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Department of Economics

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Do Temptations Sway Optimal Policy?

Abstract

We analyze the implications of temptation goods for economic policy in a general equilibrium model with dynasties of heterogeneous households. Temptation goods are defined as goods that generate positive utility for the generation that consumes them but are not valued by any previous generation. Declining temptations imply that the fraction of marginal euro spent on temptation goods declines as overall consumption increases. Our theoretical analysis shows that declining temptations increase equilibrium labor effort and equilibrium income but have no effect on the equilibrium savings rate. For quantitative analysis, we use European Union data with alcoholic beverages, tobacco and narcotics defined as temptation goods in the benchmark specification. We find that temptations have virtually no effect on equilibrium levels of labor effort, income or income inequality compared to a model in which temptations are ignored. Also, optimal policy that maximizes either income or welfare remains unchanged. However, a paternalistic government that does not value spending on temptation goods would underestimate the optimal level of redistribution by ignoring temptations.

JEL codes: D11, D31, D91, E21, E62, O12

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Authors: Arturs Kanepajs 40185, Ryan Lehr 40182

Supervisor: Yoichi Sugita

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List of abbreviations

AJR – Acemoglu, Johnson and Robinson
ATN – Alcoholic beverages, tobacco and narcotics
BD – Banerjee and Duflo
BM – Banerjee and Mullainathan
EU – European Union
EUR – Euro
FOC – First-order condition
GDP – Gross domestic product
IES – Intertemporal elasticity of substitution
TFP – Total factor productivity
US – United States

1. Introduction

It is commonly argued that redistributional policy is a waste of resources, because the poor behave myopically by spending a large proportion of their income immediately instead of saving for the future. A recent survey in the US showed that the living standard of the poorest 10% of Americans differs markedly from the common public perception. According to the survey, the median poor family with children has three color televisions, a DVD player and a video game system (Rector and Sheffield, 2011). These findings were widely covered in the media and naturally led to objections to more redistribution especially from the right wing (Tea Party Activists, 2011). Also, while the evidence about alcohol consumption is mixed, there is a tendency for low-income people to smoke more cigarettes and drink more soft drinks (Peele, 2010). Hence, the conception that the funds devoted to alleviate poverty are wasted may contribute to the lasting public sentiment against redistribution (Saad, 2012).

However, Banerjee and Mullainathan (BM) (2010) have recently argued that myopia of the poor may be an illusion caused by poverty itself. At the pith of the matter are “temptation goods” with “declining temptations.” “Temptation goods” are defined as goods that generate positive utility for the “self” that consumes them but are not valued by any “self” that anticipates their consumption. “Declining temptations” mean the fraction of marginal euro spent on temptation goods declines as overall consumption increases. In addition, declining temptations imply that the proportion of total consumption spent on temptation goods declines with the level of total consumption. For instance, spending 5 euros a day on cigarettes has different budgetary implications for someone who lives on 10 euros a day than someone who lives on 100 euros a day. Therefore, if the present self expects to be poor in the future and does not value the future consumption of cigarettes, the poor may be less willing to delay consumption. This phenomenon may be the reason why the poor can be observed to borrow at high rates and often only make investments that promise exceptional returns. The more well-off would appear to be less myopic, even if they had identical underlying preferences. Ubfal (2012) provides empirical evidence that the share of expenditures on goods with higher discount rates decreases with higher income.

Furthermore, by analyzing modified Euler equations, BM (2010) discover several intriguing possibilities. Perhaps, the most important of their findings is that declining temptations can generate a behavioral poverty trap. However, to the best of our knowledge, the effect of temptations has not been analyzed yet within a general equilibrium model.

In this paper, we attempt to fill this gap in the literature by integrating temptation goods into a general equilibrium model with dynasties of heterogeneous households and empirically based parameter values. We build on the model of Benabou (2002) that embodies credit constraints and allows for income taxes, consumption taxes, education subsidies and income transfers as policy tools.

Our theoretical analysis shows that temptations have no effect on the equilibrium savings rate but declining temptations increase equilibrium labor effort and equilibrium level of income. For quantitative analysis, we use EU data with alcoholic beverages, tobacco and narcotics defined as temptation goods in the benchmark specification. We find that the effect of temptations on equilibrium levels of labor effort, income and income inequality is small. The optimal policy that maximizes either income or welfare remains unaffected. However, the optimal policy that maximizes paternalistic income, which does not include the value of temptation goods, requires a higher level of redistribution than the optimal policy that maximizes total income. Hence, a paternalistic government that ignores temptation goods would underestimate the optimum level of redistribution.

The paper proceeds as follows. Section 2 presents an overview of the related literature. Section 3 motivates the approach taken in the rest of the paper, and Section 4 identifies our research questions. Section 5 describes the model and provides expressions for steady-state solutions. Section 6 describes the inputs of the model. Section 7 presents quantitative analysis and results, and Section 8 concludes. Section 9 summarizes.

2. Related literature

Inefficient resource allocation within an economy offers a central explanation for low growth rates in developing countries. Rates of return for the same factor in an economy can vary substantially (Banerjee and Duflo [BD], 2005). This phenomenon remains true for both physical and human capital and is defended by many studies about developing countries. For example, the best practices of an industry in a developed country are often in line with internationally accepted standards. On the contrary, only a small proportion of companies adopt such practices in developing countries.

More recently, BM (2010) argued that declining temptations may have contributed to the apparent misallocation as evidenced by the high rates for borrowing and investing money the poor often face. Declining temptations rest on two assumptions. First, some consumption items, i.e. temptation goods, generate positive utility for the self that consumes them but are not valued by any previous self that anticipates their consumption. Second, the fraction of marginal euro spent on temptation goods declines as overall consumption increases. BM argued some activities, e.g. smoking, provided immediate pleasures while other experiences, e.g. eating a healthy meal and investing in a child's education, provided a more lasting gratification and were things one would be more willing to do in the future. Some neurological evidence suggested a two-self model where one of the selves was more prone to immediate impulses and pleasures (Fudenberg and Levine, 2006; Kahneman, 2011). Furthermore, Ubfal (2012) provided evidence for both assumptions. Surveys from rural Uganda revealed that discount rates on goods differ. For example, in his paper, goods such as sugar and beef had particularly high discount rates while goods such as clothing and shoes had low discount rates. Also, he demonstrated that the share of expenditures on goods with higher discount rates tended to decrease with income.

Moreover, BM (2010) showed that declining temptations could create a poverty trap where the poor only save very little. If the poor expect to remain poor and to keep spending a large part of their income on goods they discount highly from today's perspective, they become more reluctant to save. Nonetheless, the prospects of earning enough income to decrease the proportion of income spent on temptation goods to a reasonable level may motivate the poor to save. Hence, there exists some minimum income level at which the poor find it worthwhile to save. Before reaching that level, an individual appears myopic, but after reaching that level, the same individual immediately an substantially increases savings in an attempt to escape the poverty trap. This idea implies the existence of appropriate redistribution policies which may help individuals to escape the poverty trap.

The extensive empirical evidence from developing countries supports the notion that the misallocation of resources can be remedied with redistribution policies. Based on case studies in South Africa, Latin America, the Caribbean and transition countries, Barrientos and DeJong (2006) concluded that cash transfer programs targeting children in poor households are “a sure thing" as an effective way of reducing poverty, even if they fail to reach all poor children. Barham (2011) showed that the Mexican conditional transfer program, Progresa, led to a decline in the infant mortality ratio and provided health benefits in excess of costs. Glewwe and Kassouf (2012) confirmed that the conditional cash transfer program in Brazil increased school attendance. Aguero, Carter and Woolard (2006) demonstrated how child support grants, targeted at poor families in South Africa, lessened child malnutrition. The findings of Fernald and Hidrobo (2011) regarding an unconditional cash transfer program in Ecuador were similar. Investigating an old-age cash transfer program in Bolivia, Yanez-Pagans (2008) established that transfers to women led to an increase in investment in children's human capital, which is in line with the results of some other cited studies. Finally, Haarmann et al. (2009) found that a basic income guarantee pilot project in Namibia led to substantial declines in poverty, crime and child malnutrition, while school attendance and health outcomes improved.

In addition, BD (2005) argued that aggregative explanations focusing on different total factor productivities across countries misrepresented the nature of the problem of poverty, because the "technological gap (...) is largely a within-country phenomenon and not (...) a problem at the level of the country." Therefore, "non-aggregative growth models (...) have the potential to explain why poor countries remain poor." BD (2005) further analyzed the implications of a few simple models with credit constraints and multiple firms. They revealed that such models have the potential to explain differences in growth rates and marginal returns between countries. Rodrik (2011a) noted that, if markets do not function well, many resources remain concentrated in less productive activities such as government services and traditional agriculture. Also, Rodrik (2011b) provided evidence that unconditional convergence actually happened but only in manufacturing industries, which were not exempt from international competitive pressure.

Financial restrictions have been shown to affect growth in other empirical literature and the amplitude of the estimated effects is substantial. Spulber (1996) estimated that market intermediation, including capital market intermediation, made up over 25% of US GDP. Aghion, Caroli and Garcia-Penalosa (1999) discussed the inverse relationships between inequality and growth often found in the empirical literature. They outlined a simple model with imperfect capital markets in which redistributive policies facilitated growth. Benabou (2002) developed a model with heterogeneous agents to study the effects of redistributive policies as partial substitutes for missing credit and insurance markets. He analyzed a policy mix that included redistribution of income, a consumption tax and education subsidies. Model simulations suggested that income was maximized with redistributive transfers of 6% of GDP.

More recently, several studies have used the size of the financial sector as a proxy for financial development. Midrigan and Xu (2009) estimated total factor productivity (TFP) losses due to financial frictions at 2.5%. In contrast, Buera, Kaboski and Shin (2010) estimated TFP losses of up to 40%. Greenwood, Sanchez and Wang (2010) estimated that Uganda would have had 140%-180% higher output with a fully developed financial sector implying a TFP loss of around 60%. See Moll (2010) for a recent review or Levine (2005) for a comprehensive survey of literature.

3. Our approach

The model presented by BM (2010) introduces several intriguing possibilities, the most important of which is that temptations can generate a behavioral poverty trap. The recent work of

Ubfal (2012) provides more evidence that the requirements for declining temptations are met in some developing countries. Due to the growing plausibility of temptation goods and declining temptations and their possible effect on the formation of optimal policy, we view it worthwhile to explore temptation goods in a general equilibrium model.

We decided to integrate temptation goods in Benabou (2002) based on four main criteria for model selection. First, since the poor coexist in the same economy with the rich, the model should have heterogeneous agents. This criterion follows from the importance of the within-country heterogeneity that is found in the related literature. The second criterion for the model is the inclusion of credit constraints. A large body of evidence suggests that financial frictions play a key role in an economy, and especially in poor households. Then, it seems plausible that credit constraints may be an important factor themselves and may interact with temptations in a way too important to be ignored. Third, we want to be able to analyze implications for credible government policies. Benabou's model utilizes a policy mix that includes the redistribution of income via an income tax and a consumption tax. The tax revenue is redistributed by means of income transfers and education subsidies. These methods of redistribution represent public policy tools commonly applied in developed countries. Finally, we want investment in education to play a central role in our model. According to the reviewed literature, redistributive policies may be most important when they target children in poor households. Since education plays a critical role in a child's development, it will play a significant part in our model. Furthermore, in Benabou's model, investment in education is what ultimately determines productivity, income level, and welfare.

4. Research questions

In this paper we answer two research questions. First, ***how does policy affect income and welfare when temptation goods are accounted for?*** Second, ***how does the effect of policy change when a paternalistic government does not value the consumption of temptation goods?*** As discussed above, our model embodies heterogeneous agents, credit constraints, plausible policy tools and investment in education.

Specifically, we evaluate the levels of savings, labor effort, income, inequality and welfare in steady-state. We compare the results with temptation goods in the model to results when temptation goods are ignored. To answer the first research question, we examine and compare the effect of policy for a model which includes temptation goods and a model which does not include temptation goods. Moreover, the conventional definition of income includes temptation goods, but a paternalistic government may wish to maximize the income level that does not include the value of temptation goods. Therefore, we estimate income without temptation goods, “paternalistic income,” and analyze how policy affects it. To answer the second research question we compare the effect of policy on paternalistic income with the effect of policy on overall income.

We do not have a strong inclination for the differences in results between the cases with temptation goods and without temptation goods. Like Benabou, using education subsidies, we apply a policy which keeps savings at their efficient level. Therefore, the savings level will not change even as the income tax level rises. In Benabou's model, such a policy without temptation goods decreases labor effort and decreases inequality while the redistribution level rises. In addition, income is maximized when the share of income transfers to GDP is approximately 6%

while aggregate welfare is maximized with income transfers to GDP of approximately three times that level.

5. Method

Introduction to the model

Our model is based on the simplest version of Benabou (2002). Importantly, Benabou refers to a generation (25 years) as one period and applies a discount factor of .40 in his model with one good. This assumption implies approximately a 4% discount rate per annum. According to Ubfal (2012), temptation goods tend to be discounted at higher rates than normal goods, typically at rates between 10%-20% per annum. This discount rate does not amount to anywhere near full discounting in a single year but comes very close to full discounting in a generation ($.90^{25} \approx .072$ and $.80^{25} \approx .004$). Thus, forming a model with generations of households is more consistent with our assumption and is more consistent with the assumption of BM (2010) that the value of temptation goods is discounted fully.

There are two main differences between our model and Benabou (2002). First, our model has two consumption components instead of one, temptation goods and normal goods. As discussed earlier, the consumption of temptation goods is valued only in the present but is not valued by the previous generations. Common anecdotal evidence confirms that parents tend to discourage their offspring from consuming alcohol and cigarettes.

Second, we modify several constraints so a given household does not face a trade-off between the current level of consumption and the current level of investment. Specifically, in the present period, the household chooses the savings rate for the following period, and resources of the present period are used to generate income in the following period.

