda$ is constant over time, intrahousehold risk sharing is maximized. This case corresponds to a full commitment allocation. When $\lambda$ is updated frequently in response to shocks, intrahousehold insurance is less. We measure the effects of the policy change to the volatility of individual consumption in figure 3. We have computed the variance of the log of consumption for each individual from a panel of 360,000 individuals and averaged by age group. This is calculation permits us to measure consumption uncertainty.\(^{22}\)

The figure plots changes in the variance of individual consumption relative to the original steady state. The solid line is the change in the final steady state. Notice that uncertainty drops considerably over the working life. There are two possible reasons: First more commitment improves risk sharing as we discussed previously and second, higher wealth permits to the household and its members to smooth the impact of shocks to consumption (eg. through precautionary savings). In order to measure the contribution of improved commitment, in the crossed line we represent the change in consumption volatility when we remove the influence of wealth but allow the household to be able to commit to the initial allocation as in the new steady state. We accomplish this by keeping wealth constant as in the initial steady state but simulating household behavior under the the final steady state paths for $\lambda$.\(^{23}\)

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\(^{22}\)In retirement there are no shocks and therefore this calculation does not apply.

\(^{23}\)Note that the new paths of $\lambda$ obviously reflect the joint impact of the change in the tax regime, and thus the higher wealth that families accumulate in response to lower capital taxation.
As the graph indicates there is reduction in the variance of roughly 2 to 3 percent, depending on the age group. For the sake of comparison the dashed line in the figure represents a constant $\lambda$ full commitment economy (again wealth is as in the initial steady state). Notice that under full commitment there is a substantial reduction in consumption uncertainty for young individuals, but as couples age the gains are less since more wealth leads to less renegotiations in the face of shocks. This pattern therefore echoes to our previous result that under the new policy households are able to share risks more effectively. Moreover, as the plot illustrates in the new steady state the intrahousehold allocation resembles the full commitment allocation but only for couples that are close to retirement, which is obviously due to the fact that older cohorts own more assets. Nevertheless even for the youngest families the new sharing rule implies a drop in consumption uncertainty that is 30% as large as the drop under a complete contract.

### 4.3 Welfare Evaluation

In table 6, we look at the welfare effects of the change in the tax code. We define our welfare measure as the percentage increment in consumption that keeps expected welfare constant across the two economies (with and without the reform). We report the average value of this quantity for all individuals in our economy, assigning equal weight to each individual in the welfare function, and separately for males and females single and
married.\textsuperscript{24}

As the first column shows all types of individuals are on average better off in the final steady state without capital taxation. Single females enjoy the largest welfare gains (2.4% in terms of consumption) whereas the gains are most modest for single male households (0.1%). Married women seem to benefit more than married men from the reform (1.6% vs. 0.46%). In the first period of the transition (column 2), on average individuals lose from the change in policy, and the largest loses are incurred by single males who are willing to give up 3.46% of consumption to stay in the old regime. Single females are nearly indifferent between the two tax schedules. Married males and females experience loses which correspond to 2.76% and 2.18% of consumption respectively.

Borrowing constraints and the time path of life cycle productivity are key in understanding the division of welfare gains across household types in the model, and in particular to understanding why female households benefit more from the reform. As discussed previously in the US data, the productivity path of men rises steeply with age (see the results of Hansen (1993)). Male productivity peaks at age 45–50 and the ratio of the maximum to initial productivity is 1.22. Consequently, in the model, men want to borrow against their permanent income to smooth consumption, but cannot do so due to the presence of the borrowing constraints. When capital taxes are replaced with labor taxes young single men experience a fall in income that makes their consumption path even steeper over the life cycle.\textsuperscript{25} Female productivity, on the other hand, is not steeply rising; it peaks at ages 35 to 40 and is roughly 2% higher relative to age 25. Therefore, young single women in the model are not made as worse off when the policy changes.\textsuperscript{26}

\textsuperscript{24}We construct average utility as follows:

\begin{equation}
U = \frac{1}{2\mu + (1-\mu)} \left( \sum_g V_g(a, X, \lambda, j) \Gamma_M(da \times dX \times d\lambda \times dj) + \frac{1}{2} \sum_g S_g(a, X, j) \Gamma_{S,g}(da \times dX \times dj) \right)
\end{equation}

where \(\mu\) is the fraction of households populated by couples in our economy (there are \(2\mu\) married individuals). Since preferences are the same for all individuals the value of the compensation variation is given by: \(\left( \frac{U_{\text{tax}}}{U_{\text{notax}}} \right)^{\frac{1}{\eta(1-\gamma)}} - 1\), where \(U_{\text{tax}} (U_{\text{notax}})\) is average utility in a steady state with (without) capital taxation. Similarly, when we want to make a welfare assessment for married individuals, we compute expected utility as follows:

\begin{equation}
U_M = \frac{1}{2} \left( \sum_g V_g(a, X, \lambda, j) \Gamma_M(da \times dX \times d\lambda \times dj) \right)
\end{equation}

Notice that the welfare criterion under 27 is different than the average household utility the way we define it in equation 23. For example, if we were to use the value function \(M(a, X, \lambda, j)\) in our welfare calculation, we would construct average utility for married individuals as:

\begin{equation}
W = \int M(a, X, \lambda, j) \Gamma_M(da \times dX \times d\lambda \times dj) = \int \lambda V_m(a, X, \lambda, j) + (1-\lambda) V_f(a, X, \lambda, j) \Gamma_M(da \times dX \times d\lambda \times dj)
\end{equation}

The value for \(W\) and \(U_M\) do not coincide because the planner attaches a weight equal to 1/2 to every individual, but households attach weights \(\lambda\) and \(1-\lambda\) respectively. In the ergodic distribution \(\Gamma_M\), these household weights are generally different from 1/2. Apps and Rees (1988) show that aggregating preferences of individuals into a household utility and maximizing over a policy parameter, can be misleading for policy, because the effects of changes in policies are mediated through the household sharing rule \(\lambda\).

