

Tax Affinity Hypothesis:
Do We Really Hate Paying Taxes?

by

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ABSTRACT

This thesis proposes and evaluates the tax affinity hypothesis claiming that people derive utility from paying tax. Slutsky-like equations are derived for the unique three-good utility maximization problem with leisure as the only choice variable. There is evidence for the tax affinity hypothesis from the history of the U.S. personal income tax, survey responses, field data, and experimental data. Inconsistencies found in empirical data are found to be in line with the predictions of the tax affinity hypothesis. The data from the controlled experiment show significant support for the two testable propositions of the hypothesis: the subjects worked more in the presence of tax and the change in their labor supply depended on both the net wage rate and the tax rate. The data also indicate that the impact of tax affinity is the greatest for the high- and low-income population. The tax affinity hypothesis suggests the need for fairer and simpler tax policies, an emphasis on the middle class in policy consideration, the elimination of deductions for charitable contributions, an emphasis on visible taxes, and an improvement of the taxpaying experience. This thesis extends the tax affinity model into income tax evasion and female labor participation models and predicts behavioral deviations from the standard models.

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1 INTRODUCTION

Do people really hate paying taxes? Would a worker prefer to pay 20% of her income to the government or lose the same amount on the street?

Americans have never been *inherently* anti-tax (Thorndike 2008). At various points in the nation's history, Americans have accepted a growing tax burden as the price of a growing government. While many remain concerned about the tax levels, they see taxes as an important part of their contribution to the society (Amy 2007).

For almost forty years, however, American politics has been colored with sustained anti-tax activism. Conservatives have launched a vigorous attack on taxes with such success that 2008 presidential candidates of both parties competed with each other to establish who was more anti-tax. During the final presidential debate, Barack Obama declared, "Nobody likes taxes. I would prefer that none of us had to pay taxes, including myself" (Obama 2008).

In the 1970s, anti-tax activism was prevalent at the local and state levels as sub-national taxes were the original focus of grassroots tax resistance. Since the Reagan

administration in the 1980s, anti-tax politics has been growing at the national level as well (e.g., Lipset and Schneider 1987). There are currently 800 state and local anti-tax groups in the U.S. (Amy 2007). The anti-tax politics is closely linked to the negative framing of taxes, such as the advent of the phrase “tax relief” during the Bush administration (Lakoff 2006).

This thesis is not about politics and will focus on positive analysis rather than normative judgments. Discussions on the most appropriate size of the government and the best ways to spend the tax money are beyond the scope of this thesis. Instead, the aim is to examine each individual’s decision and evaluate the tax affinity hypothesis—whether individuals derive utility from paying taxes. It then investigates the importance of this hypothesis in various economic situations.

For the purpose of testing this hypothesis, we do not need to assume homogeneity of preferences. Some individuals, due to their political alignments or for other reasons, may derive more utility from taxpaying than others. For example, liberals would derive greater utility from paying taxes than conservatives simply because they put greater value on universal healthcare and provision of other public goods that are made possible by higher taxation (e.g., Bostrom 2005). This heterogeneity may also be due to varying pro-social preferences (Frey and Meier 2004), which leads to variance in behavior as reflected in experimental settings (e.g. Weimann 1994). As a more extreme example, a *BBC* article (2008) reports that Tanzanian cashew nut traders are full of “enthusiasm for paying taxes” and they think that “it is a good deal.” One trader explains why:

“I am happy to pay this money as it makes it easier to carry out my business, but it has also made me think about tax. Paying taxes is an important thing because it helps in the development of our country. Every citizen is responsible for this as it has a direct link with our development. The people who don’t pay need to be educated. They need to understand that roads, education, and health services all depend on the taxes we pay. If they understand, they will pay.”

The enthusiasm of these Tanzanian traders to pay taxes may be an exception rather than the rule. The very fact that attitudes toward taxes vary, however, supports the tax affinity hypothesis. Otherwise, every individual would respond to taxes with the same level of enthusiasm: none. Fortunately, heterogeneity of preferences does not limit most economic analyses. Even when preferences are heterogeneous, we can predict the direction of a preference and even measure its average intensity.

If this hypothesis is true, then why do people *seem* to hate paying taxes so much? One plausible reason is the public’s dissatisfaction with current tax policies, as will be discussed at length in the next chapter. This dissatisfaction may have fueled the anti-tax activism described earlier. A stronger reason is that the hypothesis does not preclude the likely possibility that the marginal utility of paying tax is lower than that of consumption. The amount of tax paid is dependent on the amount of consumption and a worker is not able to enjoy more consumption without paying more tax¹. Thus, while tax and consumption are two different utility-producing

¹ We assume, as in the standard labor-leisure allocation model, that the worker consumes all her income to maximize utility.

goods, individuals cannot freely vary the amounts of these two goods to maximize their utility due to the potentially binding constraint imposed by tax laws. This constraint keeps workers from attaining their global optimum and forces them to consume at a point where their marginal rate of substitution is not equal to one. A taxpayer feels reluctant paying the last dollar of tax and would rather put it in her pocket as she would derive more utility spending that dollar than giving it to the IRS. This explains why, despite the utility from tax, many will continue to prefer nontaxable fringe benefits over paying tax and to advocate tax cuts.

This constraint is reflected in the unique theoretical analysis. While the utility maximization problem involves three goods (consumption, leisure, and tax), it is different from a typical three-good problem, as leisure is the only choice variable. The amount of tax paid and the maximum amount of consumption enjoyed depend on leisure. Both graphical and mathematical analyses will be performed to find the optimal solution to the problem. These analyses may also be applied to similar problems where the number of choice variables is at least two fewer than the number of goods.

As the Tanzanian trader points out, some of the utility derived from tax comes directly from the funded public goods (“roads, education, and health services”). However, the marginal effect of a dollar on the provision of public goods, especially at the federal level, is infinitesimal. The personal income tax paid in 2006 was slightly over \$1 trillion (IRS 2006); the marginal utility from an additional dollar to this pool of tax money is minute. The zero utility from tax is a central assumption in

public finance and Ramsey's (1927) seminal analysis of optimal taxation assumes that people respond to tax changes in the same way that they respond to price changes. The corollary assumption is that a rational worker derives little utility from the tax paid, that she free rides on other people's tax money, and that she chooses the quantity of labor to maximize her total utility from her *after-tax* income and leisure hours. This is the standard textbook's treatment of the labor-leisure allocation and will be referred to as the "standard theory" in the rest of this thesis.