Utility maximization problem of a household

In generation or period t , household i maximizes the following utility function:

(1) $$\ln \tilde{U}_t^i \equiv X(x_t^i) + Z(z_t^i) - L(l_t^i) + E_t[\sum_{k=1}^{\infty} \rho^k (\rho X(x_{t+k}^i) - L(l_{t+k}^i))]$$

The variables x_t^i and z_t^i denote the consumption of normal goods and temptation goods respectively, and the sub-utility functions X and Z give the value derived from the consumption of normal goods and temptation goods, respectively. $-L$ denotes the disutility from labor effort l_t^i. Utility $\ln \tilde{U}_t^i$ is maximized subject to four constraints:

(2) $$y_{t+1}^i = (h_t^i)^\lambda (l_t^i)^\mu$$

(3) $$\hat{y}_{t+1}^i = c_{t+1}^i (1+\theta) + e_{t+1}^i$$

(4) $$h_{t+1}^i = \kappa \xi_{t+1}^i \cdot (h_t^i)^\alpha ((1+a) e_{t+1}^i)^\beta$$

(5) $$x_t^i + z_t^i = c_t^i$$

Households themselves produce output y_{t+1}^i by combining their own human capital h_t^i with their own labor effort l_t^i. After income taxes and transfers (discussed later), the household is left with disposable income $\hat{y}_{t+1}^i$. The disposable income is either spent on consumption c_{t+1}^i that government taxes at a constant rate θ or invested in education e_{t+1}^i that government subsidizes at a constant rate a . The home or neighborhood environmental quality is measured by parental human capital h_t^i. The human capital in the next period h_{t+1}^i is affected by the innate ability of the offspring ξ_{t+1}^i . We assume, as did Benabou, that ξ_{t+1}^i are i.i.d. and log-normally distributed, with $\ln \xi_t^i \approx N(-\omega^2/2, \omega^2)$, hence $E[\xi]=1$. Finally, κ is a scaling parameter that can be adjusted so that the model output matches the data at hand.

We assume that in period t the household i has two control variables: the level of effort l_t^i and the savings rate s_t^i. The choice of the savings rate shows how much of the parents' disposable income will be invested in education of the offspring: $s_t^i = e_{t+1}^i / \hat{y}_{t+1}^i$. Then, the level of available resources for total consumption c_t^i is already set in period t, and the resources must be distributed optimally across x_t^i and z_t^i. If at any one level of c_t^i an optimal combination of x_t^i and z_t^i can be found only by knowing c_t^i, and we select the sub-utility functions X and Z so that it can, we can separate the maximization problem of $X(x(c_t^i)) + Z(z(c_t^i))$ from (1). After separation, and with $L(l_t^i) = E_t[L(l_t^i)]$, we are left with (6) for maximization:

(6) $$\ln U_t^i \equiv E_t[\sum_{k=0}^{\infty} \rho^k (\rho X(x(c_{t+k+1}^i)) - L(l_{t+k}^i))]$$

Then, we can write the Bellman equation as follows:

(7) $$\ln U_t^i \equiv E_t[\rho X(x(c_{t+1}^i)) - L(l_t^i) + \rho \ln U_{t+1}^i]$$

Progressive income tax

Government redistribution takes place through marginally progressive taxes and transfers that are set constant by the government. At $t+1$ household i receives disposable income $\hat{y}_{t+1}^i$ which is obtained as:

(8) $$\hat{y}_{t+1}^i = (y_{t+1}^i)^{1-\tau} (\tilde{y}_{t+1})^{\tau}$$

The break-even level of income $(\tilde{y}_{t+1})^{\tau}$ is defined by a balanced-budget constraint:

(9) $$\int (y_{t+1}^i)^{1-\tau} (\tilde{y}_{t+1})^{\tau} di = y_{t+1}^i$$

The income tax parameter $\tau \leq 1$ measures the rate of progressivity of the fiscal policy. As shown by Benabou (2002), τ shows the income-weighted average marginal tax (and transfer) rate as well. Therefore, we refer to it as the "income tax rate" in the rest of the paper.

The shape of temptations

We follow Benabou and assume that for each household, the utility function for normal good consumption, x, and the disutility from labor effort l are as follows: $X(x)=\ln(x)$ and $L(l)=l^{\eta}$. We assume that $Z(z)$ takes the form of a slightly modified standard isoelastic utility function:

(10) $$Z(z)=b_1 z^{(1-b_2)}/(1-b_2)$$

Parameter restrictions are $b_1 > 0$ and $b_2 \neq 1$ [1]. Now, we show that the function for $z(c)$ can fulfill the criteria for "temptation shape" as set forth by BM (2010, p.15). For every c:

(I) temptation good consumption does not exceed total consumption: $z(c) \leq c$,

(II) temptation good consumption is nonnegative: $z(c) \geq 0$,

(III) temptation good consumption increases with consumption $z'(c) \geq 0$,

(IV) an agent faces "declining temptations", i.e. $z''(c) < 0$.

To start with, at every level of consumption the marginal utilities must be equal: $x^{-1}=b_1 z^{-b_2}$. Using this to express c as a function of z:

(11) $$c(z)=z^{b_2}/b_1 + z$$

In (11) both right hand-side terms are nonnegative so it is clear that all the positive values of c correspond to positive but smaller values of z and $c(z=0)=0$. Therefore, criteria (I) and

1 Or $Z(z)=b_1 \ln(z)$ if $b_2=1$. However, we will estimate the parameters with empirical data, so the probability of obtaining $b_2=1$ is infinitely small, and we do not consider it in further derivations.

(II) are always satisfied.

Now, differentiating (11) w.r.t. z yields $c'(z)=b_1^{-1}b_2 z^{b_2-1}+1$, which implies:

(12) $z'(c)=1/(b_1^{-1}b_2 z^{b_2-1}+1)$

From (11) we know that, if c is nonnegative, then z is nonnegative. Therefore, (12) implies that z is increasing in c. Hence, the criterion (III), that $z'(c)\geq 0$, is always satisfied.

The second derivative w.r.t. z is $c''(z)=b_1^{-1}b_2(b_2-1)z^{b_2-2}$. Also, note that in general the second derivative can be expressed as $z''(c)=-c''(z)(z'(c))^3$, so:

(13) $z''(c)=-b_1^{-1}b_2(b_2-1)z^{b_2-2}(b_2^{-1}b_2 z^{b_2-1}+1)^{-3}$

Therefore, $z''(c)<0$ requires $b_2>1$ or $b_2<0$. Then, criterion (IV) is satisfied. Notice that having $Z(z)=b_1\ln(z)$ would yield $z''(c)=0$, which would not satisfy criterion (IV).

Coefficients b_1 and b_2 can be estimated by using the equality of marginal utilities: $x=z^{b_2}/b_1$. By taking logarithms and rearranging, we express temptation consumption as a function of the level of normal consumption $\ln z=(1/b_2)\ln b_1+(1/b_2)\ln x$. With $B_1=(1/b_2)\ln b_1$ and $B_2=1/b_2$:

(14) $\ln z=B_1+B_2\ln x$

With observations of z and x, we can estimate $b_1=\exp(B_1/B_2)$ and $b_2=1/B_2$ via regression analysis.

Note that our chosen functional form does not necessarily imply that temptations are declining. With $0<b_2<1$ the possibility remains that temptations are actually increasing. Hence, we will determine whether temptations are actually declining from empirical analysis.

Temptation tax

Consumption of household i at period t can be expressed from (3) as:

$$c_{t+1}^{i}=x_{t+1}^{i}+z_{t+1}^{i}=(\hat{y}_{t+1}^{i}-e_{t+1}^{i})/(1+\theta)=\hat{y}_{t+1}^{i}(1-s_{t}^{i})/(1+\theta) .$$

From the perspective of the parents, any consumption of temptation goods by the offspring is a waste. Since the parents know that part of the future consumption expenditure will be "wasted" on temptation goods, the parents view this as a "tax" on future consumption. Using this logic, we introduce a notion called the "temptation tax" q . Temptation tax in the period $t+1$ can be expressed as $q_{t+1}^{i}=z_{t+1}^{i}/c_{t+1}^{i}$. Then, we can express the normal good consumption as a function of total consumption $x(c_{t+1}^{i})$ as:

$$x(c_{t+1}^{i})=(1-q_{t+1}^{i})\hat{y}_{t+1}^{i}(1-s_{t}^{i})/(1+\theta) .$$

After incorporating income taxes and substituting for disposable income with equation (8) and for income with equation (2), we are left with:

$$x(c_{t+1}^{i})=(1-q_{t+1}^{i})((h_{t}^{i})^{\lambda}(l_{t}^{i})^{\mu})^{1-\tau}(\tilde{y}_{t+1})^{\tau}(1-s_{t}^{i})/(1+\theta) .$$

Taking the natural logarithm of both sides:

(15) $$\ln(x(c_{t+1}^{i}))=\ln(1-q_{t+1}^{i})+\ln(1-s_{t}^{i})-\ln(1+\theta)+(1-\tau)(\lambda\ln h_{t}^{i}+\mu\ln l_{t}^{i})+\tau\ln\tilde{y}_{t+1}$$

Now, we make an important modeling assumption that (11) can be approximated over the relevant range of values for c as:

(16) $$c(z)=(b_{3}z^{b_{2}})^{1/(1+g)}$$

Parameter restrictions are $b_{3}>0$ and $g\neq-1$. Values of b_{3} and g can be estimated by taking a logarithm of (16) and then rearranging in order to express temptation consumption as a function of total consumption:

$\ln z = -(1/b_2)\ln b_3 + ((1+g)/b_2)\ln c$. Or, with $B_3 = -(1/b_2)/\ln b_3$ and $B_g = (1+g)/b_2$:

(17) $\ln z = B_3 + B_g \ln c$

With observations of z and c and the value of $b_2 = 1/B_2$ known, we can estimate $b_3 = \exp(-B_3/B_2)$ and $g = B_g/B_2 - 1$ via regression analysis.

Now, observe from (11) that $1-q = z^{b_2}/(b_1 c)$. From (16) we can express: $z^{b_2} = c^{(1+g)}/b_3$ Inserting this into the above expression and expressing $b = b_1 b_3$ yields:

(18) $1-q = c^g/b$

Notice two things. First, having $g=0$ and $b=1$ would mean having the temptation tax q equal to zero. This would be equivalent to a model with no temptation goods. Second, the temptation tax becomes negative if consumption is high enough so that $c^g > b$. In effect, a household with such high consumption would "sell short" some of z to consume more of x . This occurrence clashes with criteria (II) and (III) discussed earlier that $z(c) \geq 0$ and $z'(c) \geq 0$. However, if these anomalies refer to only a small part of population, the above function for $z(c)$ can still be a good approximation. In order to determine whether or not the approximation is appropriate, we use the parameter values and the distribution of c^i from the data. We will elaborate on this topic later on in the results section.

Before running regressions based on (14) and (17) to estimate temptation parameters, we adjust the scaling parameter κ so that the mean consumption, as predicted by the model, matches the mean consumption in the data used for estimating the temptation parameters. We equalize the means, because we have expressed temptation tax q as a function of the absolute level c . Consider a case when consumption data for the regression estimation has a mean that is several orders of magnitude higher than the mean consumption from the model output. Then, with declining temptations, we would vastly overstate the temptation tax faced by every household in the model economy.

We continue by substituting $(1-q^i_{t+1})=(c^i_{t+1})^g/b$ into (15):

$$\ln(x(c^i_{t+1}))=\ln((c^i_{t+1})^g/b)+\ln(1-s^i_t)-\ln(1+\theta)+(1-\tau)(\lambda\ln h^i_t+\mu\ln l^i_t)+\tau\ln\tilde{y}_{t+1}$$

And simplify to express the utility derived from normal good consumption as:

$$\ln(x(c^i_{t+1}))=(1+g)(\ln(1-s^i_t)-\ln(1+\theta)+(1-\tau)(\lambda\ln h^i_t+\mu\ln l^i_t)+\tau\ln\tilde{y}_{t+1})-\ln b \tag{19}$$

The model in specific form

With the assumed forms for utility functions, given a policy sequence $\{\tau_t,\theta_t,a_t\}_{t=0}^{\infty}$, a household with human capital h^i_t solves the following dynamic programming problem:

$$\begin{aligned}&\ln U^i_t(h^i_t)\\&=\max_{l,s}\{\rho[(1+g)(\ln(1-s^i_t)-\ln(1+\theta)+(1-\tau)(\lambda\ln h^i_t+\mu\ln l^i_t)+\tau\ln\tilde{y}_{t+1})-\ln b]\\&-(l^i_t)^{\eta}+\rho E[\ln U^i_{t+1}(h^i_{t+1})]\}\end{aligned} \tag{20}$$

that we get by substituting (19) in (7) and where:

$$h^i_{t+1}=\kappa\xi^i_{t+1}((1+a)s^i_t)^{\beta}(h^i_t)^{\alpha+\beta\lambda(1-\tau_{t+1})}(l^i_t)^{\beta\mu(1-\tau_{t+1})}(\tilde{y}_{t+1})^{\beta\tau_{t+1}} \tag{21}$$

that we get from (2), (4) and (8).

Steady-state savings and labor

To begin with, we guess that the value function is of the form $\ln U^i_t=V^i_t\ln h^i_t+B^i_t$, which implies: $\partial\ln U^i_t/\partial\ln h^i_t=V^i_t$. It can then be shown that in steady-state the value function can be expressed as (see Appendix):

(22) $$V=\frac{\lambda\rho(1-\tau)(1+g)}{1-\rho p}$$

(23) $$p=\alpha+\beta\lambda(1-\tau)$$

Next, from (20), the first-order condition (FOC) for optimal savings is:

$$\frac{\partial\ln U_t^i}{\partial s_t^i}=\frac{-\rho(1+g)}{1-s_t^i}+\rho\frac{\partial E[\ln U_{t+1}^i]}{\partial h_{t+1}^i}\frac{\partial h_{t+1}^i}{\partial s_t^i}=0$$

From (21) we can see that $\delta h_{t+1}^i/\delta s_t^i=\beta h_{t+1}^i/s_t^i$. Also note that, in general: $\partial h/\partial\ln h=h$.

Substitute these results into the FOC for optimal savings to obtain:

$$\frac{\rho(1+g)}{1-s_t^i}=\rho\frac{\partial E[\ln U_{t+1}^i]}{h_{t+1}^i\partial\ln h_{t+1}^i}\frac{\beta h_{t+1}^i}{s_t^i},$$

$$\frac{s_t^i}{1-s_t^i}=\frac{\beta}{1+g}\frac{\partial E[\ln U_{t+1}^i]}{\partial\ln h_{t+1}^i}=\frac{\beta V_{t+1}^i}{1+g},$$

(24) $$s_t^i=\frac{\beta V_{t+1}/(1+g)}{1+\beta V_{t+1}/(1+g)}$$

We find steady-state level of savings by substituting $V_{t+1}^i=V$ from (22) (see Appendix):

(25) $$s=\frac{\beta\lambda\rho(1-\tau)}{1-\rho\alpha}$$

Immediately, we notice optimal savings are unaffected by any of the temptation parameters. This result runs contrary to the striking implication of the analysis of BM (2010) that temptation goods can create a poverty trap. In addition, optimal savings are reduced proportionally by the income tax rate τ.