\textsuperscript{25}See Erosa and Gervais (2002) for an analysis of the effect of life cycle income profiles on the preferences for labor and capital taxes.

\textsuperscript{26}Section A.4 in the Appendix makes a similar point by looking at the overall support for the reform, i.e. who gains and who loses (by gender and marital status) in the first period after the change in policy takes place.
### Table 6: Welfare Effects from the Reform

<table>
<thead>
<tr>
<th>Compensating Final Steady State Transition Variation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1.14%</td>
</tr>
<tr>
<td>Married Males</td>
<td>0.46%</td>
</tr>
<tr>
<td>Married Females</td>
<td>1.60%</td>
</tr>
<tr>
<td>Single Males</td>
<td>0.10%</td>
</tr>
<tr>
<td>Single Females</td>
<td>2.40%</td>
</tr>
</tbody>
</table>

Note: This table shows the percentage increment in consumption that keeps expected welfare constant across the two economies (with and without the reform).

To understand how these gender differences in the economic environment affect the overall and relative welfare gains for married individuals several remarks are important. First, note that as most of the married household’s income comes from the husband, couples are more like single men than single women. That is to say, the couple cannot to a great effect smooth the life cycle income profile by allocating more hours to the wife at the early stages of the working life, and therefore in terms of the welfare outcomes the gender differences in life cycle labor income are possibly not important.

Second, we illustrated in a previous section that after the reform, there is a stronger increase in capital accumulation in dual earner households. The wealth of married households increases by 9.5% in the final steady state whereas the average increase in single households was in the order of 6.6%. Therefore couples anticipate to gain more from the reform as more of the household’s consumption is financed through wealth. We attribute this difference in the behavioral response in asset accumulation to the difference in incentives to accumulate (precautionary) savings between married and single households. To understand this point note that in economies where individuals face uncertainty in their labor income and hence accumulate precautionary savings, the distortionary impact of capital taxation is less (see Domeij and Heathcote (2004)). The argument is as follows: with high capital taxation more of the households resources are made out of risky labor income which stimulates the demand for precautionary savings. When capital taxes are eliminated households accumulate wealth due to the higher return, but lose the strong incentive for precautionary savings, since capital income, at least in the model, is riskless.

Single households fit this profile. They have to accumulate wealth in order to insure against productivity shifts. But couple households are different; because labor income shocks are not perfectly correlated in the family, couples also possess intrahousehold insurance. The two spouses can help each other to finance a smooth consumption path through transfers. By this model property capital taxation should be more distortive to couples than to single households and the welfare gains reported in table 6 reflect this.

---

27. Even young households that are alive when the reform takes place, discount such gains in their lifetime utility.

28. To give an idea of how large these transfers are, we calculate in the initial steady state income subsidies from one household member to the other as a fraction of total household resources devoted to finance consumption. We define the transfer as the excess of private consumption over individual income, assuming that each spouse owns half of the household wealth stock each period and finances half of the wealth brought forward to the next period. We find that intrahousehold transfers are roughly 13% of total consumption spending. Moreover, transfers are largest for young households and smaller for retired households due to two reasons: First because as discussed previously in the model the initial allocation favors the wife, and is re-bargained as the household ages, and second because shocks to the labor income which are offset by transfers, do not occur during retirement.
difference.  

Finally, note that married women do better than married men according to the welfare measure in table 6. Clearly this property reflects that the outside option of women (as singles) improves relative to the outside option of men. It also reflects that the household is better able to commit to the initial allocation which tends to favor women and therefore married women receive a larger share of the gains, especially at middle ages or retirement. To emphasize this point notice that though larger changes in the intra-household allocation in our model reflect shocks to individual productivity, as discussed previously, smaller changes stem from the fact that married men start with a relatively low $\lambda$ and then re-bargain to increase their share at around age 40. The expectation of this future re-bargaining makes men, in the initial steady state, willing to tolerate a lower starting value of $\lambda$. When the tax code changes, however, and commitment to the initial allocation improves, married men do not anticipate a significant renegotiation of the contract in the future, either in response to idiosyncratic productivity shocks or in response to the life cycle pattern of wages. In effect they want an increase in $\lambda$ at the matching stage. Consistent with this view our model generates an increase in the average male share at the initial allocation of roughly one percentage point, but overall due to more commitment, women benefit more from the reform.

**Welfare gains from commitment.** Our theory predicts that lower capital taxation, affects intra-household risk sharing. Moreover as we illustrated in a previous section more risk sharing lowers individual consumption uncertainty. In this paragraph we investigate whether this improvement in insurance possibilities generates welfare gains to households. In order to isolate the effect of more commitment, from changes in the tax code and the wealth paths we solve for the gains in commitment in the old steady state. We impose that the updating rule for the weight $\lambda$ is as in the new steady state and we simulate a large number of households using the paths of $\lambda$ from the new steady state.

We find an overall gain from the higher commitment that corresponds to a 0.2% increase in consumption in terms of compensating variation. That is families require a rise in consumption of 0.2% in order to give up more risk sharing, and remain in the old steady state. Moreover, we found that the analogous gain from switching to a full commitment allocation with $\lambda$ constant over time, is roughly twice as large.