Mere public good utility is clearly not strong enough a reason for the tax affinity hypothesis. A stronger support for the hypothesis is derived from individuals' pro-social tendencies. Psychologists have studied pro-social behavior for a long time, and although the discussions of altruism in economics are not new (e.g., Becker 1974), behavioral economists have recently started to furnish and prove a number of theories beyond self-interest (Meier 2000). A survey of these theories is provided in Chapter 3. These theories are then applied to taxpaying to arrive at the tax affinity hypothesis.

The three following chapters then describe tests of this hypothesis. Chapter 4 translates the tax affinity hypothesis into two testable propositions in the labor-leisure allocation model, along with a number of other useful propositions. Chapter 5 discusses the experimental design used to test the validity of the propositions derived. Chapter 6 presents the results of the experiment and further evidence of the tax affinity hypothesis. The chapter also reviews the pro-social behavior theories

discussed in Chapter 3 and describes evidence from the experiment that provide support for these theories in their application to the tax affinity hypothesis.

The results from the experiment provide significant support for the tax affinity hypothesis. Both main propositions are supported by the data with high statistical significance and relatively high robustness. The results are also in line with initial predictions that tax affinity is stronger when tax rates are higher and in subjects who have not studied economics extensively. In addition, the predicted income and substitution effects of a wage change under the main assumptions are also confirmed by empirical data. While only based on self-reported survey answers, there is evidence for the reasons for tax affinity, which confirms the four main theories discussed: impure altruism, inequality aversion, reciprocity, and self-identity theories. The results also provide additional insights into the structure of tax affinity, suggesting that the impact of tax affinity is greatest for the high- and low-income population.

What do these results imply and what use can be made of them? First, the hypothesis suggests the need to consider the utility from tax in policy and economic analyses, especially in labor-leisure allocation models where the positive utility from tax may change the results significantly. If ignoring tax affinity is needed for a simpler economic model, then it may be useful to explicitly state such an assumption. Chapter 7 offers some suggestions that the tax affinity hypothesis presents for tax policies and Chapter 8 provides extensions of the tax affinity hypothesis to two other economic areas: income tax evasion and female labor force participation.

The focus of this thesis is the role of the tax affinity hypothesis on the labor-leisure allocation. This implies that most of the discussion will be based on the personal income tax. Additionally, while the labor-leisure tradeoff model and the tax affinity hypothesis are broadly applicable, the discussion will focus on the U.S. tax system to provide some consistency. We will therefore begin with a brief description of the U.S. income tax system, while noting preliminary evidence for the tax affinity hypothesis from the history of the income tax as well as survey and empirical data.

2 THE U.S. INCOME TAX

The U.S. income tax system is under attack. Many taxpayers are unhappy with the way it works, complaining that it is too complex, unfair, and damaging to economic growth. Despite the widespread dissatisfaction, there is very little agreement on what needs to be done to alleviate the problems. Although some argue for minor adjustments to the system, increasingly many critics demand a fundamental reform and even complete abolition of the income tax and the IRS.

Although the idea of a major reconstruction of the system is appealing to many, Americans are also concerned about significant changes in the system. Many recall the promises made during the last major change in the tax system, the Tax Reform Act of 1998, and have noticed little, if any, improvement to the system since then (Slemrod and Bakija 2000). Despite these concerns, the high frustration with the current income tax system may indicate the need for a tax reform, and as will be discussed in Chapter 7, the tax affinity hypothesis adds more weight to the case for reform.

This chapter describes the history of the U.S. personal income tax, preliminary evidence for tax affinity, and complaints about the income tax system that may have adversely impacted this tax affinity.

2.1 History of the U.S. Personal Income Tax

America's first income tax was a temporary emergency measure used during the Civil War; it was enacted in 1861 and expired in 1871. In the late 1800s and early 1900s, there was a growing opposition to the then major revenue sources for the federal government: tariffs, excise taxes, and property taxes. The insurgency against tariffs came about because they unfairly favored certain domestic industries over others and, according to social reformers, they worked regressively, driving up costs of food and basic necessities (Fox 2001). Some proposed a personal income tax as an appealing alternative because it could be made progressive, imposing a heavier burden on the rich than the poor. The Congress first enacted income taxation on a permanent basis in 1894, but the Supreme Court declared it unconstitutional a year later. This obstacle to an income tax was eliminated by the Sixteenth Amendment to the U.S. Constitution, which was ratified in February 1913. President Woodrow Wilson signed the modern personal income tax into law shortly thereafter in October 1913 (Brownlee 1989; Goode 1976; Pechman 1987; Witte 1985).

Figure 2.1 illustrates how the tax rate in the top bracket has changed since 1913. One very striking feature, which is of particular relevance to this thesis, is that the top tax rate has fallen dramatically since World War II. The top rate hit a peak of 94

percent in 1944–1945, stayed at 91 percent or higher from 1951 until the Kennedy-Johnson tax cut of 1964, and remained as high as 70 percent until 1981. By 1988, it had fallen all the way to 28 percent and in 2009 is still at a historically low 35%.

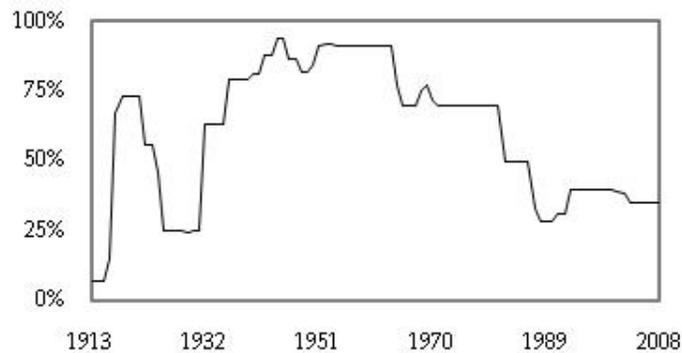


FIGURE 2.1 *The U.S. personal income tax: top rate, 1913–2008*

This top tax rate has played a central role in the public debate over taxes. It is important to note, however, that the top rate *per se* can give a quite misleading impression of the personal income tax as a whole. During the years when the top rate was extremely high, it generally affected only around 1 percent of taxpayers. In addition, historically there have been significant changes not only in the tax rates, but also in the tax base—the portion of income that is taxable after subtracting all deductions, exemptions, and other preferences.