Finally, from (20), the FOC for optimal effort is:

(26) $$\frac{\partial\ln U_t^i}{\partial l_t^i}=\rho(1+g)(1-\tau)\frac{\mu}{l_t^i}-\eta(l_t^i)^{\eta-1}+\rho\frac{\partial E[\ln U_{t+1}]}{\partial h_{t+1}^i}\frac{\partial h_{t+1}^i}{\partial l_t^i}=0$$

From (21) we can see that $\partial h^i_{t+1}/\partial l^i_t = \beta\,\mu(1-\tau)\,h^i_{t+1}/l^i_t$. Also, recall that $\partial h/\partial \ln h = h$ to get:

$$\eta(l^i_t)^{\eta-1} = \rho[(1+g)(1-\tau)\frac{\mu}{l^i_t} + \frac{\partial E[\ln U_{t+1}]}{h^i_{t+1}\partial \ln h^i_{t+1}}\frac{\beta\,\mu(1-\tau)\,h^i_{t+1}}{l^i_t}],$$

$$\eta(l^i_t)^{\eta} = \rho\,\mu(1-\tau)(1+g+\beta V^i_{t+1}),$$

(27) $$l^i_t = [\rho(\mu/\eta)(1-\tau)(1+g+\beta V^i_{t+1})]^{1/\eta}$$

In steady-state, it can be shown that (see Appendix):

(28) $$l = [\frac{\rho(\mu/\eta)(1-\tau)(1+g)(1-\rho\alpha)}{1-\rho(\alpha+\beta\lambda(1-\tau))}]^{1/\eta}$$

Immediately, we see that a higher temptation parameter g increases labor effort in steady-state. On one hand, the temptation tax means that some of the consumption in future will be wasted on temptation goods. This action of wasting consumption should, in itself, decrease the marginal utility from an extra hour of work for a given level of consumption of normal goods. However, the level of consumption of normal goods is not the same. It is lower because of the temptation tax. This second effect increases the marginal utility from an additional hour worked. Moreover, the temptation tax declines as consumption increases, i.e. it is regressive. These two latter effects combined lead to the situation where “impoverishment” due to temptations leads to increased labor effort. On the contrary, a higher income tax rate τ lowers effort. A substantial difference here is that the temptation tax is regressive, while the income tax is progressive.

We may be interested in how the policy impact differs with and without temptation goods in the model. With an income tax rate τ, we can compare the two specifications, by subtracting the percent changes in labor effort due to policy:

$$(\ln l_{t,\tau} - \ln l_{t,\tau=0}) - (\ln l_{nt,\tau} - \ln l_{nt,\tau=0}) = \ln(l_{t,\tau}/l_{nt,\tau}) - (\ln l_{t,\tau=0}/\ln l_{nt,\tau=0})$$
$$= \ln(1+g)^{1/\eta} - \ln(1+g)^{1/\eta} = 0$$

In the above equation, $l_{t,\tau}$ and $l_{nt,\tau}$ denote levels of effort with income tax rate τ for models with and without temptation goods, respectively. The variables $l_{t,\tau=0}$ and $l_{nt,\tau=0}$ denote the corresponding laissez-faire levels of labor effort. We see that temptation goods do not affect the impact of policy on labor effort.

Consumption taxes and investment subsidies

As in Benabou (2002), we explore a policy where investment distortions due to income taxes and transfers are exactly offset by another policy that consists of consumption taxes and education subsidies. On an aggregate level in steady-state under constant policy, a government must balance the budget by having proceeds from consumption tax equal to investment subsidies: $\theta c = a e$. Recall that $c = (\hat{y} - e)/(1+\theta)$ and $e = s\hat{y}$ to obtain:

(29) $$\frac{\theta(1-s)}{(1+\theta)} = a s$$

The government may wish to restore the effective (pretax) level of investment $\tilde{s}$, that can be expressed as: $\tilde{s} = s/(1-\tau) = s(1+a) = (s+\theta)/(1+\theta)$. Then, the government must set the investment subsidy as $a = \tau/(1-\tau)$ and the level of consumption tax must be:

(30) $$\theta_t = (\tilde{s} - s_t)/(1 - \tilde{s}_t)$$

It can be shown that when such a subsidy policy is combined with income tax policy it is Pareto optimal (see Benabou, 2002). Therefore, the optimal policy set is one-dimensional. As a result, we can analyze policy mixes with income taxes/transfers, consumption taxes and education subsidies by only varying levels of the income tax rate τ .

Steady-state income, welfare and inequality

To proceed, express the law of motion of human capital in (21) in a logarithmic form:

(31) $$\ln h_{t+1}^{i}=\ln\kappa+\ln\xi_{t+1}^{i}+\beta\ln((1+a)s_{t}^{i})+(\alpha+\beta\lambda(1-\tau))\ln h_{t}^{i}+\beta\mu(1-\tau)\ln l_{t}^{i}+\beta\tau\ln\tilde{y}_{t+1}$$

With the random variable $\ln\xi_{t+1}^{i}\sim N(-\omega^2/2,\omega^2)$, $\ln h_{t+1}^{i}$ is normally distributed over time, denote: $\ln h_{t}^{i}\sim N(m_t,\Delta_t^2)$. Obtaining the variance of $\ln h_{t+1}^{i}$ is straightforward from (31):

(32) $$\Delta_{t+1}^2=(\alpha+\beta\lambda(1-\tau))^2\Delta_t^2+\omega^2$$

Regarding the break-even level of taxes $\tilde{y}_{t+1}^{i}$, it can be shown that (see Appendix):

(33) $$\ln\tilde{y}_{t+1}=\lambda m_t+\mu\ln l_t+(2-\tau)\lambda^2\Delta_t^2/2$$

Inserting the above expressions in (31) yields:

$$m_{t+1}=\ln\kappa-\omega^2/2+\beta\ln((1+a)s_t^i)+(\alpha+\beta\lambda(1-\tau))m_t+\beta\mu(1-\tau)\ln l_t^i$$
$$+\beta\tau(\lambda m_t+\mu\ln l_t+(2-\tau)\lambda^2\Delta_t^2/2)$$

(34) $$m_{t+1}=\ln\kappa-\omega^2/2+\beta\ln((1+a)s_t^i)+(\alpha+\beta\lambda)m_t+\beta\mu\ln l_t^i+\beta\tau(2-\tau)\lambda^2\Delta_t^2/2$$

It can be shown that the law of motion of income per household follows (see Appendix):

(35) $$\ln y_{t+2}-\ln y_{t+1}$$
$$=\ln\bar{\kappa}+(\alpha+\beta\lambda-1)\ln y_{t+1}+\mu(\ln l_{t+1}-\alpha\ln l_t)+\beta\lambda\ln((1+a)s_t^i)-P\lambda^2\Delta_t^2/2$$

where

(36) $$\ln\bar{\kappa}=\lambda\ln\kappa-\lambda(1-\lambda)\omega^2/2$$

(37) $$P=\alpha+\beta\lambda(1-\tau)^2-(\alpha+\beta\lambda(1-\tau))^2$$

(38) $$\lambda^2\Delta^2=\frac{\lambda^2\omega^2}{1-(\alpha+\beta\lambda(1-\tau))^2}$$

From (35) we directly obtain an expression for the steady-state income level per household:

(39) $$\ln y = \frac{\ln\bar{\kappa} + \mu(1-\alpha)\ln l + \beta\lambda\ln((1+a)s) - P\lambda^2\Delta_t^2/2}{1-\alpha-\beta\lambda}$$

Finally, it can be shown that aggregate welfare can be expressed as (see Appendix):

(40) $$W = \frac{\rho[(1+g)(\ln((1-s)/(1+\theta)) + \lambda m + \mu\ln l + \tau(2-\tau)\lambda^2\Delta^2/2) - \ln b] - l^\eta}{1-\rho}$$

With the steady-state average human capital m expressed from (34):

(41) $$m = \frac{\ln\kappa - \omega^2/2 + \beta\ln((1+a)s) + \beta\mu\ln l + \beta\tau(2-\tau)\lambda^2\Delta^2/2}{1-(\alpha+\beta\lambda)}$$

Notice that the income level $\ln y$ includes income that is spent on temptation goods. On the other hand, aggregate welfare W assumes that utility is derived only from normal goods. Thus, it is in that sense a "paternalistic" aggregate welfare.

Observe that the expression for income in (39) is only affected by temptations through labor effort, which is expressed in (28), and is influenced by temptation parameter g. We already concluded that labor effort increases with g. In addition, we saw that the impact of policy on labor effort is unaffected by temptations. It is easy to see from (39) that these two conclusions for labor effort apply for the level of income per household also.

The expression for aggregate welfare is affected by temptations in a more complex way: it contains expressions for labor, as well as an expression with a temptation parameter $\ln b$. Hence, we will analyze it in the quantitative analysis section.

With g held constant, the effect of the income tax rate τ on income and welfare is ambiguous and depends on the values of other parameters. To that end, the effect of the income tax rate on income and welfare will be explored in more detail in the quantitative analysis section.

From $\ln h_t^i \sim N(m_t, \Delta_t^2)$ and $\ln y_{t+1}^i = \lambda \ln h_t^i + \mu \ln l_t^i$ it follows that the log of income is normally distributed: $\ln y_{t+1}^i \sim N(\lambda m_t + \mu \ln l_t, \lambda^2 \Delta_t^2)$. Then, (38) shows the level of income variance. The level of income inequality I_{inc} can be expressed as the standard deviation of income via (38):

$$(42) \qquad I_{inc} = \sqrt{\frac{\lambda^2 \omega^2}{1-(\alpha+\beta\lambda(1-\tau))^2}}$$

From (8) we see that the inequality in disposable income I_{dinc} can be expressed as $(1-\tau) I_{inc}$:

$$(43) \qquad I_{dinc} = (1-\tau)\sqrt{\frac{\lambda^2 \omega^2}{1-(\alpha+\beta\lambda(1-\tau))^2}}$$

We can observe that the temptation parameter g has no effect on income inequality as expressed in (42) and (43). Also, note that a higher income tax rate τ leads to a decrease in both income inequality and disposable income inequality, as should be expected. In the quantitative analysis section we will divide these measures of inequality by the corresponding level of income, so the conclusions about the effect of g and τ may differ.

A paternalistic government may be interested in estimating the level of output that does not include temptation goods, call it "paternalistic income." For this we first use the fact that $\ln y^i \sim N(\lambda m + \mu \ln l, \lambda^2 \Delta^2)$ and obtain a random selection of household incomes. Second, we obtain $\tilde{y}$ via (33). Now, for every household i calculate the disposable level of income from (8) and the level of consumption from (3): $\hat{y}^i = (y^i)^{1-\tau} \tilde{y}^{\tau}$, $c^i = \hat{y}^i (1-s)/(1+\theta)$.

Given the individual total consumption levels c^i, we can estimate temptation good consumption levels z^i from (11). Then, we can obtain the paternalistic income y_p^i as:

(44) $y_p^i = y^i - z^i$

Note that, in total, a household will spend $(1+\theta) z^i$ on temptation goods. However, the proceeds from the consumption tax θz^i are used to subsidize education. Therefore, a paternalistic government would not want to fully discount the value of the consumption taxes collected. Only what is directly spent on consumption of temptation goods, namely z^i, should be discounted.

By aggregating the individual outcomes y_p^i, we can obtain the mean for the distribution of paternalistic incomes per household. Instead of maximizing the total income per household or welfare, maximizing the mean y_p^i can itself be a policy aim.

Finally, Benabou (2002, p.492) shows that the share of net transfers in national income (or GDP) T that results from a given level of income tax rate τ can be expressed as:

(45) $T = 2\Phi(\tau \lambda \Delta/2) - 1$

In the above equation, Φ denotes the cumulative distribution function of a standard normal.

6. Data and sources

For most of the parameter values in the benchmark specification we apply those of Benabou (2002). They are mostly based on United States data, so they may be applicable for the European Union, which consists of developed economies as well. However, since Benabou (2002), there has been intensive research with respect to the value of the intertemporal elasticity of substitution (IES) for labor supply $\epsilon = 1/(\eta - 1)$. We examine alternative values for IES with sensitivity analysis later. In the rest of this section, we describe the data and sources used for estimating the temptation parameters, which are new in our model.

Temptation parameters

The new parameters in our model are the temptation parameters: b_1, b_2, b_3, g and b. These parameters can be estimated via regression analysis from the relationships expressed in (14) and (17). To perform regression analysis we need observations with pairs of z, temptation goods, and x, normal goods. By definition, the sum of the two make up total goods, $c=x+z$.

What exactly constitutes temptation goods and normal goods is not well defined in the literature. As discussed by BM (2010), a wide variety of goods may have at least some temptation component. What this proportion might be provides an area for further research. However, tobacco products and alcoholic drinks, the two most visible addictive goods, arguably do have significant temptation components. Due to the addictiveness of the good, one derives even more utility from the future consumption of an addictive good if that good is consumed today. For example, if one is addicted to cigarettes, smoking this year increases his or her utility from smoking next year, because in one year he or she will be even more addicted to smoking than he or she is this year. As a result, prior to any consumption, the preceding self attaches a lower value to future addictive goods than the future self. In effect, the past self applies a higher discount rate for the addictive goods, and this is what characterizes temptation goods according to the definition of BM. Moreover, in our paper, instead of past selves and future selves we have parents and offspring. As noted previously, common anecdotal evidence shows that parents tend to discourage their offspring from consuming alcohol and cigarettes.

An implicit assumption in our analysis is that preferences are the same for all agents in an economy. If we work under this assumption, we can estimate the utility function from cross-sectional data. Therefore, experimental techniques, as suggested by BM, are not necessary even though these tests can be useful to determine the validity of the assumption.

We use cross-sectional Eurostat Household Budget Surveys data on the consumption expenditure structures and levels (Eurostat, 2012a). We employ the most recent data, i.e. data for 2005, that is available for 26 of the 27 EU countries (not available for Italy), 5 income quintiles for each country, yielding 130 observations in total. One of the consumption categories is “Alcoholic beverages, tobacco and narcotics” (ATN), which is further divided into these three subcategories.