### 5 Conclusion

In this paper, we study the welfare effects of a reform that eliminates capital taxation, in a model with gender and marital status heterogeneity, uncertain labor income and incomplete financial markets. Decision making within the couple is represented as a contract under limited commitment. When the labor income of one spouse increases, the household must allocate more weight to her well-being. The household gives up some risk sharing to satisfy a participation constraint. We investigate how the tax code affects the intra-household allocation and especially the risk sharing possibilities of the couple. We show that lower capital taxes, lead to wealth accumulation and more insurance within

---

29 In the Appendix (see section A.2) we study the impact of limited commitment on the savings behavior of families and show that though there is an effect, additional terms that appear in the Euler equation do not reflect precautionary savings; moreover, it is not possible to establish whether these increased or reduced the demand for assets. Therefore, though under household bargaining individuals give up risk sharing they do not necessarily behave more like single agents, insofar as their attitude towards saving is concerned. We leave the important task of investigating how differences in preferences for wealth accumulation ultimately translate into differences in preferences over the tax code to future research.
the family. Higher labor taxes, on the other hand have an ambiguous effect; they make the distribution of disposable income less dispersed and therefore alleviate the limited commitment problem but also reduce the overall household resources and may therefore make more tempting to renege on past commitments. In our quantitative model, we find that when the policy changes the new intrahousehold allocation features less rebargaining, and therefore more insurance.

We view this paper as a first step towards a larger research project aiming to incorporate, in a unified framework, a realistic demographic structure and a realistic formulation of intrahousehold decision making. We believe that to this end, there is a number of important extensions that need to be made to the model in order for it to represent a theory of optimal household behavior and thus to be useful as a benchmark for policy evaluation. The first set of extensions is to add those features to the model that improve matching the wealth distribution by gender and marital status. On top of this list is the incentive of individuals to leave bequests to their descendants, but also modeling carefully marriage and divorce decisions that give rise to selection effects as in the data. A second set is to extend this model to consider nonlinear taxation. A very important implication of risk sharing within the family is that it can limit the scope of insurance provided through the tax system. For example, progressive taxation will promote equity between households by taxing at higher marginal rates wealthier families, but little is known about its effects on inequality within the household. We are convinced that the model proposed in this paper can be used to study these questions jointly.

References


A Appendix

A.1 Derivations in the Two Period Model

In this section, we derive explicitly the formulas from the two period model of section 2 that were omitted from the text. We assume that household members value the consumption-leisure bundle according to a utility function of the form \( \frac{c^{\eta(1-\gamma)}g^{1-\gamma}}{1-\gamma} \). The optimal consumption and leisure choices in period 2 satisfy:

\[
\lambda_2 \eta c^{\eta(1-\gamma)} g^{1-\gamma} = (1 - \lambda_2) \eta f^{\eta(1-\gamma)} g^{1-\gamma} \quad \text{and} \quad \frac{(1 - \eta) g}{\eta f} = w(1 - \tau_N) \epsilon_g
\]

Assuming an interior solution, we can substitute the intraperiod consumption-leisure optimality condition into the consumption first-order condition and obtain:

\[
\frac{\lambda_2 \eta c^\gamma_m}{(w(1 - \tau_N) \epsilon_m)^{(1-\eta)(1-\gamma)}} = (1 - \lambda_2) \frac{c_f^\gamma}{(w(1 - \tau_N) \epsilon_f)^{(1-\eta)(1-\gamma)}}
\]

which gives that female consumption is \( f(\lambda_2, \epsilon) = \left( \frac{\lambda_2}{1-\lambda_2} \right)^{\gamma} \left( \frac{\epsilon_f}{\epsilon_m} \right)^{(1-\eta)(1-\gamma)} \) times male consumption in the model. Solving for the optimal choices, we can write male and female utility as:

\[
\left( \frac{A_c + \sum_g w(1 - \tau_N) \epsilon_g}{(1 + f(\lambda_2, \epsilon))(w(1 - \tau_N) \epsilon_m)^{1-\eta}} \right)^{1-\gamma} \frac{X}{1 - \gamma} + \xi \geq \left( \frac{A_f + w(1 - \tau_N) \epsilon_m}{(w(1 - \tau_N) \epsilon_f)^{1-\eta}} \right)^{1-\gamma} \frac{X}{1 - \gamma}
\]

\[
\left( \frac{f(\lambda_2, \epsilon)}{(1 + f(\lambda_2, \epsilon))} \right)^{1-\gamma} \frac{A_c + \sum_g w(1 - \tau_N) \epsilon_g}{(w(1 - \tau_N) \epsilon_f)^{1-\eta}} \frac{X}{1 - \gamma} + \xi \geq \left( \frac{A_f + w(1 - \tau_N) \epsilon_m}{(w(1 - \tau_N) \epsilon_f)^{1-\eta}} \right)^{1-\gamma} \frac{X}{1 - \gamma}
\]
where \( \chi = (\eta^n(1 - \eta)^{1-n})^{1-\gamma} \). Rearranging, we can express the sharing rule with the following nonlinear equations:

\[
\begin{align*}
(28) \quad &\left( \frac{1}{(1 + f(\lambda_2, \epsilon))} \right)^{1-\gamma} \leq \tilde{\xi} \left( \frac{(w(1 - \tau_N)\epsilon_m)^{(1-\eta)}}{A_c + \sum_g w(1 - \tau_N)\epsilon_g} \right)^{1-\gamma} + \left( \frac{A_c + w(1 - \tau_N)\epsilon_m}{A_c + \sum_g w(1 - \tau_N)\epsilon_g} \right)^{1-\gamma} \\
(29) \quad &\left( \frac{f(\lambda_2, \epsilon)}{(1 + f(\lambda_2, \epsilon))} \right)^{1-\gamma} \leq \tilde{\xi} \left( \frac{(w(1 - \tau_N)\epsilon_f)^{(1-\eta)}}{A_c + \sum_g w(1 - \tau_N)\epsilon_g} \right)^{1-\gamma} + \left( \frac{A_c + w(1 - \tau_N)\epsilon_f}{A_c + \sum_g w(1 - \tau_N)\epsilon_g} \right)^{1-\gamma}
\end{align*}
\]

where \( \tilde{\xi} = -\frac{\xi^{(1-\gamma)}}{(\eta^n(1 - \eta)^{1-n})^{1-\gamma}} > 0 \).