2.2 Public Benefits of Tax

President Franklin Roosevelt said that “[taxes] are dues that we pay for the privileges of membership in an organized society” (Roosevelt 1936) and Chief Justice Oliver Wendell Holmes mirrored this statement by claiming that “taxes are what we

pay for civilized society” (Holmes 1907). In some respects, an “organized” and “civilized society” is the rationale for government in the first place. The signers of the Declaration of Independence set out to establish a new form of government for the protection of “Life, Liberty, and the pursuit of Happiness.” To this end, the proper fiscal function of government is “to pay the Debts and provide for the common Defense and general Welfare of the United States” (U.S. Constitution Article I, Section 8). Taxes are simply the preferred method for paying for these governmental functions (U.S. Dept of Treasury 2009). For a given level of government expenditure, the alternative to taxes is to run large-budget deficits, financed either by borrowing or the printing of money. This strategy runs the risk of causing high interest rates and high inflation, hurting private investment, and damaging our long-term prospects for economic growth (Slemrod and Bakija 2000).

One of the most important government activities is the provision of public goods, including the Tanzanian trader’s “roads, education, and health services” and government’s contribution to research and non-profit organizations. Provision of public goods by the government is important because pure public goods are generally undersupplied by voluntary contributions (Bergstrom, Blume and Varian 1986). Without government interventions, the socially optimal quantities of public goods are not achieved.

Aside from funding government activities and public goods, taxes also have other important functions. Taxes provide citizens with basic information regarding the total prices of various economic activities. Government plays a dominant role in

the economy, absorbing significant resources for its purposes and redirecting these resources through its regulatory policies and through a mixture of taxation and spending programs that transfer resources from one area to another. It is critical, therefore, that citizens have as much information as possible regarding these programs to help them evaluate whether the government's activities are appropriate. Taxes, and especially the paying of taxes, yield citizens a personal sense of the total price of those activities (U.S. Dept of Treasury 2009).

Finally, some taxes, known as Pigouvian taxes, are levied to correct the negative externalities of market activities. Similarly, the government can encourage certain behaviors by subsidizing them; such a subsidy of a positive externality can be considered a negative Pigouvian tax or a Pigouvian subsidy (Baumol 1972). While the income tax itself is hardly a Pigouvian tax, tax policies are often shaped to produce desired externalities. For example, the federal government has used different tax benefits and credits to encourage home ownership and saving for retirement (U.S. Dept of State 2008).

2.3 Preliminary Evidence for the Tax Affinity Hypothesis

2.3.1 Historical Evidence

We can find some evidence for tax affinity throughout the history of the U.S. income tax. The introduction of the income tax in the U.S. was accepted peacefully by the citizens, as was the case in many other countries. In comparison, the introduction of

the first excise tax on distilled spirits and carriages in 1791, which was justified by the first Secretary of the Treasury Alexander Hamilton “more as a measure of social discipline than as a source of revenue” (Morrison 1927) and to “advance and secure the power of the new federal government” (Graetz and Schenk 2005) received much fiercer opposition, which in turn led to the infamous Whiskey Rebellion. This provides evidence for the existence of pro-social behavior in taxpaying; taxes that are imposed for the common good fare better than those imposed to discipline citizens. Economic historians also find it curious that the Sixteenth Amendment, which laid the foundation for the modern income tax, received unanimous votes by a U.S. Senate dominated by millionaires in 1909 (Fox 2001).

The affinity for income tax was not only displayed by the government. People and the media also showed constant support for the income tax. The *New York Times* (1862) praised it as “probably one of the most equitable and bearable taxes that can be imposed.” The re-enactment of the income tax in 1913 was welcomed by the *Wall Street Journal*, which noted that the “change from indirect to direct taxation is a mark of economic progress.” The House Ways and Means Committee was confident that “all good citizens will willingly and cheerfully support and sustain this, the fairest and cheapest of all taxes.”

History shows that the more we trust the government to defend or expand on our privileges, the more willing we are to pay these dues. As explained in Chapter 3, this is evidence for tax affinity by reciprocity. World War II was an extreme case in point, during which the marginal income tax rate reached 94 percent. President

Franklin Roosevelt had even originally proposed a 100 percent tax rate, arguing that at a time of “grave national danger,” “no American citizen ought to have a net income, after he has paid his taxes, of more than \$25,000 a year” (Roosevelt 1942). This income cap proposal invoked no feverish reaction. The nation, most Americans agreed, faced an emergency and all Americans needed to do their part. The high marginal tax rates did not significantly change the economic behavior of the rich either. In 1943, America’s very richest still paid 78% of their total incomes in federal income tax (IRS 2003). Four months after Pearl Harbor, the National Association of Manufacturers, normally opposed to high tax rates, urged that “all income over and above that needed to keep our business structure alive should be taxed to the limit—leaving only enough for survival” (Paul 1947).

Even years after the war, concerns about the large federal debt due to the war and the looming dangers of inflation kept the top marginal rate in the range of 90 percent. However, there were no remarkable protests against the high tax rates. The income tax continued to be perceived as a fair tax, just as most Americans trusted the government to do the right thing (Fox 2001).

2.3.2 Evidence from Surveys

A 2003 Public Interests Project survey on 1,002 adults (cited in Bostrom 2005) found that the majority of respondents do not mind paying taxes especially when the statements are framed in ways that highlight the benefits of taxes. The main findings from the survey are replicated in Table 2.1.

Statement	Agree	Disagree
I don't mind paying taxes because my taxes contribute to making sure we have public schools, clean streets, public safety and a national defense, and a cleaner environment.	84%	15%
I don't mind paying taxes because my taxes are part of my contribution to society as a citizen of the United States.	81%	17%
I don't mind paying taxes because I want government to play a strong role in helping people when in need.	76%	23%
I don't mind paying taxes because it is my contribution to make sure our government helps create opportunities and keeps the economy growing.	75%	23%

TABLE 2.1 *Survey results on the relationship of taxes and citizenship*

While the use of surveys in economic analyses should not be over-emphasized, these results provide preliminary evidence of tax affinity among American taxpayers.

2.3.3 Evidence from Labor Supply

While past research on labor supply did not set out to test tax affinity, there is some evidence for tax affinity in empirical data on labor supply. Borjas and Heckman (1978) provided a survey of labor elasticities ignoring the income tax, while Hausman (1983) gave a survey of labor elasticities from studies that took the income tax into account. All studies focused on “prime age males,” men between 25 and 60 (or 35 in some studies) years old, because labor force participation in this group is almost 100% and unemployment is typically low in non-recession years. Most studies therefore did not account specifically for unemployment or constraints on labor market activity. Results from studies that ignored the income tax are summarized in Table 2.2, while results from studies that did not are summarized in Table 2.3.