One advantage of Eurostat data stems from the relatively consistent estimation techniques utilized across countries. Also, the economies in the EU are relatively homogeneous. However, there exist two main drawbacks for the data from Eurostat. First, the data does not describe consumption structures for extremely poor households. We should not relate the results to economies that have a significant share of such households, because then we would face the problems related to out-of-sample prediction. Second, the dataset we use does not distinguish sugary and fatty foods from other food consumption. Consequently, we are unable to determine how much of the food consumption pertains to temptation goods (BM, 2010; Ubfal, 2012). Thus, the statistics regarding food consumption cannot be used.

As a result, we limit the categories included as a proxy for temptation goods to ATN. Nonetheless, this deficiency should be at least partly compensated for if the following two conditions are satisfied. One, if we view ATN as having some “normal good” portion, which seems reasonable since it is not uncommon to store at least some alcohol and preplan for parties. Second, if sugary and fatty food consumption is correlated with the consumption of the above goods. Both effects would tend to cancel out meaning that ATN could be a more appropriate proxy for overall temptation goods.

For each observation, we obtain the proportion of ATN in total consumption. Also, we have data on the average total consumption expenditure for each income quintile in each country. From Tables 1 to 5 several characteristics jump out immediately. First, the proportion of consumption expenditure spent on tobacco is negatively related to the income quintile. Second, no clear negative relationship exists for alcoholic beverages. In fact, there might even be a slight positive relationship. Hence, the overall negative relationship for ATN must be driven by tobacco. Third, the mean and the median values are close in all cases, and the maximum values are not very far from the mean. Thus, the results are not likely to be driven by a few outliers.

Next, we multiply the average income for each quintile with the proportion of expenditure on temptation goods and do this separately for alcohol and tobacco. Then, we plot the values in Figures 1-3. We can conclude the following. First, the ratio of ATN consumption to total consumption is negatively related to the spending level (Figure 1). Second, the relationship is driven by tobacco (Figures 1-3). Third, country-specific effects are important. For example, the five highest observations in Figure 2 all belong to Ireland.

For the base case we define ATN as the temptation good. Still, the problem with alcoholic drinks is that they can vary greatly in quality and price. For instance, high-end wines may serve as an investment unlike most low-end beers. In contrast, any tobacco consumed is much more uniform in terms of price, quality and durability. Because of these phenomena, we obtain results with only tobacco as a temptation good as well. These results will serve the purpose of a sensitivity test for temptation good composition.

Table 1: ATN proportion in consumption (%) by ATN component

	Total	Alcoholic beverages	Tobacco	Narcotics
Max	7.5	4.5	4.2	0.0
Mean	3.0	1.4	1.6	0.0
Median	2.7	1.2	1.4	0.0
Min	1.3	0.4	0.3	0.0

Table 2: ATN proportion in consumption (%) by income quintile

	Total	Q1	Q2	Q3	Q4	Q5
Max	8.6	7.5	6.3	5.9	5.9	5.1
Mean	3.1	3.5	3.1	2.9	2.8	2.5
Median	2.8	3.2	2.8	2.7	2.6	2.3
Min	1.3	2.1	2.0	1.8	1.6	1.3

Table 3: Proportion of alcoholic beverages in consumption (%) by income quintile

	Total	Q1	Q2	Q3	Q4	Q5
Max	4.5	4.1	3.8	4.1	4.5	4.1
Mean	1.4	1.3	1.3	1.3	1.4	1.5
Median	1.2	1.2	1.2	1.2	1.3	1.4
Min	0.4	0.7	0.5	0.5	0.4	0.4

Table 4: Proportion of tobacco in consumption (%) by income quintile

	Total	Q1	Q2	Q3	Q4	Q5
Max	4.2	4.2	3.9	3.5	3.6	3.0
Mean	1.6	2.2	1.8	1.6	1.4	1.1
Median	1.4	2.0	1.7	1.4	1.3	1.0
Min	0.3	1.1	0.9	0.7	0.6	0.3

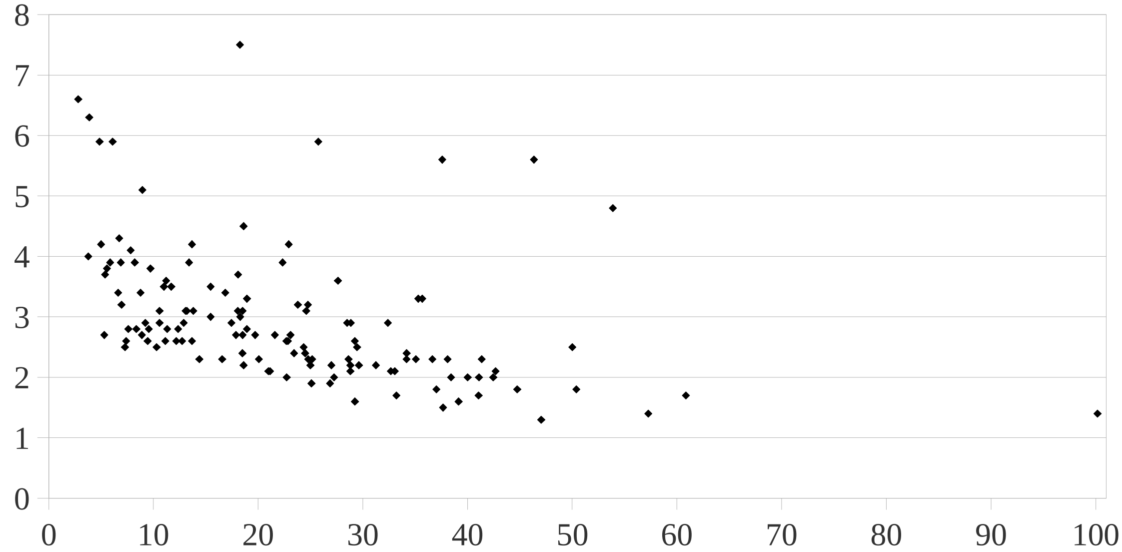
Table 5: Mean total consumption expenditure per household (EUR, PPS) by income quintile

	Total	Q1	Q2	Q3	Q4	Q5
Max	100,177	24,766	32,673	44,751	60,862	100,177
Mean	22,815	12,920	17,079	21,401	26,029	34,975
Median	20,530	13,536	19,295	24,468	28,819	37,885
Min	2,828	2,828	3,870	4,859	6,112	8,952

Source for Tables 1-5: Eurostat (2012a).

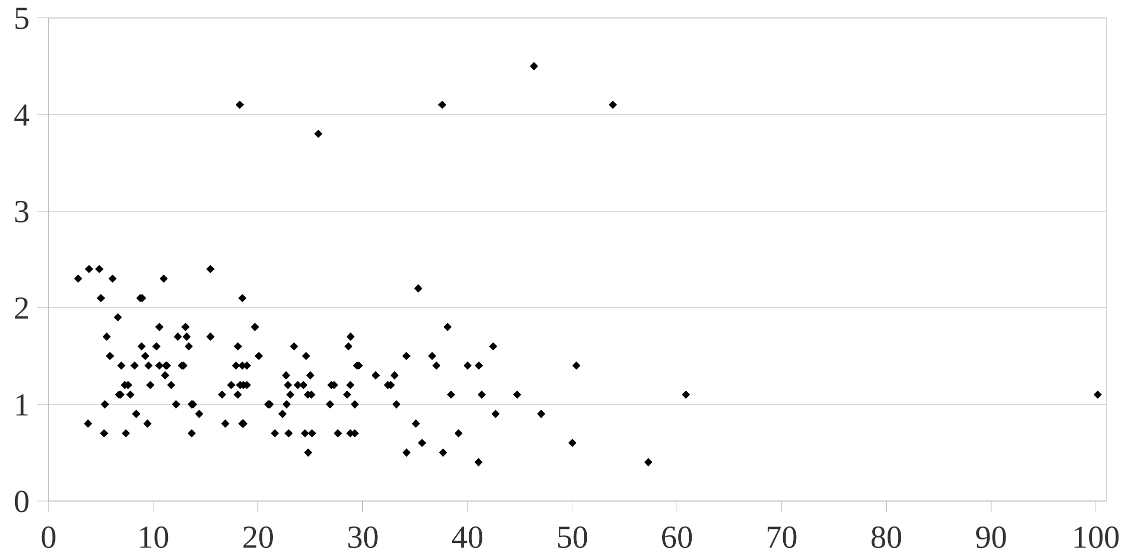
Note for Tables 1-5: Consumption expenditure of households for 5 income quintiles in 26 of the 27 EU countries (data not available for Italy) in 2005, 130 observations in total. There are no observations with reported consumption expenditure on narcotics exceeding zero.

Figure 1: ATN proportion in consumption (%) and total consumption expenditure (thousands of EUR, PPS)



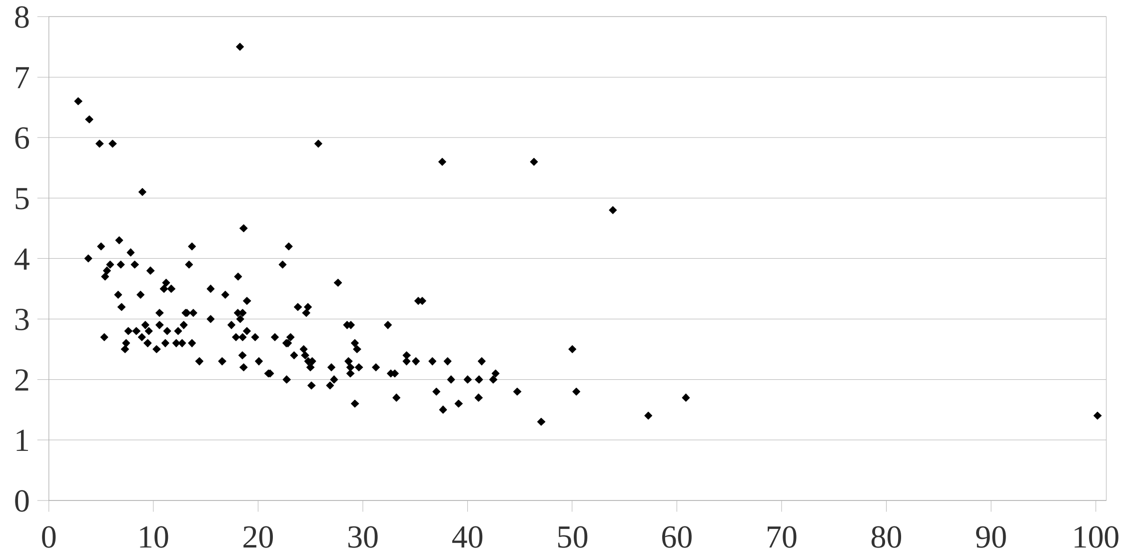
Source: Eurostat (2012a).
Note: Mean total consumption expenditure of households for 5 income quintiles in 26 of the 27 EU countries (data not available for Italy) in 2005, 130 observations in total.

Figure 2: Proportion of alcoholic beverages in consumption (%) and total consumption expenditure (thousands of EUR, PPS)



Source: Eurostat (2012a).
Note: Mean total consumption expenditure of households for 5 income quintiles in 26 of the 27 EU countries (data not available for Italy) in 2005, 130 observations in total.

Figure 3: Proportion of tobacco in consumption (%) and total consumption expenditure (thousands of EUR, PPS)



Source: Eurostat (2012a).
Note: Mean total consumption expenditure of households for 5 income quintiles in 26 of the 27 EU countries (data not available for Italy) in 2005, 130 observations in total.

In our regressions for (14) and (17) we utilize fixed effects to control for unobserved heterogeneity across the 26 countries in our cross-sectional data set. This heterogeneity might stem from cultural differences among the different countries. For instance, recall the high expenditure on drinks in Ireland. Consider what would happen if we had data on two countries with different average income levels, and if the temptation tax would be similar in a given country for all income quintiles but differ across these two countries. Having country-fixed effects would accurately show that change in income is not related to the temptation tax. In contrast, a simple OLS regression would show biased results. If along with a country's low temptation tax a low income level prevailed as well, the results would show a positive correlation even though one may think that the whole relationship is due to cultural factors. Also, we use clustered errors to account for the possibility that the error terms are related within a country.

7. Quantitative analysis

Production, accumulation, innate ability and discounting, and labor supply

We follow Benabou and use parameters as follows for the benchmark specification: share for human capital in output $\lambda = .625$, share for labor in output $\mu = .375$, innate ability parameter $\beta = 1.0$, human capital persistence parameter $\alpha = .35$, human capital investment parameter $\beta = .4$. We employ a discount factor per generation of $\rho = .4$, which implies a discount factor of approximately $.96$ per annum. IES for labor is set at $\epsilon = 0.20$ for the benchmark specification.

Temptation parameters

For our benchmark specification we define ATN as the temptation good. For sensitivity analysis we use only tobacco as a temptation good. In each case, for countries $i \in \{1,\dots,26\}$ and income quintiles $q \in \{1,\dots,5\}$, we have a total of 130 observations for temptation good consumption z_{iq} and total consumption c_{iq}. The normal good consumption x_{iq} is obtained as $x_{iq} = c_{iq} - z_{iq}$.

Then, we estimate the temptation parameters via equations (14) and (17), controlling for country-fixed effects:

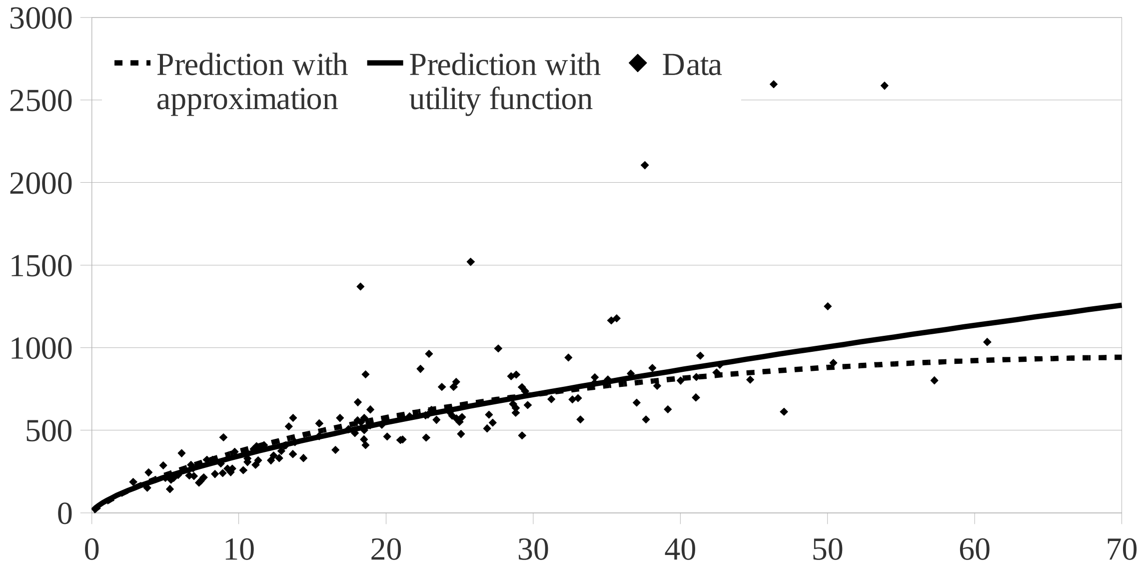
$$\ln z_{iq} = B_1 + B_2 \ln x_{iq} + v_i + \varepsilon_{iq},$$

$$\ln z_{iq} = B_3 + B_g \ln c_{iq} + v_i + \varepsilon_{iq}.$$

In the above equations, the country fixed effects are $B_1 + v_i$ and $B_3 + v_i$ respectively, with the average v_i equal to zero. Thus, B_1 and B_3 represent the average intercept for the individual country equations with identical slopes. For the benchmark specification, we obtain $g = 0.01252$ and $b = 1.1656$ (see A.Table 1 in the Appendix for the detailed results).