The effect of changes in labor taxes. Equations 28 and 29 define the upper and the lower bound that the weight \( \lambda_2 \) needs to respect in order for the participation constraints to be satisfied. The partial derivatives of the right hand side of equation 28 with respect to \((1 - \tau_N)\) are:

\[
(30) \quad (1 - \gamma) \left[ \tilde{\xi} \left( A_c \frac{(1 - \eta)}{1 - \tau_N} - \eta \sum_g w \epsilon_g \right) \kappa_1(A_c, \epsilon) + (A_c w (\epsilon_m - \frac{\sum_g \epsilon_g}{2})) \kappa_2(A_c, \epsilon) \right]
\]

where \( \kappa_1 = \frac{(w(1 - \tau_N)\epsilon_m)^{(1-\eta)(1-\gamma)}}{(A_c + \sum_g w(1 - \tau_N)\epsilon_g)^{2-\gamma}} > 0 \) and \( \kappa_2 = \frac{(A_c + w(1 - \tau_N)\epsilon_m)^{-\gamma}}{(A_c + \sum_g w(1 - \tau_N)\epsilon_g)^{2-\gamma}} > 0 \). The derivative of equation 29 is similar and for the sake of brevity omitted. As discussed in text, 30 illustrates that the effect of changes in labor taxation on the household sharing rule depends on the level of wealth of the household \( A_c \). If \( A_c = 0 \), it reduces to:

\[
(31) \quad - (1 - \gamma) \left[ \tilde{\xi} \eta \sum_g w \epsilon_g \right] \kappa_1(A_c, \epsilon) > 0
\]

As the LHS of 28 is decreasing in \( \lambda_2 \), a positive partial derivative means that \( \lambda_2 \) has to increase by less to satisfy the participation constraint of the male spouse. Therefore, in the case of \( \epsilon_m > \epsilon_f \) where the lower bound applies, the disturbance to the household sharing rule is smaller. The converse may obtain if \( A_c > 0 \). As in the case of log separable utility, an overall negative derivative 30 yields that lowering labor taxes makes it more difficult for household members to commit to an allocation.

The effect of changes in capital taxes. We derive the partial derivative of equation 28 with respect to financial income as:

\[
(32) \quad (\gamma - 1) \left[ \tilde{\xi} \left( \frac{(w(1 - \tau_N)\epsilon_m)^{(1-\eta)}}{A_c + \sum_g w(1 - \tau_N)\epsilon_g)^{2-\gamma}} + \left( \frac{A_c + w(1 - \tau_N)\epsilon_m}{(A_c + \sum_g w(1 - \tau_N)\epsilon_g)^{2-\gamma}} (\epsilon_m - \frac{\sum_g \epsilon_g}{2}) \right) \right]
\]

The leading term in 32 is always positive, meaning that an increase of financial income relaxes the constraint. The second term is positive only when \( \epsilon_m > \epsilon_f \). Since equation 28 defines the lower bound on \( \lambda_2 \), it binds only when male productivity exceeds female productivity. Therefore, higher financial wealth or lower capital taxation enhance the households commitment. This proves proposition 3 in the main text.

Nash Bargaining. We derive the impact of wealth on the intrahousehold allocation under the assumption that couples bargain each period using a Nash protocol. We argued
in text that under Nash bargaining the period 2 allocation \( \lambda_2 \) solves the following product:

\[
\lambda_2^2(a, \epsilon) \in \arg \max_{\lambda_2} \quad (33)
\]

\[
\left( \frac{A_c + \sum_g w(1 - \tau_N)\epsilon_g}{(1 + f(\lambda_2^2, \epsilon))((w(1 - \tau_N)\epsilon_m)^{1-\eta})} \right)^{1-\gamma} \frac{\chi}{1 - \gamma} + \xi - \left( \frac{A_c + w(1 - \tau_N)\epsilon_m}{(w(1 - \tau_N)\epsilon_m)^{1-\eta}} \right)^{1-\gamma} \frac{\chi}{1 - \gamma}
\]

\[
\left( \frac{f(\lambda_2^2, \epsilon)}{(1 + f(\lambda_2^2, \epsilon))} \right)^{1-\gamma} \frac{\chi}{1 - \gamma} + \xi - \left( \frac{A_c + w(1 - \tau_N)\epsilon_f}{(w(1 - \tau_N)\epsilon_f)^{1-\eta}} \right)^{1-\gamma} \frac{\chi}{1 - \gamma}
\]