Studies	Wage Elasticity	Substitution Elasticity	Income Elasticity
Ashenfelter-Heckman (1974)	-.15	.12	-.27
Boskin (1973)	-.07	.10	-.17
Fleisher, Parsons, Porter (1974)	-.19	.04	-.23
Greenberg, Kusters (1973)	-.09	.20	-.29
Hall (1973)	-.18 to -.45	.06	-.24 to -.51
Hill (1973)	-.21 to -.34	.47 to .52	-.68 to -.86
Kalachek, Raines (1970)	.55	.86 to .96	-.31 to -.33
Masters, Garfinkle (1977)	.01 to -.11	-.04 to .06	-.06 to -.12
Rosen, Welch (1971)	-.27	.14	-.41

TABLE 2.2 *Labor supply elasticities in studies that ignore income tax*

Studies	Wage Elasticity	Substitution Elasticity	Income Elasticity
Ashworth, Ulph (1981)	.13	.18	-.05
Blomquist (1982)	.08	.12	-.04
Hausman (1981)	.00	.17	-.17
Hausman (1982)	.03	.17	-.14
Wales, Woodland (1979)	.09	.20	-.11

TABLE 2.3 *Labor supply elasticities in studies that account for income tax*

By comparing the two tables, we find that (uncompensated) wage elasticity is positive when the presence of income tax is considered and negative when income tax is ignored. In addition, the magnitude of the income elasticity is considerably smaller in studies that accounted for the income tax. While Hausman attributed these differences to the nonlinearity of the budget set created by the income tax, it is argued here that this is not by itself a strong argument since the marginal tax rate stays constant for most workers when they vary their work hours (Eissa 1996).

The differences in the empirical results may be explained using the tax affinity hypothesis. The less negative income effect and the positive overall wage elasticity when taxes are accounted for imply that tax must have some impact on labor supply

decision. The standard theory would assume that the tax paid is lost money and predict that the empirical results should be the same for the same net wage regardless of whether income taxes are considered.

Both Heckman (1993) and Triest (1994) provided surveys of more recent labor supply studies and concluded that economists widely agree that changing the tax rate has only minor incentive effects on male labor supply, contrary to what the standard theory would predict (Slemrod and Bakija 2000). In addition, while earlier studies suggested that female labor supply was more responsive than male labor supply in changes in tax rates, more recent studies questioned these results.

Labor supply data from the last three decades have shown deviation from the standard theory, which provides preliminary evidence for tax affinity. We will now study the impact of the Tax Reform Act (TRA) 1986 when tax rates were drastically changed. While the focus of the thesis is on the personal income tax, TRA 1986 also gives us the opportunity to investigate the tax affinity hypothesis in behavioral responses to other taxes.

2.3.4 Evidence from TRA 1986

The Tax Reform Act (TRA) 1986 aimed to lower the statutory tax rates and to recover the revenue lost by broadening the tax base. The basic rate of corporate income tax was reduced from 46 percent to 34 percent and, on the individual side, both the standard deduction and personal exemption allowance increased significantly while

tax rates were reduced. The most significant of such reductions was that of the top marginal rate of the personal income tax, which fell from 50 percent to 28 percent.

The standard theory would predict that the aforementioned changes would significantly impact the behavior of all economic agents, from individuals to corporations (Slemrod and Bakija 2000; Fox 2001). In addition, the standard theory would argue that the magnitude of this impact should be roughly equal for all economic agents under similar changes in tax rates. However, empirical data show that the impact of TRA 1986 was generally much less than expected and there was a great variation in the impact depending on the economic agents. As suggested by the pro-social theories discussed in the next chapter, the tax affinity hypothesis predicts that tax affinity is exhibited more strongly by individuals than by corporations. This is because individuals are more likely to be interested in the well-being of others, whereas corporations' behavior is restricted to their profit-maximization goal.² The data provide evidence for this prediction; TRA 1986 had little impact on labor supply, personal savings and investment, homeownership, and charitable contributions, but it had significant impact on corporate finance and organizational form as well as foreign direct investment.

Similar to the findings discussed in the previous subsection, studies that focused on TRA 1986 also showed insignificant impact of the change in tax rates on labor supply. Eissa (1996) estimated that college-educated men increased their hours of

² Of course, the shareholders may decide to incorporate tax affinity into their voting decisions and this will then be reflected in the corporate actions. However, it can be argued that this is unlikely because the shareholders will prefer to reflect tax affinity in their own individual behavior, such as through the capital gains tax.

work by only 2 percent in response to reduced marginal tax rates, while Moffitt and Wilhelm (1998) and Gravelle (1993) found no evidence of a significant labor supply response to lower marginal tax rates, even among the high-income group that experienced the greatest reduction in their tax rate. Still within the high-income group, there was no indication that the fraction of compensation received in the form of wages and salaries increased after the tax reform (Slemrod 1994). Surprisingly, the greatest increase in work hours occurred among workers in the lower income quintile whose tax rates either stayed the same or even increased after TRA 1986. As we will see in Chapter 6, the tax affinity hypothesis may account for this finding.

Under the standard theory, many expected that TRA 1986 would reduce personal savings, arguing that the reduction in individual tax rates would be outweighed by the increase in the capital gains tax and the tightening of restrictions on IRAs. However, personal saving rates instead climbed from 4% in 1986 to 5.4% by the second quarter of 1989 (Skinner and Feenberg 1990). While it is hard to establish any causal relationship based on basic figures pre- and post-TRA 1986, the economic literature on the effect of taxes on personal savings agrees with the observation. Virtually no empirical study suggests a large saving response by households to changes in taxes (Engen and Gale 1996) and the substitution effect on the rate of savings “may well be zero” (Hall 1988) contrary to the standard theory’s predictions.

The premise of the standard theory that personal investment, homeownership, and charitable contributions are significantly affected by tax rate changes (Fox 2001) is also not substantiated by empirical data from TRA 1986. Slemrod (1994) found no

evidence of a noticeable shift out of tax-exempt securities into taxable securities despite the drop in marginal tax rates. Poterba (1990) argued that reduced depreciation allowances, lower marginal rates, and anti-tax-shelter provisions in TRA 1986 should reduce the attraction of homeownership, but he found no pronounced shift away from homeownership. Finally, although TRA 1986 dramatically increased the net cost of charitable contributions, aggregate giving has in fact increased each year since 1986 (Clotfelter 1990).

While the impact of TRA 1986 on individuals was insignificant, the impact on corporations was much more pronounced. Gordon and MacKie-Mason (1990) argued that because TRA 1986 increased the tax cost of equity more than that of debt, debt-to-value ratios should have risen. This has in fact occurred, although to a lesser extent than expected. In addition, because the top individual tax rate lied below the corporate tax rate after TRA 1986, there was a greater incentive for closely held firms to reorganize as subchapter S corporations to avoid corporate-level taxation. Indeed, there was a massive surge in S corporation elections immediately following TRA 1986. There may have also been some movement of loss operations toward the more highly taxed corporate sector, while more gain operations were taxed at the lower personal rates.