With the obtained parameter values we compare the value of z as predicted by the original utility function (from (11)) with the temptation tax q (from (18)) that was obtained with our modeling assumption in (16). We plot the predictions against the actual observations in Figure 4. We see that the values predicted by our approximation match closely to the values predicted by the utility function up to consumption levels of approx. 40,000 EUR or about twice the level of the mean consumption. This level is exceeded by 12% of the observations. The discrepancy increases toward the end of the range. We conclude that the approximation in (18) closely reflects the decisions that a typical randomly selected household with utility function (11) makes when making trade-offs between z and c even though it underestimates the temptation tax at very high income levels.

Figure 4: ATN consumption (EUR, PPS) as a function of total consumption expenditure (thousands of EUR, PPS)



Source: Eurostat (2012a), authors' calculations.
Note: Mean total consumption expenditure of households for 5 income quintiles in 26 of the 27 EU countries (data not available for Italy) in 2005, 130 observations in total. One observation is not shown (5th income quintile in Luxembourg, mean consumption expenditure = 100,177 EUR, PPS). Prediction with approximation is obtained via equation (18). Prediction with utility function is obtained via equation (11).

Scaling parameter

To obtain the scaling parameter κ , we match the mean consumption expenditure from the model and the mean consumption expenditure in the data. Since we have data on consumption expenditures that include consumption taxes, for normalization we use the consumption expenditure that includes taxes as well. Consumption expenditure that includes consumption taxes, c_{wtax} , can be expressed via (3) as: $c_{wtax}=c(1+\theta)=\hat{y}(1-s)$. Average disposable income $\hat{y}$ is equal to the average income, which can be obtained via (39). Also, we apply a tax rate of $\tau=.40$, which could be appropriate for the EU.[2] We obtain $\kappa\approx 2600.0$.

Labor effort

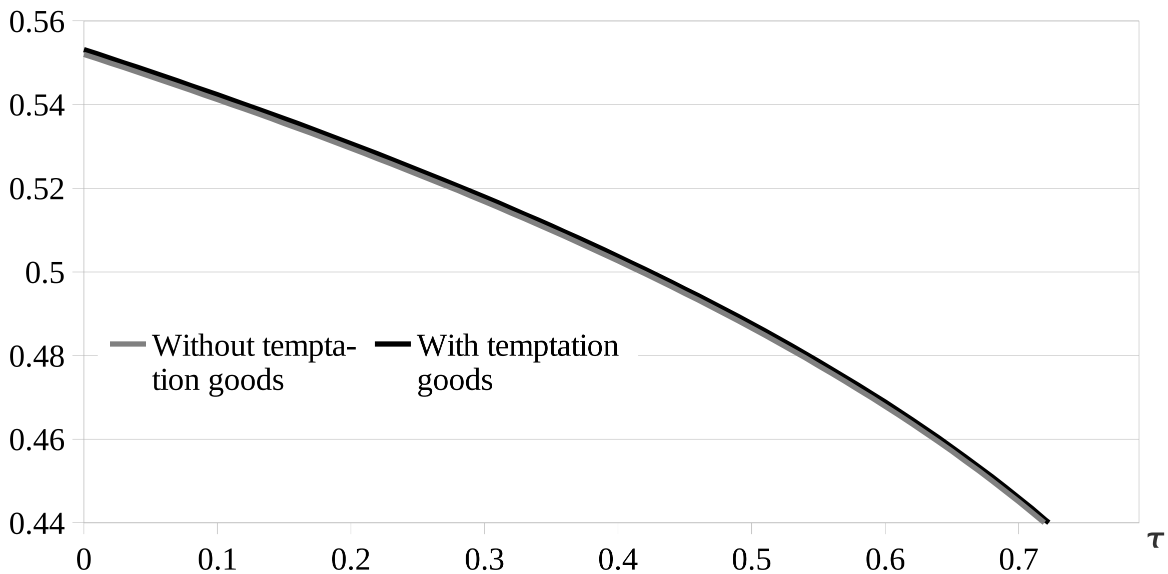
From (28) we know that the labor effort declines as the income tax rate increases. This relationship is demonstrated in Figure 5. In addition, equation (28) predicts higher labor effort if we take into account the temptation goods. As shown in Figure 5, the quantitative effect of temptations on labor effort is, however, negligible.

Income

We already established in the methodology section that temptations affect income only through the level of labor effort. Because the quantitative effect of temptations is negligible on labor, it is even more so for the level of income (Figure 6). Then, we examine the effect of policy on income. As established earlier, the effect of the tax rate on the impact of policy is identical in the case with and without temptation goods. the total income is maximized with $\tau=21\%$, and the

2 Benabou (2002, pp.501-502) argues that the weighted average marginal tax rate in the US is about 20%. Since transfers are probably more progressive than taxes, τ could be between .3 and .4. According to Eurostat (2012b), the sum of taxes on income, wealth etc., and total social contributions in the EU-27 in 2005 were 25.6% of GDP. By similar reasoning as Benabou, we deem that τ is perhaps higher, approx. 40% of GDP or 40% of total income.

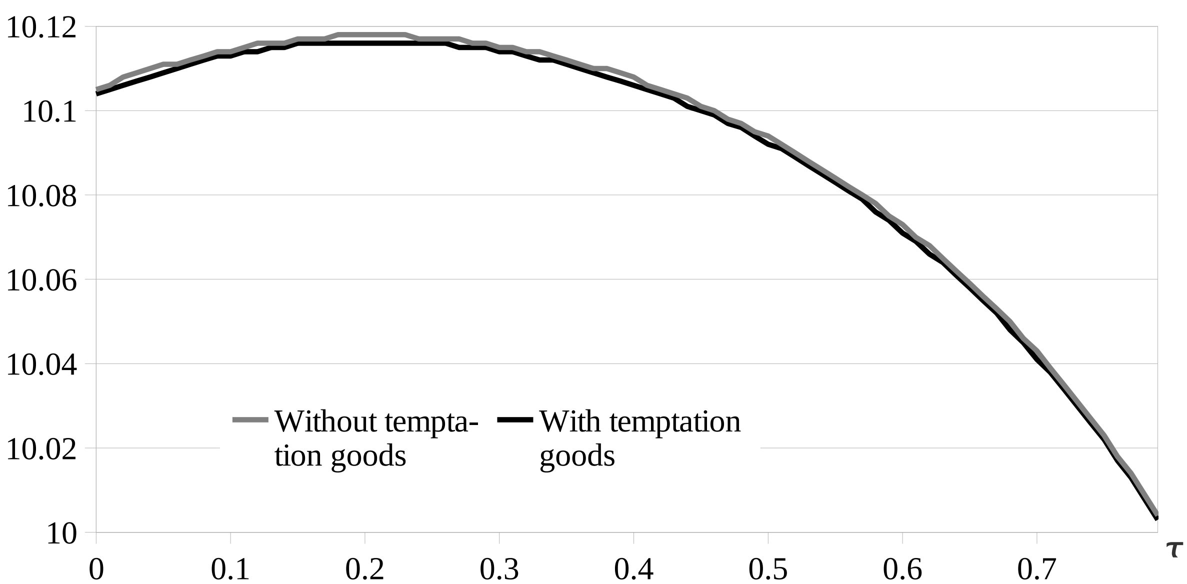
Figure 5: Labor effort at different levels of income tax rate τ



Source: Authors' calculations.

Note: The lines show the levels of labor effort for models with temptation goods and without temptation goods calculated via equation (28) at different levels of the income tax rate.

Figure 6: Income at different levels of income tax rate τ



Source: Authors' calculations.

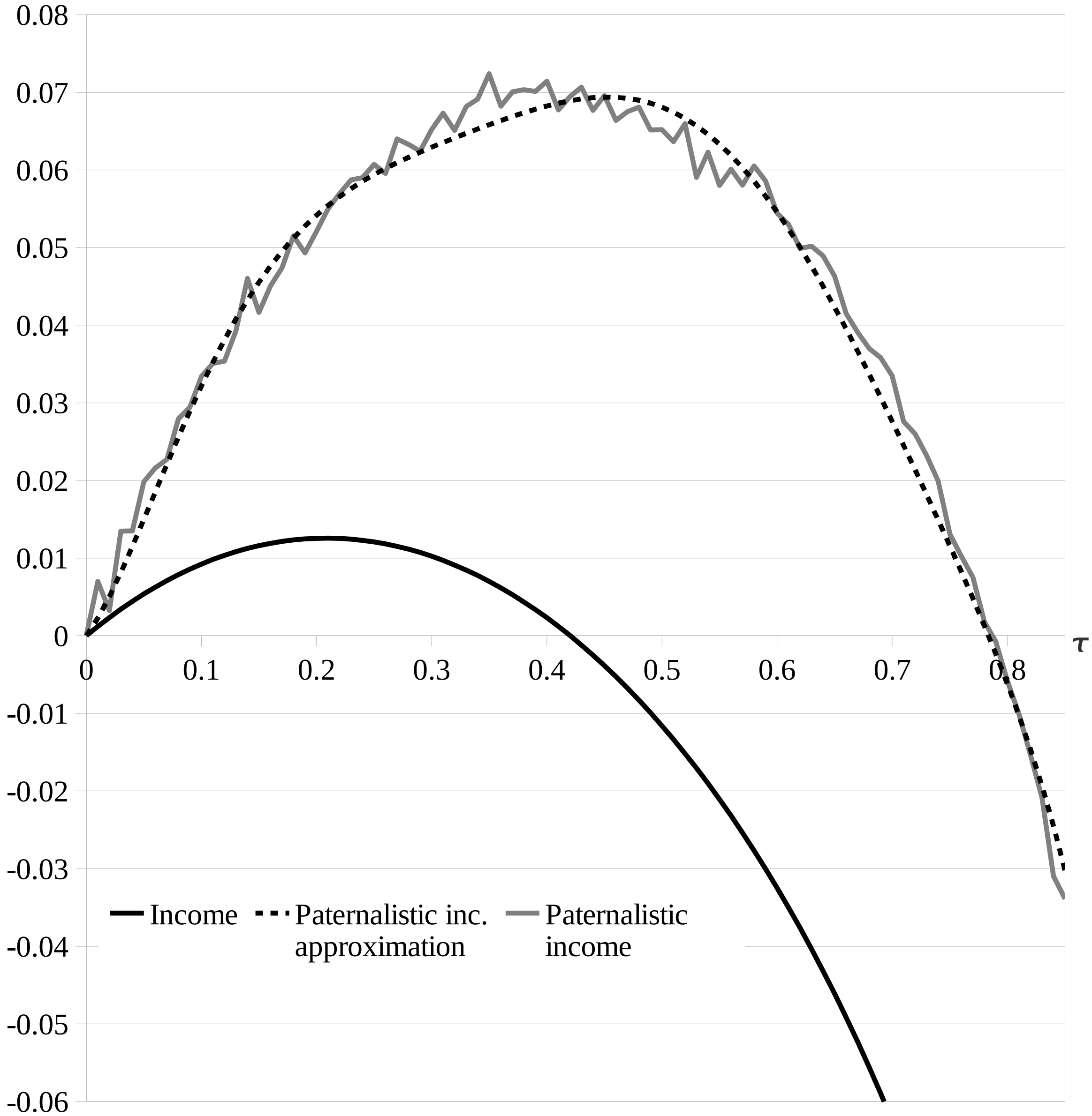
Note: The lines show the level of the natural logarithm of income with temptation goods and without temptation goods calculated via equation (39) at different levels of the income tax rate.

associated share of transfers in GDP is $T=6\%$ (see Figure 7 and Table 6).

The paternalistic income, which excludes the consumption of temptation goods, peaks at a higher income tax level of $\tau=45\%$, with more than twice the share of transfers in GDP, $T=13\%$. This somewhat counterintuitive finding can be understood by analyzing the two opposite effects that are at work here. On one hand, because the poor spend a larger proportion of each additional euro on temptation goods, income redistribution from the rich to the poor causes the overall proportion of temptation goods in consumption expenditure z/c to increase. This redistribution decreases the proportion of normal good consumption with respect to overall consumption expenditure. This decrease in the ratio of normal good consumption to total consumption adds a negative effect to income redistribution from the point of view of a paternalistic government. Therefore, this effect alone would have a negative effect on the optimal tax rate τ. On the other hand, the presence of temptation goods decreases the value of overall consumption in the eyes of the paternalistic government. Hence, the government would be willing to increase the consumption tax rate θ and invest the proceeds in education.

However, because the investment in education now exceeds it's efficient laissez-faire level, the government wishes to decrease the investment in education. With the available policy tools, the government can decrease the investment in education by increasing the income tax rate τ. An increase in the income tax rate leads to a decrease in the labor effort such that the aggregate disposable income available for investment in education decreases as well. Thus, the second effect would have a positive effect on the equilibrium income tax rate τ. Apparently, the latter effect outweighs the former one, and the paternalistic government finds that the presence of temptation goods increases the optimum level of income tax rate.

Figure 7: Income change at different levels of income tax rate τ



Source: Authors' calculations.

Note: The lines show the difference between the natural logarithm of income and the natural logarithm of laissez-faire level of income at different levels of the income tax rate. “Income” denotes income per household and was obtained via equation (39). The results shown for “income” are the same with and without temptation goods in the model. “Paternalistic income” denotes estimates of income per household that we obtain by generating a random sample of 100,000 households via equation (44). “Paternalistic inc. approximation” was obtained by approximating the paternalistic income with a 7th order polynomial equation.