The first order derivative with respect to \( \lambda_2 \) in 33 leads to the following optimality condition:

\[
\frac{\Phi^{1-\gamma}}{\Omega_m} = \frac{\Phi^{1-\gamma}}{f(\lambda_2^*, \epsilon)\Omega_f}
\]

where:

\[
\Phi_m = \left( \frac{A_c + \sum_g w(1 - \tau_N)\epsilon_g}{(1 + f(\lambda_2^*, \epsilon))((w(1 - \tau_N)\epsilon_m)^{1-\eta})} \right) , \quad \Phi_f = \left( \frac{f(\lambda_2^*, \epsilon)(A_c + \sum_g w(1 - \tau_N)\epsilon_g)}{(1 + f(\lambda_2^*, \epsilon))((w(1 - \tau_N)\epsilon_f)^{1-\eta})} \right)
\]

\[
\Omega_m = \left( \frac{A_c + \sum_g w(1 - \tau_N)\epsilon_g}{(1 + f(\lambda_2^*, \epsilon))((w(1 - \tau_N)\epsilon_m)^{1-\eta})} \right)^{1-\gamma} \frac{\chi}{1 - \gamma} + \xi - \left( \frac{A_c + w(1 - \tau_N)\epsilon_m}{(w(1 - \tau_N)\epsilon_m)^{1-\eta}} \right)^{1-\gamma} \frac{\chi}{1 - \gamma}
\]

\[
\Omega_f = \left( \frac{f(\lambda_2^*, \epsilon)}{(1 + f(\lambda_2^*, \epsilon))} \right)^{1-\gamma} \frac{\chi}{1 - \gamma} + \xi - \left( \frac{A_c + w(1 - \tau_N)\epsilon_f}{(w(1 - \tau_N)\epsilon_f)^{1-\eta}} \right)^{1-\gamma} \frac{\chi}{1 - \gamma}
\]

In order to obtain the derivative \( \frac{d\lambda_2^*}{dA_c} \) we utilize the Implicit Function Theorem. The derivative satisfies:

\[
\frac{-\chi}{\Omega_m} \left( A_c + \sum_g w(1 - \tau_N)\epsilon_g \right) - \frac{\Phi^{1-\gamma}}{\Phi_m^{1-\gamma}} (1 - \frac{(A_c + \epsilon_m w(1 - \tau_N))^{1-\gamma}}{f(\lambda_2^*, \epsilon)\Omega_f f(\lambda_2^*, \epsilon)(1 + f(\lambda_2^*, \epsilon))}) + \frac{\Phi^{1-\gamma}}{\Phi_f^{1-\gamma}} (1 - \frac{(A_c + \epsilon_f w(1 - \tau_N))^{1-\gamma}}{f(\lambda_2^*, \epsilon)\Omega_m (1 + f(\lambda_2^*, \epsilon))})
\]

where \( f_{\lambda_2^*} \) represents the partial derivative. Note that for the sake of brevity the detailed derivations of A.1 are omitted. Moreover, note that since the sign of the bottom term in A.1 is positive by the properties of \( f_{\lambda_2^*} \) the sign of \( \frac{d\lambda_2^*}{dA_c} \) is basically the sign of the top lines in A.1. These terms may be written as follows:

\[
\frac{-\chi}{\Omega_m} \left( A_c + \sum_g w(1 - \tau_N)\epsilon_g \right) (1 - \frac{U_{s,m}}{U_{m,m}}) + \frac{\chi}{\Omega_f} \left( A_c + \sum_g w(1 - \tau_N)\epsilon_g \right) (1 - \frac{U_{s,f}}{U_{m,f}})
\]

where \( U_{j,g} \), \( j \in \{s, m\} \) is the utility of the spouse of gender \( g \) as a single ( \( j = s \) ) or under the marriage (subscription \( j = m \) ). Making use of the optimality condition of program 33 we can write:

\[
\frac{\chi}{\Omega_m} \left( A_c + \sum_g w(1 - \tau_N)\epsilon_g \right) (1 - \frac{U_{s,m}}{U_{m,m}}) + \frac{\chi}{\Omega_f} \left( A_c + \sum_g w(1 - \tau_N)\epsilon_g \right) (1 - \frac{U_{s,f}}{U_{m,f}})
\]
Note that in the case where \( \epsilon_m = \epsilon_f, \lambda_2^* = \frac{1}{2} \) and \( f(\lambda_2^*, \epsilon) = 1 \). In this case 37 equals zero because the utility that either spouse gets from the marriage (net of \( \xi \)) is precisely the utility they get as singles. If however, \( \epsilon_m > \epsilon_f \) then \( \lambda_2^* > \frac{1}{2} \) and \( f(\lambda_2^*, \epsilon) < 1 \). In this case the male spouse gets a higher utility from being married because his bargaining power (relative to the outside option) increases. This makes the leading term in brackets negative. Analogously with \( f(\lambda_2^*, \epsilon) < 1 \) the second (positive) term in the brackets is reduced, though positive. Overall, the derivative \( \frac{d\lambda^*_2}{dA_c} \) is negative. To put it differently when \( \lambda_2^* > \frac{1}{2} \), higher wealth reduces the value and when \( \lambda_2^* < \frac{1}{2} \) the opposite holds; there is a rise in \( \lambda_2^* \) with higher wealth.

**Divorces.** In the two period model of section 2 a couple would not divorce for as long as \( \xi > 0 \). To put this differently it is always possible in the second period of the model to give to the male and the female spouse what they would get if they were bachelors (i.e. \( A_c + \epsilon_g w(1 - \tau_N) \)). The feasibility of this allocation coupled with the assumption that the benefit from being married is positive, proves that divorcing is not optimal in equilibrium. Divorces may occur if \( \xi \) in period 2 can become negative. This environment is considered by Voena (2012) who estimates how changes in divorce laws affect the wealth accumulation profiles of families. We briefly describe here how changes in the value of \( \xi \) over time, the simplest way to motivate endogenous divorce affect the results of section 2.