TRA 1986 also had significant implications on the real decisions of firms. Although the tax reform did not set out to materially change the tax incentives for Foreign Direct Investment (FDI), the post-TRA 1986 period saw dramatic changes in FDI. The strength of outward FDI to low-tax countries, the predominance of

Japanese and U.K. investment for inward FDI, the relative decline of debt transfer, and the increased reported rates of return on investment were all consistent with the changed incentives of the new tax provisions (Slemrod 2000).

The insignificant impact of the changes introduced by TRA 1986 on individuals and the more significant impact of the changed incentives on firms provide preliminary evidence for tax affinity and suggest that tax affinity is stronger for individuals who naturally exhibit greater pro-social tendencies than do firms.

2.3.5 Evidence from Tax Compliance

Further evidence for tax affinity is derived from taxpayers' compliance decisions. Economists model tax cheating as if it were adding a risky asset to a household's portfolio (refer to Section 8.1). However, many households comply more fully than is predicted by these models (Andreoni, Erard, and Feinstein 1998).

Findings from other social sciences have been utilized to explain the observed compliance levels. Erard and Feinstein (1994) and Grasmick and Bursick (1990) adapted guilt and shame to tax compliance by introducing stigma costs into the model, but the new model still failed to fully explain the high level of compliance. Two other social factors were tested in the experimental setting: fairness (Spicer and Becker 1980 and Gordon 1989) and the degree of satisfaction with the government (Spicer and Lundstedt 1976; Webley 1991; Alm, Jackson, and McKee 1992; Smith 1992). The findings showed that these factors play an important part in tax compliance.

The fact that taxpayers care about the fairness of the tax system and about the government's performance provides another piece of evidence for the tax affinity hypothesis. In fact, the surprisingly high level of compliance may well be explained by the tax affinity hypothesis. Section 8.1 provides a preliminary discussion on this topic.

2.4 Complaints about the Income Tax

The most common complaint about the income tax is that it is simply too high. In the 2008 Gallup poll, 52 percent of respondents said the amount of federal income tax paid was "too high" (cited in Bowman 2008). Disappointment with the tax rates also arises from ideological differences about the appropriate role of government in society or fears that the government is wasting money. The 2006 Fox News/Opinion Dynamics poll found that 52 percent favored "a smaller government with fewer services," while only 34 percent favored "a larger government with many services" (cited in Bowman 2008).

However, compared to citizens of other nations, Americans are not taxed heavily. In 2004, the overall tax burden in the United States was 26 percent of GDP, compared to an average of 36 percent for the member countries of the OECD, which includes most of the world's democratic, market economies (Tax Policy Center 2004). The dissatisfaction of Americans may then be attributable to four other reasons: the

tax system is too complicated, difficult to enforce, harmful to the economy, and unfair.

First, many find the U.S. income tax systems overly complicated. Billions of hours are spent annually on tax-related activities, from recordkeeping to hunting for deductions and credits to ensuring compliance with the tax regulations. This complexity is costly. In total, an average taxpayer spends 27 hours on tax matters and over half of taxpayers purchase professional assistance from accountants and lawyers to help them prepare their tax returns. The total cost of collecting income taxes is approximated to be around \$100 billion per year, which is roughly 10% of the revenue raised (Slemrod and Bakija 2000).

Second, some argue that the U.S. tax code is difficult to enforce because legislators have made it so complex; the tax code has around 6,000 pages. Despite the considerable expenditures on IRS enforcement and the significant compliance costs borne by the public, there is still a great deal of cheating on taxes. Although it is hard to measure these losses accurately, the IRS estimates that \$195 billion of revenue is lost to noncompliance annually. This then leads to higher tax rates and a heavier burden for the majority of taxpayers who are honest or who have little opportunity to cheat.

Third, taxes are considered to have an adverse impact on the long-term prosperity of the economy. High tax rates on the workers earning high incomes discourage hard work, innovation, and entrepreneurship, which are all ingredients for a vibrant economy. In addition, the tax system is biased against saving and

investment, which are vital for maintaining the country's long-run standard of living. Moreover, credits and preferences prevalent in income tax codes can significantly distort economic choices and it is worried that the tax system causes an inefficient distribution of resources.

Lastly, many believe that the tax system is unfair. 35 percent of respondents in the 2008 Gallup poll and 48 percent of respondents in the 2007 PSRA/Pew poll believed that the income tax system is unfair (cited in Bowman 2008). However, an agreement on what is fair is hard to reach. For some, a fair tax system means maintaining graduated rates and possibly increasing the burden on those with high incomes. Others, on the other hand, prefer a much less progressive system. However, there seems to be wider agreement on a few aspects of unfairness. For example, many agree that those with good lobbyists, lawyers, and accountants are able to manipulate the tax code and take advantage of numerous loopholes to minimize their own tax burden. Those who believe this generally prefer a more streamlined tax system with fewer opportunities for tax avoidance.

2.5 The U.S. Income Tax and the Tax Affinity Hypothesis

This chapter has discussed the U.S. income tax system: its history, merits, and problems, and also provided preliminary evidence for the tax affinity hypothesis from history, surveys, and empirical studies on labor supply and the Tax Reform Act 1986.

Historically, Americans' support of the income tax has always been correlated with their support for the government. The high tax rates during World War II were accepted by virtually all citizens regardless of their income level, occupations, and political affiliations. Respondents to polls also indicated their support for the tax system and their willingness to pay taxes. Empirically, there is evidence that when the income tax is accounted for, there are differences in the labor elasticities of prime age males. Studies on the Tax Reform Act of 1986 also found negligible impact of the reform on individual decisions, such as homeownership and personal savings, but more significant impact on corporate decisions. Tax compliance has also been higher than expected by the standard theory. These inconsistencies are in line with the prediction of the tax affinity hypothesis.

If there is evidence supporting the tax affinity hypothesis, then why is there so much more hostility toward income tax as we see today? The four complaints about the current income tax system may be partly responsible for this. Taxpayers are often frustrated with the amount of time that they have to allocate for tax compliance purposes, in addition to the amount of tax that they have to pay. Moreover, with the overly complicated tax codes and numerous loopholes, taxpayers grow increasingly skeptical about others' tax evasion and avoidance. As described further in the next chapter, by the reciprocity theory, every taxpayer then wants to reduce her own tax burden, either by avoiding and/or evading taxes or working less.