Inequality

As expected, income inequality and disposable income inequality, divided by their respective income levels, decline as income tax rate increases (Figure 8). Income inequality rises somewhat at very high tax levels, which is driven by the rapid decline of income which is in the denominator. As was the case with income level, temptations have no implications for the effect of policy on the levels of inequality.

Welfare

First, we observe that the presence of temptations lowers the level of welfare by about 2% at at all income tax levels (Figure 9). Since the calculation of total welfare ignores the value of temptation goods in our model, what we obtain is "paternalistic welfare." The level of welfare that ignores temptations peaks at a tax rate of $\tau = 62\%$, when the share of transfers in GDP reaches $T = 17\%$ (Table 6). The presence of temptations slightly increases the positive impact of policy, but it has no effect on the optimal policy itself (Figure 10).

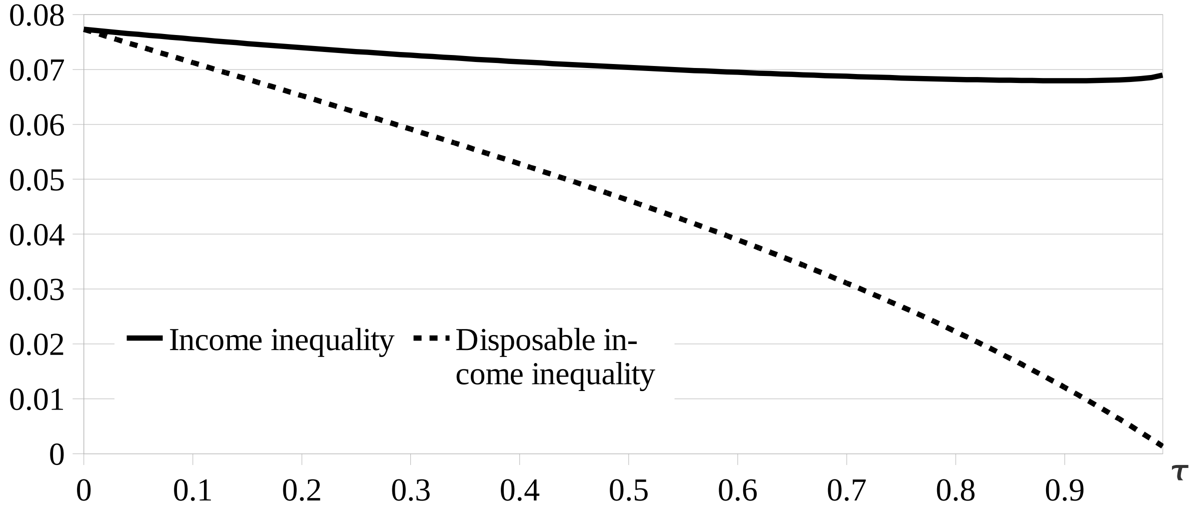
Table 6: Income and welfare with optimal policy

	Optimal income tax rate τ (%)	Share of transfers in GDP T (% of GDP)	Increase of income/welfare over laissez-faire levels (%)
Income without temptations*	21	6	1.3
Income with temptations	21	6	1.3
Paternalistic income	45	13	6.9
Welfare without temptations	62	17	18.5
Welfare with temptations	62	17	18.8

Source: Authors' calculations.

Note: Optimal τ and the increase of income/welfare over laissez-faire levels are obtained from model results. T is obtained via equation (45). *Without temptations, paternalistic income and total income are equal.

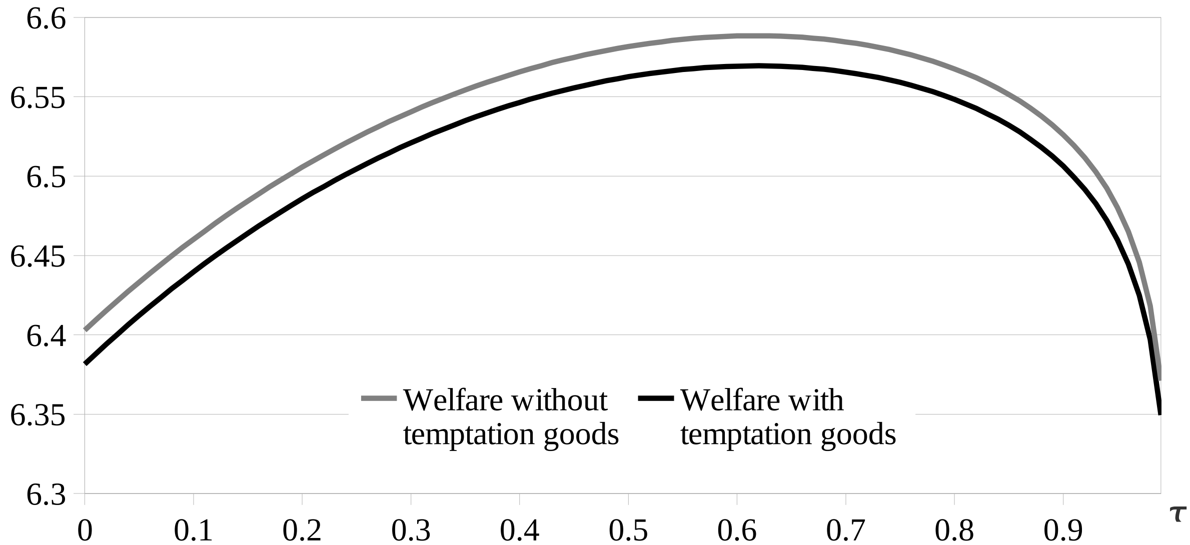
Figure 8: Income inequality at different levels of income tax rate τ



Source: Authors' calculations.

Note: The lines show income inequality and disposable income inequality obtained via equations (42) and (43), which are divided by the corresponding level of natural logarithm of income with temptation goods, at different levels of the income tax rate. The results for the measures of inequality expressed in (42) and (43) are the same with and without temptation goods in the model.

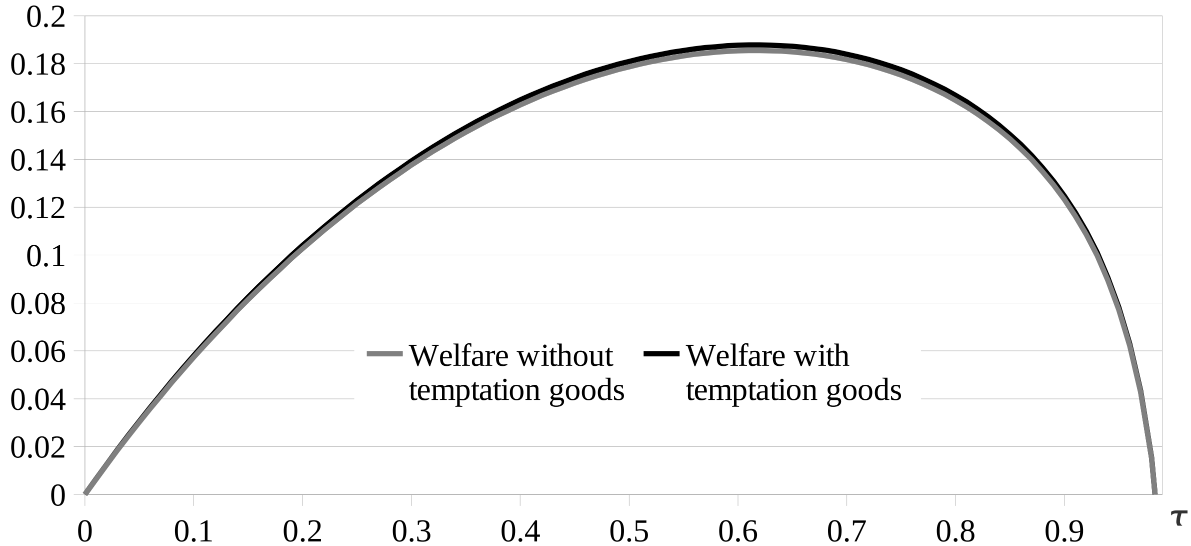
Figure 9: Welfare at different levels of income tax rate τ



Source: Authors' calculations.

Note: The lines show the level of welfare with temptation goods and without temptation goods calculated via equation (40) at different levels of the income tax rate.

Figure 10: Welfare change at different levels of income tax rate τ



Source: Authors' calculations.
Note: The lines show the difference between welfare and the laissez-faire level of welfare at different levels of the income tax rate. Both welfare without temptation goods and welfare with temptation goods are obtained via equation (40).

Overall, we can conclude that in our model the striking implications discussed by BM (2010) are not realized. In methodology section we already established that declining temptations have no effect on the level of savings or income inequality. In addition, the effect on labor effort is negligible. Finally, the optimal policy that maximizes either income or welfare remains unaffected by declining temptations.

However, there are important implications for a paternalistic government that does not attach any value to temptation goods. After recognizing the presence of temptation goods, such a government may, wish to apply a higher consumption tax rate. Consequently, the income tax rate is also set higher, and the level of redistribution is higher. This finding runs contrary to the popular notion that redistribution should not be engaged in if the poor spend a larger part of their consumption expenditure on temptation goods than the rich.

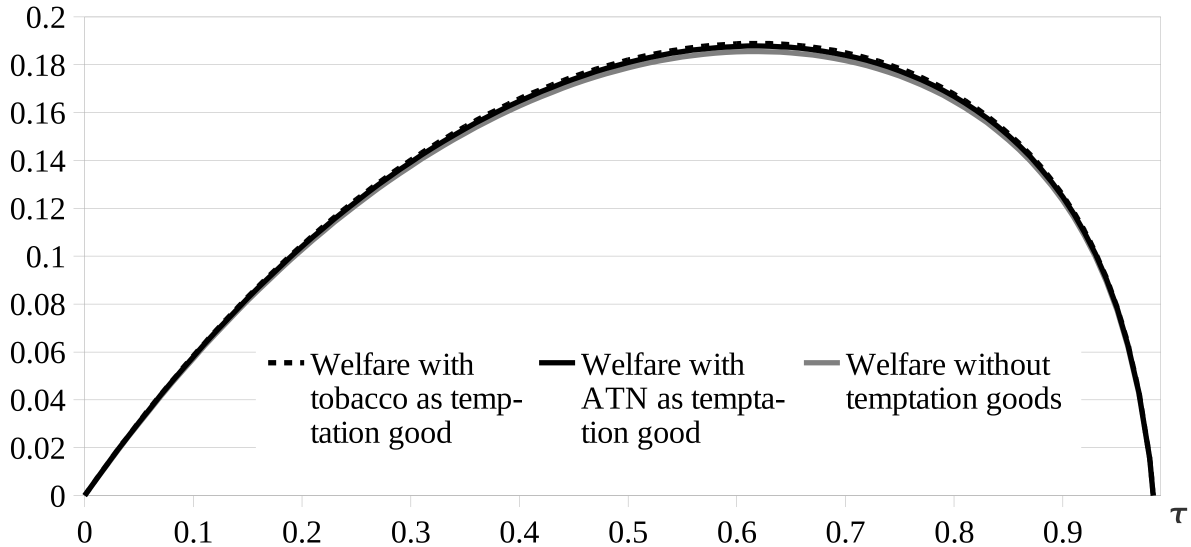
8. Sensitivity analysis

Temptation good composition

We obtain results with only tobacco defined as the temptation good. This analysis leads to different values for temptation parameters (see Appendix) and a slightly different value for the scaling parameter, $\kappa \approx 2602.3$.

As we established in the methodology section, temptation goods have no implication for the effect of policy on income. Hence, we only perform sensitivity analysis for welfare, which is shown in Figure 11. We can observe that the positive effect of policy is higher than with ATN as the temptation good. However, the difference is negligible. As is the case when ATN is the temptation good, the optimal policy remains unchanged.

Figure 11: Welfare change at different levels of income tax rate τ : sensitivity analysis for temptation good composition



Source: Authors' calculations.
Note: The lines show the difference between welfare and the laissez-faire level of welfare at different levels of the income tax rate. Both welfare without temptation goods and welfare with temptation goods were obtained via equation (40).

Intertemporal elasticity of substitution

Since Benabou (2002), much literature has been written with respect to the IES, $\epsilon=1/(\eta-1)$. Benabou sets $\epsilon=0.20$ which may be to low. Along with Keane and Imai (2004), Wallenius (2011) claims IES is biased due to a lack of consideration for human capital accumulation. Wallenius examines two separate means of accumulating human capital, learning by doing and Ben-Porath type training. Keane and Imai find similar results with a model that incorporates learning by doing. In our paper and in Benabou (2002), human capital is formed as in (4):

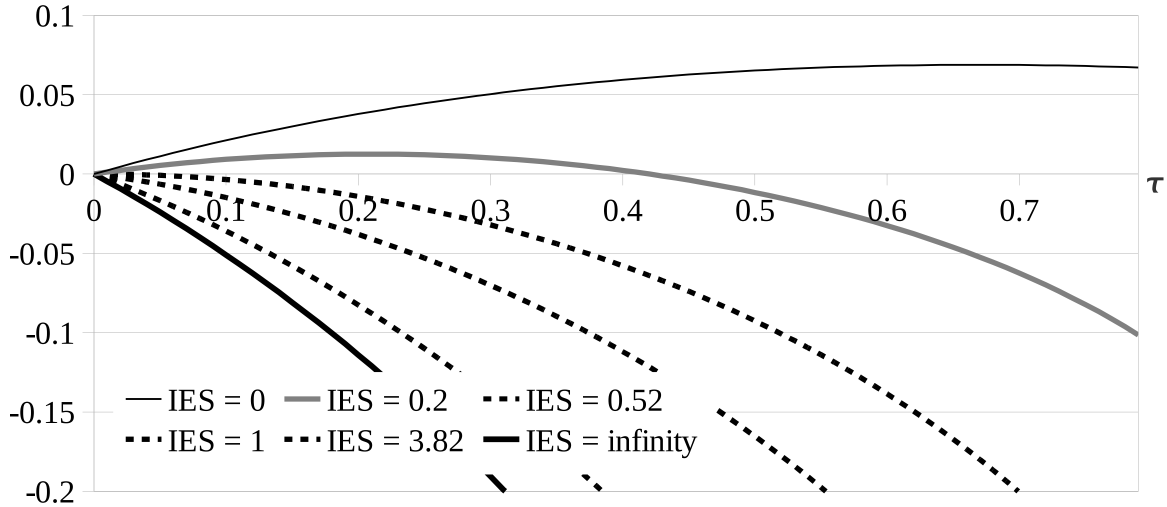
$h_{t+1}^{i}=\kappa\xi_{t+1}^{i}\cdot(h_{t}^{i})^{\alpha}((1+a)e_{t+1}^{i})^{\beta}$.