Assume that the couple draws a value \( \xi_2 \) in period 2. As long as this value falls below zero the marital surplus will become negative and the couple will divorce. However, in the case where \( \xi_2 \) is positive, its realized value will affect the intrahousehold allocation given the levels of productivity in the household. Consider the case of \( \epsilon_m > \epsilon_f \). We showed in text that the updating rule under log-log preferences is of the following form:

\[
\lambda_2 \in \left\{ e^{-\xi_2} \frac{A_c + \epsilon_m w(1 - \tau_N)}{A_c + \sum g \epsilon_g w(1 - \tau_N)}, 1 - e^{-\xi_2} \frac{A_c + \epsilon_f w(1 - \tau_N)}{A_c + \sum g \epsilon_g w(1 - \tau_N)} \right\}
\]

Clearly a high value of \( \xi_2 \) such that \( e^{-\xi_2} \frac{A_c + \epsilon_m w(1 - \tau_N)}{A_c + \sum g \epsilon_g w(1 - \tau_N)} < \frac{1}{2} \) implies that the allocation doesn’t have to be rebargained and therefore \( \lambda_2 = \lambda_1 = \frac{1}{2} \). However, under the assumption \( e^{-\xi_2} \frac{A_c + \epsilon_m w(1 - \tau_N)}{A_c + \sum g \epsilon_g w(1 - \tau_N)} > \frac{1}{2} \) the male share has to increase to make the male spouse as well off as he would be in bachelorhood. Note that it is straightforward to show (following the argument developed in section 2) that more wealth will reduce the responsiveness of \( \lambda_2 \) to the \( \xi_2 \) shock. Therefore though in our simplified model wealth cannot affect the decision to divorce, it can insulate the intrahousehold allocation from shocks (of the type commonly used in the literature) that give rise to endogenous divorces. This principle can obviously be generalized to non separable preferences.

### A.2 Optimal Savings

In this section, we investigate what determines a couple household’s savings. Since our focus is on the intertemporal behavior of families we want to assess whether limited commitment affects the households demand for assets. Moreover, given our results that policies that lower capital taxation lead to gains in terms of commitment we want to

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Note that this property is not relevant for the multiperiod setup, in which case a low but positive value of \( \xi \) may lead to separation.
investigate here whether more commitment is an additional channel that encourages asset accumulation in the model. To preview our results we find that household bargaining has an impact on the savings schedule but that it is impossible to sign its effect, meaning that over some parts of the state space more commitment may encourage savings but may discourage them in other parts.

Consider a couple that starts the first period of the life cycle with a weight \( \lambda_1 = \frac{1}{2} \). Note that an increase in savings in the first period entails a cost in terms of marginal utility. If utility is log-log separable, this cost is given by the expression \( \frac{1}{1 - a_1 + 2w(1 - \tau_N)} \), and if \( \gamma > 1 \) it is given by \( \frac{\chi(1 - \gamma)(1 - \tau_N)(1 - \eta)(1 - \gamma)}{(w(1 - \tau_N))^{(1 - \eta)(1 - \gamma)} \chi} \) where \( \chi = \eta^0(1 - \gamma)(1 - \eta)(1 - \gamma)^3 \). The second period benefit from higher savings is given by:

\[
\beta(1 + r(1 - \tau_K))E_1 \left[ \lambda_2 \frac{du_m}{dA_c} + (1 - \lambda_2) \frac{df}{dA_c} + \frac{d\lambda_2}{dA_c} (u_m - u_f) \right]
\]

The leading two bracketed terms in 39 represent the marginal benefit, keeping the household sharing rule constant, whereas the last term measures the effect of higher savings on the sharing rule. If the couple was able to commit to the first period contract, setting \( \lambda_2 = \frac{1}{2} \) everywhere on the state space, the derivative \( \frac{d\lambda_2}{dA_c} \) would equal zero; the marginal utility terms would be the only ones that would count for the marginal benefit of household savings.

Under log separable utility, we can show that

\[
E_1 \left[ \lambda_2 \frac{du_m}{dA_c} + (1 - \lambda_2) \frac{df}{dA_c} \right] = \frac{1}{\sum_g \epsilon_g w(1 - \tau_N) + A_c}
\]

Notice that the right hand side of 40 is independent of the weight \( \lambda_2 \). In fact, this expression is the same as the one we would get if we were to solve for the full commitment allocation that sets \( \lambda_2 = \frac{1}{2} \) regardless of the productivity levels of the male and female spouse. Under log utility, therefore, it is the last term in 39 \((\frac{d\lambda_2}{dA_c} (u_m - u_f))\) that describes the impact of limited commitment on the households savings. We therefore have to focus on that term.

We consider separately each relevant region in the state space where \( \frac{d\lambda_2}{dA_c} (u_m - u_f) \) is different from zero, that is every region where the marital contract is rebargained. As discussed previously, for male productivity \( \epsilon_m \) less than a lower bound \( \epsilon_m(A_c, \epsilon_f) \) the weight \( \lambda_2 \) will fall to \( \lambda_2^U \) (there is an increase in the female spouse’s share). Conversely, if \( \epsilon_m > \epsilon_m(A_c, \epsilon_f) \) (upper bound) then \( \lambda_2 = \lambda_2^L \). In any other region there is no rebargaining of the households allocation and, therefore, \( \lambda_2 = \frac{1}{2} \). Thus we can write the conditional expectation of \( \frac{d\lambda_2}{dA_c} (u_m - u_f) \) as:

\[
E_1 \frac{d\lambda_2}{dA_c} (u_m - u_f) = \int_{0}^{\epsilon_m(A_c, \epsilon_f)} \int \frac{d\lambda_2}{dA_c} (u_m - u_f) dF(\epsilon_f, \epsilon_m)
\]

\[
+ \int_{\epsilon_m(A_c, \epsilon_f)}^{\infty} \int \frac{d\lambda_2}{dA_c} (u_m - u_f) dF(\epsilon_f, \epsilon_m)
\]

where \( F \) is the joint density of idiosyncratic productivity in the household.