The growing dissatisfaction with the tax system gives further support for the tax affinity hypothesis. The differing enthusiasm, not only across countries or

individuals, but also across time, provides a support for the hypothesis. Otherwise, taxpayers would get zero utility from each dollar of tax paid, regardless of whether they find the tax system effective or whether the government spends the tax money wisely. Similarly, a taxpayer who does not completely approve of the way the government spends the tax money may still receive some utility from the tax paid, although arguably much less than another taxpayer who does.³ This is supported by historical evidence that citizens are happier to pay taxes when they support and trust the government (Fox 2001).

In the following chapter, we will study the most important theories of pro-social behavior that give the strongest support for the hypothesis. These theories may shed some light on why the richest Americans, who paid 78 percent income tax in the 1940s, maintained their productivity despite the high marginal tax rates and why taxpayers want to minimize their own tax burdens when they know that others are doing the same.

³ The author thanks Prof. Joyce Jacobsen who raised this issue, albeit more as a concern, during the presentation in December 2008. Of course, the argument can be brought to the extreme by proposing that individuals receive disutility from paying tax if they completely disagree with the way the government spends the tax money. However, there is no evidence that this is the case.

3 PRO-SOCIAL BEHAVIOR

Adam Smith, who praised the selfishness of individuals in *The Wealth of Nations*, believed that selfish motives are not the only ones that matter for human beings. In his first book, *The Theory of Moral Sentiment* (1759), Smith wrote: “How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it, except the pleasure of seeing it.”

Economic theory predicts that public goods are always underprovided because individuals free ride on the contributions of others since they cannot be excluded from using the public good. For example, people free ride on others’ efforts to protect the environment and no one donates blood because everyone assumes others will. These individual calculations result in suboptimal outcomes; the socially optimal amount of clean air, blood donations, and other socially desirable goods is not achieved.

Similarly, the standard theory predicts that individuals want to minimize their tax burden as much as possible even if they fully understand the social benefits of taxes. Tax, however, is a unique social good, because unlike most other social goods, its collection is enforced by the power of the governments or appointed tax collection authorities. Thus, individuals who want to reduce their tax burden have to vary their other economic decisions. These decisions then become socially suboptimal. Shoppers spend less when the sales tax is raised and workers work less when the income tax is raised even though these decisions may not be socially beneficial. Economists refer to these behavioral changes as distortions due to tax.

However, the reality shows that people are less selfish than economic theory predicts. There are a number of situations in which people demonstrate pro-social as opposed to narrow self-interest behaviors. In the U.S. alone, more than 68 percent of households contributed to charitable organizations, amounting to more than \$134 billion in 1998 (Andreoni 2002). In the same year, more than 50 percent of all adult Americans did volunteer work, amounting to 5 million full-time equivalents (Anheier and Salamon 1999). Pro-social behavior has also been reaffirmed in numerous laboratory experiments (see Ledyard 1995; Camerer 2003).

In the past few years, various theories have been proposed that model one's interest in the happiness of others. Following the structure proposed by Meier (2007), three groups of these models can be broadly distinguished: (1) outcome-based *pro-social preference* theories assume that an individual's utility depends directly on the utility of others around the individual; (2) *reciprocity* theories assume that

individuals reciprocate the good or bad intentions of others; and (3) *self-identity* theories assume that self-image encourages individuals to behave pro-socially.

3.1 Outcome-Based Pro-Social Preferences

Theories of outcome-based pro-social preferences assume that individuals care about the well-being of others and thus, a higher utility of others surrounding an individual affects the utility of the individual positively. These theories can be further broken down into three main groups: (1) *pure altruism* theories state that the utility of others influences one's utility directly; (2) *impure altruism* theories assert that it is the act of helping others that increases one's utility; and (3) *inequality aversion* theories state that one's utility depends on the difference between one's own and others' well-being.

3.1.1 Pure Altruism

Pure altruism theories state that others' utility directly affects an individual's own utility (e.g., Becker 1974). These theories suggest that people behave pro-socially because they derive utility from the well-being of others. Altruism theories have been used to explain various pro-social behaviors: donations (Smith, Kehoe, and Cremer 1995), volunteering (Unger 1991), behavior in the workplace (Rotemberg 1994), and contributions in laboratory experiments like dictator games (Eckel and Grossman 1996; Andreoni and Miller 2002).

However, because individuals derive utility simply from the improvement of the well-being of others, regardless of the source of this improvement, their contributions are expected to be inversely related to others' contributions. If other private individuals or the government contributes to the public good, then people will reduce their contribution by the same magnitude (e.g., Roberts 1984). This implication has been widely questioned. From a theoretical point of view, no altruist would contribute to public goods since everyone could free ride on the contributions of others to drive the social utility higher (Sugden 1982; Andreoni 1988; Croson 1998). However, in reality, people donate to large charities like UNICEF and Red Cross. Empirically, the evidence is also against the one-to-one crowding-out of private contribution by public grants. Government grants have been found to crowd out private contributions, but the crowding-out is far from complete and lies in the range of zero to one-half (see Andreoni 2006 for a survey).

3.1.2 Impure Altruism

The discrepancy between pure altruism's prediction of complete crowding-out by others' contribution and the observed behavior of altruists demands an adjustment to the pure altruism model. Andreoni (1990) extended the altruism model with a "warm glow" motive for giving. This impure altruism model states that, in addition to the higher utility derived from the well-being of others, an individual also receives some private good benefit from the act of giving itself. Psychologically,

various underlying motivations may cause the ultimately egoistic warm glow, such as self-reward, negative state relief, or guilt reduction (see Bierhoff 2002 for a survey).

The prediction of the impure altruism model fits the observed altruistic behavior better. Most individuals do not see public grants as perfect substitutes for private contributions and value making contributions themselves. However, the impure altruism model still predicts that individuals will reduce their own contributions when other individuals or the government contributes to the same public good, although the crowding-out is not perfect.

3.1.3 Inequality Aversion

Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) claimed in their models that people dislike inequality. Such models attempt to explain why people behave altruistically toward others worse off than they are, while on the other hand they punish those who are better off than they are. Numerous studies in experimental economics have tested this hypothesis and found that people's behavior in many situations can be explained by inequality aversion (e.g., Fehr and Schmidt 1999). Inequality aversion, like impure altruism, gives utility to an individual when the *act* of eradicating inequality is undertaken. While the actual impact of this act may not be significant, the individual still receives the warm glow utility just from committing the act. An example is the act of signing petitions against injustice. While signers may be fully aware that an additional signature has insignificant impact on

the success of the petition, many people still sign petitions because they dislike injustice and derive pleasure from small acts they take to fight against it.