As mentioned earlier, $(1+a)e_{t+1}$ is the investment in education for the next generation that can be compared to Ben-Porath training where investment is made on the job. In addition, h_{t}^{i} is the parental human capital accumulated by the parent household over the previous period.

The parental human capital can be viewed as the equivalent of learning by doing. Imai and Keane estimate IES to be 3.82 while Wallenius estimates that IES will increase by a factor of 2.1 and 2.6 for learning by doing and Ben-Porath training respectively.

We perform sensitivity analysis with IES set at $\epsilon=0.0$, $\epsilon=0.2$, $\epsilon=0.52$, $\epsilon=1$, $\epsilon=3.82$ and $\epsilon=+\infty$, with ATN as the temptation good in all cases. The results are shown in Figures 12-14 below. We can observe that in all cases higher IES reduces the positive impact of redistributive policy. The income tax rate τ that maximizes income is zero already with $\epsilon=0.52$. However, the income tax rate that maximizes paternalistic income remains positive with $\epsilon=1$. The income tax rate that maximizes welfare remains positive even with $\epsilon=+\infty$. The results of sensitivity analysis are summarized in A.Tables 2-4 in the Appendix.

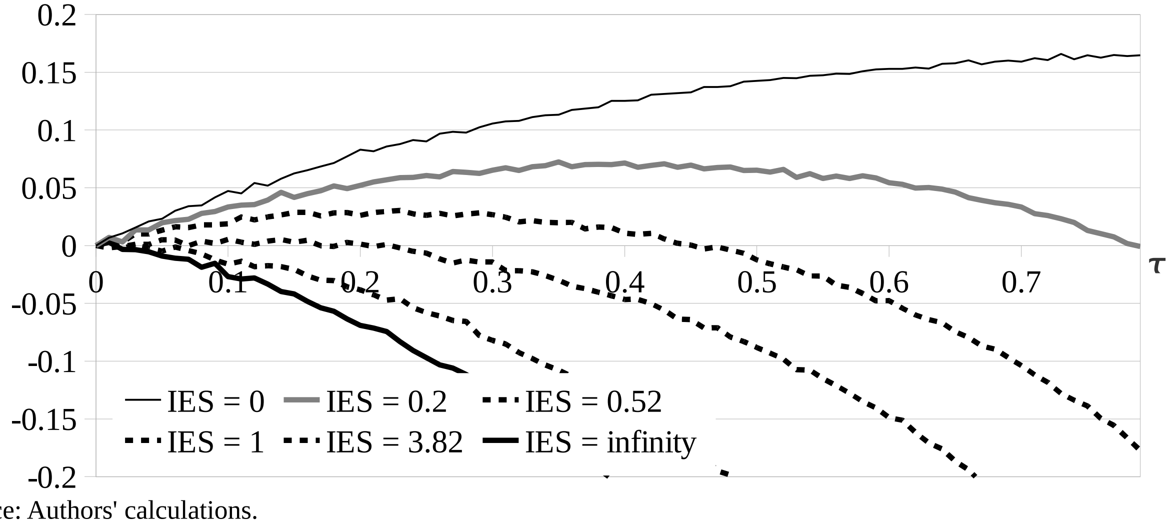
Figure 12: Income change at different levels of income tax rate τ : sensitivity analysis for the level of IES



Source: Authors' calculations.

Note: The lines show the difference between the natural logarithm of income and the natural logarithm of laissez-faire level of income at different levels of the income tax rate. Results are the same with and without temptation goods in the model, and were obtained via equation (39).

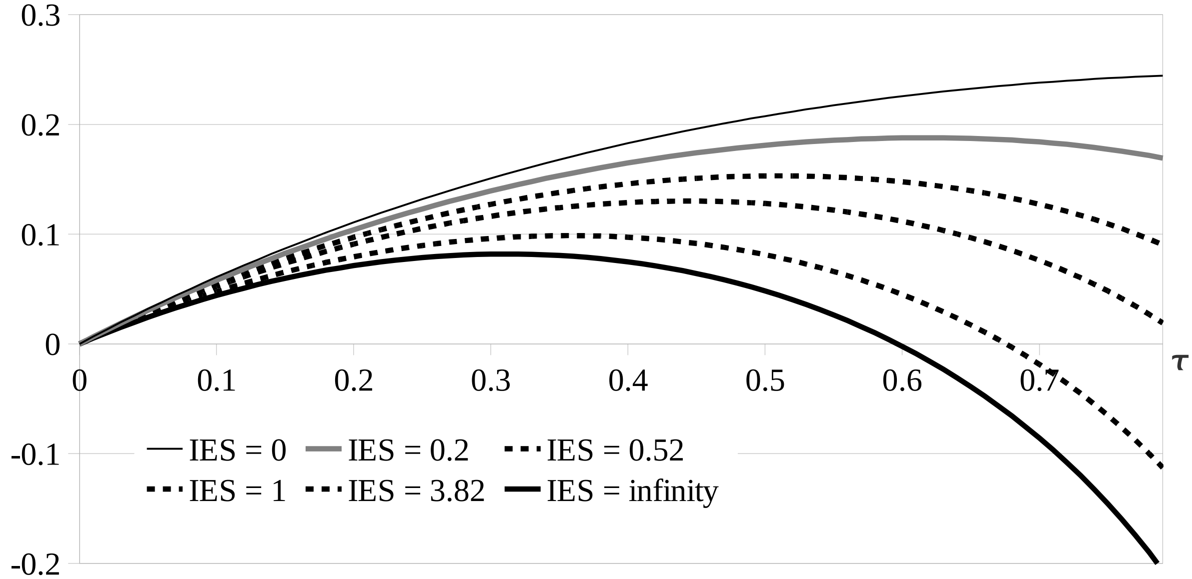
Figure 13: Paternalistic income at different levels of income tax rate τ : sensitivity analysis for the level of IES



Source: Authors' calculations.

Note: The lines show the difference between the natural logarithm of income and the natural logarithm of laissez-faire level of income at different levels of the income tax rate. We estimated the levels of paternalistic income level per household by generating a random sample of 100,000 households for each level of IES via equation (44).

Figure 14: Welfare change at different levels of income tax rate τ : sensitivity analysis for the level of IES



Source: Authors' calculations.
Note: The lines show the difference between welfare and the laissez-faire level of welfare at different levels of the income tax rate. ATN is included as the temptation good. Welfare levels were obtained via equation (40).

9. Conclusion and discussion

In this paper we answer two research questions. The first research question is: ***how does policy affect income and welfare when temptation goods are accounted for?*** Initially, in the methodology section, we determined that the presence of temptation goods does not affect savings. However, the presence of temptation goods with declining temptations does increase the labor effort for all households. Because increased labor effort results in higher aggregate income, aggregate income increases as well.

To test the quantitative impact of temptation goods, we use EU country data with alcoholic beverages, tobacco and narcotics defined as the temptation goods in our benchmark specification. Initial data overview shows that since the less well-off spend proportionally more on temptation goods than the well-off declining temptations are indeed present. Through the use of a general equilibrium model we find that the recognition of temptation goods in the model has a positive but negligible impact on the equilibrium level of labor effort. Consequently, the temptation goods have virtually no effect on the equilibrium level of income. The optimal policy that maximizes income or welfare remains completely unaffected by temptation goods also. Income and welfare are maximized with a share of transfers in GDP of 6% and 17% respectively. Overall, these results run contrary to the proposition of Banerjee and Mullainathan (2010) that the presence of temptation goods may have striking implications, for instance, by creating a poverty trap.

However, important policy implications may be provided by our answer to the second research question: ***how does the effect of policy change when a paternalistic government does not value the consumption of temptation goods?*** We find that the optimal policy prescribes a share of transfers in GDP of 13%. This percentage is two times higher than in cases when temptation goods are ignored or cases when temptation goods are not ignored but the government does value the consumption of temptation goods. The root cause for this effect is the fact that, with temptations, the government values consumption less and wishes to apply a higher consumption tax.

The above conclusion contrasts the popular notion that redistribution is a waste of resources if the poor devote a larger part of their consumption expenditure to temptation goods than the rich. In addition, the above conclusion shows that temptation goods may be more important than suggested by policy analysis that ignores them and may provide a basis for measures that aim to restrict temptation good consumption. The more conventional of such measures are excise taxes on goods like alcohol and tobacco, which are already present in most developed countries. Furthermore, less conventional measures could be implemented. For instance, Kocher et al. (2012) have recently argued that the government should intervene to improve children's self-control. Because self-control is related to life outcomes, such interventions may be redistributional and serve as a partial substitute for income redistribution.

Although it remains unclear what exactly temptation goods are, it seems unlikely that other definitions of temptation good bundles or other approximations for declining temptations may lead to radically different conclusions within our model, because the impact of temptation goods should differ by at least an order of magnitude. However, it may be premature to relate our results, that are based on the EU data, to developing economies, where poverty traps may be a more widespread problem. Also, the underlying model assumptions and data used may have driven the results obtained. Two of the most important assumptions are the credit constraints that prevent any level of non-investment saving and the use of government policy that always returns saving to its efficient level. Moreover, the results imply an identical savings rate for all agents in the economy. A different model might lead to different results.

Finally, even if the evaluated optimal policies have some merit, political constraints may render optimal redistribution less likely. Acemoglu (2003) and Acemoglu, Johnson and Robinson (AJR) (2004) argue that those at economic and political power cannot afford to let one of these powers go, or they will lose both. The reason is the inability of the benefiting party to commit to not using one kind of power to obtain the other. So, economic resources often remain concentrated in activities that help those at the top retain power even at the cost of overall economy. A recent relevant case may be the debate on the introduction of the basic income grant in Namibia (Haarmann et al., 2009). Although the evidence from the pilot project suggests substantial benefits from redistribution, there has been a large political reluctance to explore the possibility of introducing a basic income grant nation-wide. Yet, even if the AJR framework sets some restrictions on the optimal policy, it may be useful to first know what the optimal policies are. As a result, we believe that this paper can provide valuable insights about the implications of temptation goods for economic policy.

10. Summary

Banerjee and Mullainathan (BM) (2010) have recently argued that, if the poor spend a larger proportion of their income than the rich on "temptation goods," the value of which they discount fully, like cigarettes and alcohol, they may remain trapped in poverty. We survey the literature and find that credit constraints combined with income heterogeneity have been found to be possible explanations of economic backwardness and poverty traps. Furthermore, evidence from developing countries shows that redistributive policies that target children in poor households can mediate poverty.

Thus, we model declining temptations by building on the model of Benabou (2002) that has heterogeneous agents, embodies credit constraints, devotes a central role for investment in education and allows for redistributive policies. With alcohol, tobacco and narcotics defined as temptation goods, European Union data show that the proportion of temptation goods in consumption expenditure declines with income. We find that temptations affect labor effort, income and income inequality by a very small amount and leave the optimal policy that maximizes either income or welfare unaffected. All the same, a paternalistic government that does value the consumption of temptation goods has twice as high of an income-maximizing tax level. The root cause for this effect is that with temptations the government values consumption less and wishes to apply a higher consumption tax. Sensitivity tests show that intertemporal elasticity of substitution can significantly decrease the optimum levels of government intervention.

We conclude that declining temptations may be less likely to explain the persistence of poverty than hoped but identifying temptation goods may be instructive for a paternalistic government.

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Appendix

Proof for (22)

With $\ln U_t^i = V_t^i \ln h_t^i + B_t^i$, substituting the value function $\partial \ln U_t^i / \partial \ln h_t^i = V_t^i$ in (20) yields:

$$
\begin{aligned}
& V_t^i \ln h_t^i + B_t^i = \rho(B_{t+1}^i + V_{t+1}^i(\ln\kappa - \omega^2/2)) \\
& + \max_{l_t^i}\{\rho(1+g)(1-\tau)\mu\ln l_t^i - (l_t^i)^\eta + \rho\beta V_{t+1}^i(1-\tau)\mu\ln l_t^i\} \\
& + \max_{s_t^i}\{\rho(1+g)\ln((1-s_t^i)/(1+\theta)) + \rho\beta V_{t+1}^i \ln(s_t^i(1+a))\} \\
& + (\rho(1+g)(1-\tau)\lambda + \rho V_{t+1}^i(\alpha+\beta\lambda(1-\tau)))\ln h_t^i \\
& + (\rho(1+g) + \rho\beta V_{t+1}^i)\tau\ln\tilde{y}_{t+1} - \rho\ln b
\end{aligned}
$$

The above equation requires that $V_t^i = \rho(1+g)(1-\tau)\lambda + \rho(\alpha+\beta\lambda(1-\tau))V_{t+1}^i$. Under steady-state with $V_t^i = V_{t+1}^i = V$, expressing $p = \alpha + \beta\lambda(1-\tau)$: $V = \dfrac{\lambda\rho(1-\tau)(1+g)}{1-\rho p}$.