From equation 9 it is easy to establish that the derivative \( \frac{d\lambda_2}{dA_c} \) is positive and the derivative \( \frac{d\lambda_2}{dA_c} \) is negative. In order to sign \( \frac{d\lambda_2}{dA_c} (u_m - u_f) \), in each relevant region of 41,

\[31\] Notice that the period one idiosyncratic productivity endowments are normalized to unity for both spouses.
we need to determine the difference in the welfare levels of husbands and wives. As it turns out, this difference is not of one sign. This is so because the limited commitment model has nothing to say about the absolute level of utility; it simply states that if ever participation is violated, a correction has to be made that makes one of the spouses as well off as if they were single. Since the model does not admit an analytical solution for the conditional expectation, we used numerical methods to compute the relevant integrals. Depending on the level of assets, we found that $E_1 \frac{d^2}{dA_m}(u_m-u_f)$ could be both positive or negative, which implies that the effect of limited commitment on household savings is ambiguous.\(^{32}\)

The more general case for $\gamma > 1$ yields similar results. For this model we can derive the following expression for the leading term in 39:

$$E_1 \left[ \lambda_2 \frac{d u_m}{d A_e} + (1 - \lambda_2) \frac{d u_f}{d A_e} \right] = E_1 \left[ (Ac + \sum_g w(1 - \tau_N)\epsilon_g)^{-\gamma} \chi \left( \frac{1}{1 + f(\lambda_2, \epsilon)} - \frac{\lambda_2}{\omega} (w(1 - \tau_N)\epsilon_m)^{(1-\eta)(1-\gamma)} + \left( \frac{f(\lambda_2, \epsilon)}{1 + f(\lambda_2, \epsilon)} \right)^{1-\gamma} \frac{1 - \lambda_2}{(w(1 - \tau_N)\epsilon_f)^{(1-\eta)(1-\gamma)}} \right) \right]$$

The above expression suggests that the intrahousehold allocation affects the optimal savings of the family relative to the full commitment model, even beyond the term $E_1 \frac{d^2}{dA_m}(u_m-u_f)$. To see how, first note that the bottom line of 42 can be further simplified into:

$$(43) \quad (\frac{1}{1 + f(\lambda_2, \epsilon)} - \frac{\lambda_2}{\omega} (w(1 - \tau_N)\epsilon_m)^{(1-\eta)(1-\gamma)}) = (\frac{1}{\omega} \epsilon_m^\omega + (1 - \lambda_2) \frac{1}{\omega} \epsilon_f^\omega)$$

where $\omega = -(1 - \eta)(1 - \gamma)/\gamma < 0$. Second, assume that male and female productivities in period 2 are perfectly negatively correlated, so that $\epsilon_m + \epsilon_f = \tau$ which is constant. It is obvious that 43 is the only term that matters for household savings, as under these assumptions $(A_e + \sum_g w(1 - \tau_N)\epsilon_g)^{-\gamma} \chi$ would be constant, no matter the realizations of $\epsilon_m$ and $\epsilon_f$.\(^{33}\) The term in 43 exerts an influence to household savings because it changes the marginal benefit to the household. Since it is a concave function in $\epsilon_m$, higher uncertainty decreases the marginal utility, even under full commitment when the shares are constant. Moreover, if the shares $\lambda_2$ change with the endowment, as they do under limited commitment, they contribute further to the variability of 43. This lowers the marginal gain from an extra unit of savings even further. In this example limited commitment means less rather than more savings. The analysis of the term $E_1 \frac{d^2}{dA_m}(u_m-u_f)$ is similar with the log log case and, for the sake of brevity, is omitted.

**A.3 Competitive Equilibrium**

In this section we briefly define the time invariant competitive equilibrium. Given a level of expenditure $G$ in the steady state, the tax schedule $\{\tau_K, \tau_W, \tau_C, \tau_{SS}\}$, social security

\(^{32}\)This result emerges also in Ligon, Thomas and Worrall (2000).

\(^{33}\)Note that the covariance structure of wages within the household is extremely important for the sharing rule and, of course, the optimal allocation. In the two period model of this section, more negatively correlated shocks imply that the limited commitment problem in the household is more severe. If, on the other hand, shocks were perfectly correlated yielding $\epsilon_m = \epsilon_f$, then it is trivial to show that household rebargaining would not occur in equilibrium. The optimal weight $\lambda_2$ would equal a half, and the demand for savings of a two member household would be identical to the demand of a single earner household. When shocks are not perfectly correlated, the need to accumulate assets to buffer shocks to the labor income is less, and as a consequence couple households accumulate less wealth.
policy and unintended bequests, the competitive equilibrium is a set of value functions \( \{ S_g, M, V_g \} \), household decision rules for consumption, savings and leisure, and measures of households over the state vector of assets, productivity, age, gender, marital status and the sharing rule \( \lambda \) such that:

1. Given prices, \( S_m, S_f \) and \( M \) solve the functional equations and optimal policies derive. In particular, optimal policies are functions \( c_{S,g}(a, X, j), a'_{S,g}(a, X, j), n_{S,g}(a, X, j) \) for consumption, assets and hours for singles and analogously \( c_{M,g}(a, X, \lambda, j), a'_{M}(a, X, \lambda, j), n_{M,g}(a, X, \lambda, j) \) for couples.