3.2 Reciprocity

The previous three theories of pro-social behavior focus on the distributional consequences of an individual's and others' actions and their impact on each individual's utility. In the reciprocity theory, individuals are also concerned about the intentions that others have in making their choices. This theory explains why individuals act in a more altruistic manner in response to the friendly behavior of others and in a hostile manner to unfriendly behaviors (Rabin 1993; Dufwenberg and Kirchsteiger 2004; Falk and Fischbacher 2006).

The reciprocity theory has gained support from both experimental and field studies. A large number of studies in experimental economics (e.g., Fehr and Gächter 2000) support the hypothesis that reciprocity is an important factor in pro-social behavior. Outside the laboratory, Fong (2001), Fong (2003), and Bowles, Fong, and Gintis (2006) provided evidence for reciprocity theory by using survey data about support for redistribution. They found that people who believe that the poor are poor because of unfortunate external circumstances are more supportive of redistribution, whereas those who believe that the poor are not doing enough to escape poverty are less supportive. This represents the view that if the poor do not contribute, or try to contribute, to the society, then they should not receive help.

Other research shows the importance of reciprocity theory in various fields, from political “logrolling” (Cialdini 1993), tipping in restaurants (Seligman, et al. 1985; Conlin, Lynn, and O’Donoghue 2003), effort in the workplace (e.g., Akerlof 1982; Frey 1993; Fehr, Gächter, and Kirchsteiger 1997), and charitable giving (Falk 2004). More relevant to this thesis, Wenzel (2001) found in a field experiment that when individuals were informed during the experiment that other taxpayers were more honest than they expected them to be, they significantly reduced their claims for tax reductions compared to the control group.

3.3 Self-Identity

Recently, behavioral economists have recognized the importance of self-identity for human behavior (Akerlof and Kranton 2000). People not only care about their reputation with others, but they also care about maintaining a good self-image. As a result, people behave pro-socially to signal their good traits to themselves.

Bodner and Prelec (2003) and Bénabou and Tirole (2004) present two models that take into account the importance of self-identity in explaining pro-social behavior. An important difference to the outcome-based models in Section 3.1 is that individuals do not necessarily care about the impact of an altruistic action *per se*, but their altruistic behavior affects their self-identity positively.

Whether a pro-social action produces a good self-image depends on two questions: what constitutes a “good” action and in what circumstances a “good” action serves as a valuable signal of one’s good traits. First, what constitutes a good

action is defined by the social norm. Maintaining good self-identity thus generally means conforming to the social norm in one's own group (e.g., Bernheim 1994). Second, the context in which a decision is made determines whether a good action is needed and valuable in maintaining a good self-image. For example, a financial incentive to behave pro-socially might make the self-signal less valuable and in fact provide a disincentive to behaving pro-socially, producing the so-called motivational crowding effect. This detrimental impact of external incentives on intrinsic motivation has long been acknowledged in psychology (e.g., Deci 1975) and has also been supported by evidence in economics (Frey and Oberholzer-Gee 1997; Frey and Goette 1999; Gneezy and Rustichini 2000; Gneezy 2003; Heyman and Ariely 2004).

3.4 Pro-Social Behavior and the Tax Affinity Hypothesis

In his concluding remarks, Meier (2007) aptly argues:

“The evidence is overwhelming that human behavior is not solely motivated by narrow self-interest. People accept costs when engaging in pro-social activities, like voluntarily contributing money or time to public goods or enforcing social norms. Pro-social behavior is widespread and quantitatively important for economic and societal outcomes. When designing institutions, pro-social behavior has to be taken into account. If not, the institutions may not reach their intended goals.”

This thesis aims to test the presence of pro-social motivation in taxpaying, which lays the foundation for the tax affinity hypothesis. Most individuals are aware of the uses of tax money in public good provision and income redistribution (Bowman 2008). Since there is evidence that individuals often behave pro-socially, it is argued

here that taxpayers' pro-social motivation should also cause them to derive some pleasure from paying taxes, knowing that the tax money will be used in helping others, improving the community, and alleviating inequality. To find support for the tax affinity hypothesis in the pro-social theories, we will look at each theory and investigate its relevance to the tax affinity hypothesis. We will also study the impact of each theory for the different income groups to predict the size of tax affinity among individuals with various income levels.⁴

The pure altruism theory is undoubtedly relevant for the act of taxpaying. A citizen enjoys seeing an improvement in the welfare of other citizens, regardless of whether she contributes to the improvement. However, the assumption of this theory also implies that all taxpayers would free ride on others' tax payments and since the actual impact of each dollar of tax paid is infinitesimal, the utility derived due to pure altruism of the taxpayer would be insignificant. Thus, we will discount pure altruism as a reason for tax affinity, except for the wealthiest of individuals, whose tax payments may be significant in magnitude.⁵

While the impact of pure altruism on tax affinity is arguably minute, the impact of impure altruism is significantly larger. A taxpayer enjoys not only the improvement of the general welfare, but also the contribution she makes through her tax money. Thus, she enjoys paying every dollar of her tax and would prefer paying more tax if her after-tax income were to be kept constant because she derives warm

⁴ The estimates and the categorization of incomes are only preliminary predictions and acknowledged to be a simplification of the intricacies of taxpayers' decision-making.

⁵ For example, in 2006, 0.02% wealthiest individuals (AGI > \$1,000,000) paid 15% of all total income tax revenues (IRS 2006).

glow utility from contributing to her fellow citizens' well-being. Since the only way a taxpayer can enjoy more warm glow is by working more, impure altruism also affects the labor supply decision of workers.⁶ Note that the utility from impure altruism is directly dependent on the amount of tax paid (refer to Andreoni 1990 for a model of giving to public goods). This implies that the impact of tax affinity due to impure altruism is greatest for the high-income individuals and smallest for the low-income individuals.

Inequality aversion theory also provides support for the tax affinity hypothesis because of the redistributive feature of income tax. While the impact of an individual's tax money on the society's inequality is diluted by the sheer size of the taxpaying population, it is the *act* of helping to solve the inequality problem that gives pleasure to the taxpayer. It is hard to estimate the magnitude of tax affinity for the different income groups since this will heavily depend on each individual's perception of the tax progressivity. However, it can be argued that the impact of inequality aversion in tax affinity is greatest for the high-income individuals as they may enjoy tax as a way of sharing their income to minimize inequality.

⁶ As discussed, the impure altruism model predicts that an increase in others' contributions crowds-out an individual's contribution, although not completely. An application of this in the tax affinity hypothesis is that when tax rates are increased, everyone's tax payment increases and this reduces the warm glow from paying tax for each individual, thereby affecting the labor supply decision accordingly. This complexity, however, is ignored in the rest of the thesis for two reasons. First, an increase in taxes results in more funding to various public goods or previously unfunded public goods and thus taxpayers do not contribute to the same cause. Second, impure altruism is only one of the reasons for tax affinity and its impact may be diluted by the impact of the other reasons discussed in this section.