Proof for (25)

Given from (24), (22), (23), that:

$$s_t^i = \frac{\beta V_{t+1}/(1+g)}{1+\beta V_{t+1}/(1+g)}, \quad V_{t+1}^i = V = \frac{\lambda\rho(1-\tau)(1+g)}{1-\rho p}, \quad p = \alpha+\beta\lambda(1-\tau):$$

$$s = \frac{\beta\lambda\rho(1-\tau)}{(1-\rho p)(1+\beta\lambda\rho(1-\tau)/(1-\rho p))} = \frac{\beta\lambda\rho(1-\tau)}{1-\rho(\alpha+\beta\lambda(1-\tau))+\beta\lambda\rho(1-\tau)} = \frac{\beta\lambda\rho(1-\tau)}{1-\rho\alpha}$$

Proof for (28)

Given from (27), (22), (23) that:

$$l_t^i = [\rho(\mu/\eta)(1-\tau_{t+1})(1+g+\beta V_{t+1}^i)]^{1/\eta}, \quad V_{t+1}^i = V = \frac{\lambda\rho(1-\tau)(1+g)}{1-\rho p}, \quad p = \alpha+\beta\lambda(1-\tau):$$

$$l=[\rho(\mu/\eta)(1-\tau)(1+g+\frac{\beta\lambda\rho(1-\tau)(1+g)}{1-\rho p})]^{1/\eta}$$
$$=[\rho(\mu/\eta)(1-\tau)\frac{(1+g)(1-\rho(\alpha+\beta\lambda(1-\tau))+\beta\lambda\rho(1-\tau))}{1-\rho p}]^{1/\eta}$$
$$=[\frac{\rho(\mu/\eta)(1-\tau)(1+g)(1-\rho\alpha)}{1-\rho(\alpha+\beta\lambda(1-\tau))}]^{1/\eta}$$

Proof for (33)

Given that $\ln h_t^i \sim N(m_t, \Delta_t^2)$ and $\ln y_{t+1}^i = \lambda \ln h_t^i + \mu \ln l_t^i$:

$$\ln y_{t+1}^i \sim N(\lambda m_t + \mu \ln l_t, \lambda^2 \Delta_t^2) \text{ , } \ln({y_{t+1}^i}^{1-\tau}) \sim N((1-\tau)(\lambda m_t + \mu \ln l_t), (1-\tau)^2 \lambda^2 \Delta_t^2) \text{ ,}$$

$$\ln E(y_{t+1}^i) = \lambda m_t + \mu \ln l_t + \lambda^2 \Delta_t^2/2 \text{ , } \ln E({y_{t+1}^i}^{1-\tau}) = (1-\tau)(\lambda m_t + \mu \ln l_t) + (1-\tau)^2 \lambda^2 \Delta_t^2/2 \text{ .}$$

Next, apply expectations operator to non-constant variables in the individual budget constraint (8):

$$E(\hat{y}_{t+1}^i) = E((y_{t+1}^i)^{1-\tau})(\tilde{y}_{t+1})^{\tau_t}$$

Since the net tax paid must be, on average, zero, we have that $E(\hat{y}_t^i) = E(y_t^i)$. Substitute in the above equation:

$$\ln E(y_{t+1}^i) = \ln E((y_{t+1}^i)^{1-\tau}) + \tau \ln \tilde{y}_{t+1}^i$$

And insert the above expressions to get:

$$\lambda m_t + \mu \ln l_t + \lambda^2 \Delta_t^2/2 = (1-\tau)(\lambda m_t + \mu \ln l_t) + (1-2\tau+\tau^2)\lambda^2 \Delta_t^2/2 + \tau \ln \tilde{y}_{t+1}^i \text{ ,}$$

$$0 = -\tau(\lambda m_t + \mu \ln l_t) + (-2\tau+\tau^2)\lambda^2 \Delta_t^2/2 + \tau \ln \tilde{y}_{t+1}^i \text{ ,}$$

$$\ln \tilde{y}_{t+1}^i = \lambda m_t + \mu \ln l_t + (2-\tau)\lambda^2 \Delta_t^2/2 \text{ .}$$

Proof for (35), (36), (37), (38)

From $\ln h_t^i \sim N(m_t, \Delta_t^2)$ and $\ln y_{t+1}^i = \lambda \ln h_t^i + \mu \ln l_t^i$ it follows that :

$$\ln y_{t+1}^i \sim N(\lambda m_t + \mu \ln l_t, \lambda^2 \Delta_t^2)$$

Hence the difference equation for income per household:

$$\ln y_{t+2} - \ln y_{t+1} = \lambda m_{t+1} + \mu \ln l_{t+1} + \lambda^2 \Delta_{t+1}^2/2 - \lambda m_t - \mu \ln l_t - \lambda^2 \Delta_t^2/2$$

$$= \lambda(\ln\kappa - \omega^2/2 + \beta \ln((1+a)s_t^i) + (\alpha+\beta\lambda)m_t + \beta\mu \ln l_t^i + \beta\tau(2-\tau)\lambda^2 \Delta_t^2/2)$$
$$+ \mu \ln l_{t+1} + \lambda^2((\alpha+\beta\lambda(1-\tau))^2 \Delta_t^2 + \omega^2)/2 - \lambda m_t - \mu \ln l_t - \lambda^2 \Delta_t^2/2$$

$$= \ln\bar{\kappa} + (\alpha+\beta\lambda-1)\ln y_{t+1} + \mu(\ln l_{t+1} - \alpha \ln l_t) + \beta\lambda \ln((1+a)s_t^i)$$
$$-(\alpha+\beta\lambda(1-\tau)^2 - (\alpha+\beta\lambda(1-\tau))^2)\lambda^2 \Delta_t^2/2$$

$$= \ln\bar{\kappa} + (\alpha+\beta\lambda-1)\ln y_{t+1} + \mu(\ln l_{t+1} - \alpha \ln l_t) + \beta\lambda \ln((1+a)s_t^i) - P\lambda^2 \Delta_t^2/2$$

With, at steady-state:

$$P = \alpha + \beta\lambda(1-\tau)^2 - (\alpha+\beta\lambda(1-\tau))^2$$

$$\ln\bar{\kappa} = \lambda \ln\kappa - \lambda(1-\lambda)\omega^2/2$$

In steady-state, use (32) to get:

$$\Delta^2 = \frac{\omega^2}{1-(\alpha+\beta\lambda(1-\tau))^2}\ ; \quad \lambda^2\Delta^2 = \frac{\lambda^2\omega^2}{1-(\alpha+\beta\lambda(1-\tau))^2}\ .$$

Proof for (40)

Recall that with $\ln U_t^i = V_t^i \ln h_t^i + B_t^i$, substituting the value function $\partial \ln U_t^i / \partial \ln h_t^i = V_t^i$ in (20) yields:

$$V_t^i \ln h_t^i + B_t^i = \rho(B_{t+1}^i + V_{t+1}^i(\ln\kappa - \omega^2/2))$$
$$+ \max_{l_t^i}\{\rho(1+g)(1-\tau)\mu \ln l_t^i - (l_t^i)^\eta + \rho\beta V_{t+1}^i (1-\tau)\mu \ln l_t^i\}$$
$$+ \max_{s_t^i}\{\rho(1+g)\ln((1-s_t^i)/(1+\theta)) + \rho\beta V_{t+1}^i \ln(s_t^i(1+a))\}$$
$$+(\rho(1+g)(1-\tau)\lambda + \rho V_{t+1}^i(\alpha+\beta\lambda(1-\tau)))\ln h_t^i$$
$$+(\rho(1+g) + \rho\beta V_{t+1}^i)\tau \ln \tilde{y}_{t+1} - \rho \ln b$$

Eliminating terms with $\ln h_t$ and rearranging yields:

$$B_t^i - \rho B_{t+1}^i = (\rho(1+g) + \rho\beta V_{t+1}^i)(1-\tau)\mu \ln l_t^i - (l_t^i)^\eta + \rho V_{t+1}^i(\ln\kappa - \omega^2/2)$$
$$+\rho(1+g)\ln((1-s_t^i)/(1+\theta)) + \rho\beta V_{t+1}^i \ln(s_t^i(1+a))$$
$$+(\rho(1+g)+\rho\beta V_{t+1}^i)\tau \ln\tilde{y}_{t+1} - \rho\ln b$$

Define aggregate welfare $W_t = V_t m_t + B_t$, so that $\ln U_t(h) = V_t(\ln h - m_t) + W_t$.

Substituting $B_t = W_t - V_t m_t$ in the above equation and rearranging yields:

$$W_t - \rho W_{t+1}$$
$$= (\rho(1+g)+\rho\beta V_{t+1}^i)(1-\tau)\mu\ln l_t^i - (l_t^i)^\eta + \rho V_{t+1}^i(\ln\kappa - \omega^2/2)$$
$$+\rho(1+g)\ln((1-s_t^i)/(1+\theta)) + \rho\beta V_{t+1}^i\ln(s_t^i(1+a))$$
$$+(\rho(1+g)+\rho\beta V_{t+1}^i)\tau\ln\tilde{y}_{t+1} - \rho\ln b + V_t m_t - \rho V_{t+1} m_{t+1}$$

Then use (33) to express $\ln\tilde{y}_{t+1}$ and (34) to express m_{t+1}:

$$W_t - \rho W_{t+1}$$
$$= (\rho(1+g)+\rho\beta V_{t+1}^i)(1-\tau)\mu\ln l_t^i - (l_t^i)^\eta + \rho V_{t+1}^i(\ln\kappa - \omega^2/2)$$
$$+\rho(1+g)\ln((1-s_t^i)/(1+\theta)) + \rho\beta V_{t+1}^i\ln(s_t^i(1+a))$$
$$+(\rho(1+g)+\rho\beta V_{t+1}^i)\tau(\lambda m_t + \mu\ln l_t + (2-\tau)\lambda^2\Delta_t^2/2) - \rho\ln b + V_t m_t$$
$$-\rho V_{t+1}[\ln\kappa - \omega^2/2 + \beta\ln((1+a)s_t^i) + (\alpha+\beta\lambda)m_t + \beta\mu\ln l_t^i + \beta\tau(2-\tau)\lambda^2\Delta_t^2/2]$$

Some terms with $\rho\beta V_{t+1}^i$ cancel out:

$$W_t - \rho W_{t+1}$$
$$= \rho(1+g)\mu\ln l_t^i - (l_t^i)^\eta + \rho(1+g)\ln((1-s_t^i)/(1+\theta))$$
$$+\rho(1+g)\tau(2-\tau)\lambda^2\Delta_t^2/2$$
$$+(\rho(1+g)+\rho\beta V_{t+1}^i)\tau\lambda m_t - \rho\ln b + V_t m_t$$
$$-\rho V_{t+1}(\alpha+\beta\lambda)m_t$$

From now assume steady-state and group the terms with m:

$$W - \rho W = \rho(1+g)\mu\ln l + \rho(1+g)\ln((1-s)/(1+\theta)) + \rho(1+g)\tau(2-\tau)\lambda^2\Delta^2/2 - \rho\ln b - l^\eta$$
$$+[(\rho(1+g)+\rho\beta V)\tau\lambda + V - \rho V(\alpha+\beta\lambda)]m$$

Now use (23), i.e. $p = \alpha + \beta\lambda(1-\tau)$, to express the coefficient next to m the following way:

$$W - \rho W = \rho(1+g)\mu\ln l + \rho(1+g)\ln((1-s)/(1+\theta)) + \rho(1+g)\tau(2-\tau)\lambda^2\Delta^2/2 - \rho\ln b - l^\eta$$
$$+[\lambda\rho(1+g)\tau + V(1-\rho p)]m$$

From (22) we have $V=\frac{\lambda\rho(1-\tau)(1+g)}{1-\rho p}$. With that the above equation simplifies to:

$$W-\rho W=\rho(1+g)\mu\ln l+\rho(1+g)\ln((1-s)/(1+\theta))+\rho(1+g)\tau(2-\tau)\lambda^2\Delta^2/2-\rho\ln b-l^\eta$$
$$+\lambda\rho(1+g)m$$

And finally:

$$W=\frac{\rho[(1+g)(\ln((1-s)/(1+\theta))+\lambda m+\mu\ln l+\tau(2-\tau)\lambda^2\Delta^2/2)-\ln b]-l^\eta}{1-\rho}$$

Additional tables

A.Table 1: Regression results and temptation parameters

Coefficient	Temptation good: tobacco		Temptation good: ATN	
	Value	Standard Error	Value	Standard Error
B_1	-0.2243	0.3519	2.8943	0.7270
B_2	0.6609	0.03592	0.2712	0.07412
B_3	-0.3256	0.3494	2.8413	0.7325
B_g	0.6691	0.0356	0.2762	0.07455
b_1	0.7122		43089	
b_2	1.5132		3.6869	
b_3	1.6367		0.00002822	
g	0.01252		0.01827	
b	1.1656		1.2162	

Source: Eurostat (2012a), authors' calculations.
Note: The regressions are specified as:
$\ln z_{iq}=B_1+B_2\ln x_{iq}+v_i+\varepsilon_{iq}$, $\ln z_{iq}=B_3+B_g\ln c_{iq}+v_i+\varepsilon_{iq}$.
Indices i and q denote country and income quantile, respectively. Variables $\ln z$, $\ln x$ and $\ln c$ denote the natural logarithm of consumption expenditure on temptation goods, consumption expenditure on normal goods and total consumption expenditure respectively. Regressions control for country fixed-effects v_i . Values of temptation parameters $b_{1,}b_{2,}b_{3,}g,b$ are obtained from regression results as:
$b_1=\exp(B_1/B_2)$, $b_2=1/B_2$, $b_3=\exp(-B_3/B_2)$, $g=B_g/B_2-1$, $b=\exp((B_1-B_3)/B_2)$.
Data: Consumption expenditure of households for 5 income quintiles in 26 of 27 EU countries (data not available for Italy) in 2005, 130 observations in total.

A.Table 2: Sensitivity analysis: optimal income tax rate τ (%)

	Benchmark	Tobacco	IES= 0	IES= 0.52	IES= 1	IES= 3.82	IES= infinity
Income without temptations*	21	21	67	0	0	0	0
Income with temptations	21	21	67	0	0	0	0
Paternalistic income	45	45	91	18	15	0	0
Welfare without temptations	62	62	89	51	44	36	31
Welfare with temptations	62	62	89	51	44	36	31

A.Table 3: Sensitivity analysis: share of transfers in GDP T (%)

	Benchmark	Tobacco	IES= 0	IES= 0.52	IES= 1	IES= 3.82	IES= infinity
Income without temptations*	6	6	18	0	0	0	0
Income with temptations	6	6	18	0	0	0	0
Paternalistic income	13	13	24	5	5	0	0
Welfare without temptations	17	17	24	14	13	10	9
Welfare with temptations	17	17	24	14	13	10	9

A.Table 4: Sensitivity analysis: increase of income/welfare over laissez-faire levels (%)

	Benchmark	Tobacco	IES= 0	IES= 0.52	IES= 1	IES= 3.82	IES= infinity
Income without temptations*	1.3	1.3	6.9	0	0	0	0
Income with temptations	1.3	1.3	6.9	0	0	0	0
Paternalistic income	6.9	6.9	16.8	32.5	1	0	0
Welfare without temptations	18.5	18.6	24.4	15.1	12.8	9.7	8.1
Welfare with temptations	18.8	18.9	24.7	15.3	13	9.9	8.2

Source for A.Tables 2-4: Authors' calculations.

Note for A.Tables 2-4: Benchmark specification has ATN as the temptation good and IES=0.2. Tobacco specification has tobacco as the temptation good and IES=0.2. Sensitivity tests that vary the level of IES have ATN as the temptation good. Optimal τ and increase of income/welfare over laissez-faire levels are obtained from model results. Optimum level of τ for paternalistic income was obtained by approximating the paternalistic income with a 7th order polynomial equation. T is obtained via equation (45). *Without temptations, paternalistic income and total income are equal.