2. Prices \( w \) and \( r \) satisfy:

\[
w = (1 - \alpha)K^\alpha N^{-\alpha} \quad r = \alpha K^{\alpha - 1} N^{1 - \alpha} - \delta
\]

where \( N \) is the aggregate labor input in units of effective labor.

3. The social security policy satisfies:

\[
w N \tau_{SS} = \left( \sum_g \frac{1 - \mu}{2} \int SS_g(\alpha, j) \Gamma_{S,g}(da \times dX \times \{ j_R, \ldots, J \}) \right) + \left( \mu \int SS_g(\alpha, j) \Gamma_M(da \times dX \times d\lambda \times \{ j_R, \ldots, J \}) \right)
\]

where \( \Gamma_{S,g} \) is the measure of bachelors over relevant states and \( \Gamma_M \) is the analogous object for married couples.

4. Accidental bequests satisfy:

\[
B = \frac{1}{\Phi_o} \left( \sum_g \frac{1 - \mu}{2} \int a'_{S,g}(a, X, j)(1 - \psi_j) \Gamma_{S,g}(da \times dX \times \{ 1, \ldots, j_R - 1 \}) \right) + \mu \int a'_{M}(a, X, \lambda, j)(1 - \psi_j) \Gamma_{M}(da \times dX \times d\lambda \times \{ 1, \ldots, j_R - 1 \})
\]

5. The government budget constraint is balanced:

\[
G = w \tau_N \left( \sum_g \frac{1 - \mu}{2} \int n_{S,g}(a, X, j)L_g(j)\epsilon_g \alpha_g \Gamma_{S,g}(da \times dX \times \{ 1, \ldots, j_R - 1 \}) \right) + \left( \sum_g \mu \int n_{M,g}(a, X, \lambda, j)\alpha_g \epsilon_g L_g(j) \Gamma_{M}(da \times dX \times d\lambda \times \{ 1, \ldots, j_R - 1 \}) \right)
\]

\[
+ \tau_C \left( \sum_g \frac{1 - \mu}{2} \int c_{S,g}(a, X, j) \Gamma_{S,g}(da \times dX \times dj) \right) + \left( \sum_g \mu \int c_{M,g}(a, X, \lambda, j) \Gamma_{M}(da \times dX \times d\lambda \times dj) \right)
\]

\[
+ \tau_K \left( \sum_g \frac{1 - \mu}{2} \int (ra + B) \Gamma_{S,g}(da \times dX \times dj) + \mu \int (ra + 2B) \Gamma_{M}(da \times dX \times d\lambda \times dj) \right)
\]
6. Market Clearing:

\[ K = \sum_g \int \frac{1 - \mu}{2} a \Gamma_{S,g}(da \times dX \times dj) + \mu \int a \Gamma_M(da \times dX \times d\lambda \times dj) \]

\[ N = \sum_g \int \frac{1 - \mu}{2} n_{S,g}(a, X, j) L_g(j) \epsilon_g \alpha_g \Gamma_{S,g}(da \times dX \times \{1, \ldots, j_R - 1\}) \]

\[ + \sum_g \mu \int n_{M,g}(a, X, \lambda, j) \alpha_g \epsilon_g L_g(j) \Gamma_M(da \times dX \times d\lambda \times \{1, \ldots, j_R - 1\}) \]

7. The measures \( \Gamma_{S,g} \) and \( \Gamma_M \) are consistent. In particular, for all subsets \( \mathcal{A}, \mathcal{X}, \Lambda, \mathcal{J} \) of the state space such that \( 1 \notin \mathcal{J} \)

\[ \Gamma_{S,g}(\mathcal{A}, \mathcal{X}, \mathcal{J}) = \psi_j \int_{\mathcal{X}' \in \mathcal{X}, a'_{S,g} \in \mathcal{A}, j+1 \in \mathcal{J}} \Gamma_{S,g}(da \times dX \times dj) \]

\[ \Gamma_{M,g}(\mathcal{A}, \mathcal{X}, \Lambda, \mathcal{J}) = \psi_j \int_{\mathcal{X}' \in \mathcal{X}, a'_{M,g} \in \mathcal{A}, \lambda \in \Lambda, j+1 \in \mathcal{J}} \Gamma_{M,g}(da \times dX \times d\lambda \times dj) \]

A.4 Support for the reform

Summarizing welfare gains and loses by the average compensating variation (as we did in section 4) masks a large degree of heterogeneity in the economy. Welfare loses could be very large for a few families, but for the rest there might be moderate gains from the reform. We are, therefore, interested in determining whether the policy change is acceptable to a significant fraction of individuals in the economy. We focus on the first period the transition. Our findings are as follows: Total support is in the order of 53%. Moreover, consistent with our previous findings, a larger fraction (65.1%) of single women are better off from the change in policy. For single men the analogous fraction is 45.3%, for married men it is 48.9% and for married women 53.8%.

These results can be contrasted with previous findings in the literature. For example, Domeij and Heathcote (2004) use a model with incomplete financial markets but with single households and find that only a small fraction of individuals benefits from the elimination of capital taxation in the transition. (see also Garcia-Milà, Marcet and Ventura (2010)). While the structure of the economy is different in these papers than in ours (Domeij and Heathcote (2004) consider an infinite horizon model which they calibrate to match the wealth distribution) we want to stress that the inclusion in gender and marital status heterogeneity in our model exerts an influence to the difference in our results. For instance, we calculate the total support in an economy where every household has a single male breadwinner, and the fraction of those who benefit in the transition is only 39%. As discussed in text, in our model households, by gender and marital status, differ in terms of the incentives to save and therefore differ in terms of their preferences for the capital and labor taxes.