The reciprocity theory plays an important part of the tax affinity hypothesis on two fronts: (1) a taxpayer's relation to other taxpayers and (2) a taxpayer's relation to the government. A taxpayer will want to reciprocate the good intentions of other taxpayers and derive more utility from each dollar of tax paid when others also do their part by paying the full tax amount and not trying to minimize their own tax burden. This is in line with Wenzel's (2001) findings. The reciprocity theory also applies to the support that the taxpayer has for the government. In particular, if a taxpayer thinks that the government has good intentions in spending the tax money well and has done so effectively, she is more likely to reciprocate the good intentions by working more in order to pay higher taxes. In this case, she also derives greater utility from each dollar of tax paid. The impact of reciprocity on tax affinity is argued to be greatest for low-income individuals. As implied by Brooks (2007) in her findings from charitable contribution data, low-income individuals may enjoy more paying tax because they may have benefited significantly from government-funded public goods or received assistance and welfare from the government and wish to reciprocate the favor whenever possible.

Self-identity also plays a major role in the tax affinity hypothesis. We may argue that taxpayers enjoy being active citizens, who contribute to the development of the community by paying their tax, and signaling this fulfillment of civic responsibility to themselves. Indeed, the utility derived depends on the amount of tax paid, as the extent to which a taxpayer helps the community is directly dependent on the amount of tax paid. In addition, a taxpayer may feel more satisfied when she pays a larger

check to the IRS as that confirms her social status, in addition to reaffirming her self-identity as an invaluable part of her community. The impact of self-identity in tax affinity is estimated by to be greatest for the low-income individuals. The opportunity to contribute the first and the next few dollars to the society yields high utility because of an increased sense of independence and participation in civic responsibilities, which may not matter as much for the middle- and high-income individuals who are already paying significant amounts of tax.

To conclude, we will consider the magnitudes of the impact that each theory plays in tax affinity for each income group and predict the overall impact of tax affinity. These estimates are summarized in Table 3.1.

	Pure altruism	Impure altruism	Inequality aversion	Reci- procity	Self- identity	Total impact
Low-income		+	+	+	+	+
Middle-income		+	+	+	+	+
High-income	+	+	+	+	+	+

TABLE 3.1 *Estimated impact of tax affinity on different income groups*
The size of the sign represents the magnitude of the effect

While these are only preliminary estimates, they receive support from the experimental data and charitable giving data. These will be discussed further in Chapter 6. We will first utilize these theories to formally develop the tax affinity hypothesis in the following chapter.

4 TAX AFFINITY HYPOTHESIS

Formally expressed, the tax affinity hypothesis states that an individual derives some utility from each dollar of tax paid. Mathematically, the hypothesis proposes that:

$$U_X > 0$$

where X , as will be used in the rest of this thesis, denotes the amount of tax paid.

This utility diminishes marginally:

$$U_{XX} < 0$$

The standard theory ignores any utility from tax paid and thus assumes:

$$U_X = U_{XX} = 0$$

Two preliminary observations can be made about the tax affinity hypothesis. First, it does not make any assumption regarding the variability of this utility for different individuals and second, it does not make any assumption regarding the magnitude of the utility. While future work may be directed at investigating the size of this utility and the measurable impact of this utility on a person's economic

behavior, we are more interested in confirming the presence of such a utility and laying the foundation for future discussions on tax affinity.

There are potentially numerous ways to test the validity of the tax affinity hypothesis. For example, by applying the hypothesis to the sales tax, we could study a buyer's behavior in response to changes in sales taxes. Alternatively, by applying the hypothesis to the capital gains tax, we could investigate changes in an individual's investment decisions.

Instead, we will focus on the impact of the income tax on the labor-leisure allocation of a worker for two reasons. First, it is relatively easy to derive testable propositions that can be tested in a controlled experiment. Second, it is important and relevant to relate any study on tax to the labor-leisure allocation as economists and policymakers are often most concerned with the impact of the income tax on workers' productivity and labor supply. After all, labor income, in the form of wages, salaries, and benefits, constitutes nearly three-quarters of national income (Slemrod and Bakija 2000).

In this chapter, we will derive testable hypotheses that can be tested in the laboratory. In these analyses, an individual is assumed to obtain utility from three goods: consumption, leisure, and tax. As in most other optimization models (e.g., Allingham and Sandmo 1972), all utilities are assumed to diminish marginally and all mixed partials are assumed to be non-negative:

$$\begin{aligned}U_C &> 0, U_H > 0, U_X > 0 \\U_{CC} &< 0, U_{HH} < 0, U_{XX} < 0 \\U_{CH} &\geq 0, U_{CX} \geq 0, U_{HX} \geq 0\end{aligned}$$

4.1 Utility Functions and Assumptions

This section discusses the way tax enters the utility function. While there are infinite possibilities of utility functions of the three goods (consumption, leisure, and tax), we will focus on two groups of well-behaved functions that yield two mutually exclusive and exhaustive sets of assumptions: (1) $U_{HX} > 0$ and (2) $U_{HX} = 0$.

4.1.1 $U_{HX} > 0$

When tax enters the utility function directly, all the mixed partials of the utility function $U = U(C, H, X)$ are not zero. Two examples are the Cobb-Douglas function⁷ $U = C^\alpha H^\beta X^{1-\alpha-\beta}$ (refer to Figure B.2 in Appendix B) and the Constant Elasticity of Substitution (CES) utility function $U = (\alpha C^p + \beta H^p + (1-\alpha-\beta)X^p)^{1/p}$, where $0 < \alpha, \beta < 1$ in both examples. While this family of functions is more general, limited theoretical predictions can be derived. On the other hand, there is reason to believe that the complementarity between leisure and tax is negligible and this leads to the next family of utility functions.

4.1.2 $U_{HX} = 0$

The second group of utility functions generates the assumption $U_{HX} = 0$. The most general form of such functions is $U = V(C, H) + W(C, X)$. A quasi-linear utility function $U = V(C, H) + X$ is an extreme example, where U_{CX} is also zero. Note that

⁷ Note that the Cobb-Douglas function breaks down in the case of zero tax.

this general form consists of two components. The first component, $V(C,H)$, is the typical utility function under the standard theory, where $V_C > 0$, $V_H > 0$, $V_{CC} < 0$, $V_{HH} < 0$, and $V_{CH} > 0$. The second component, $W(C,X)$, is the additional element introduced by the tax affinity hypothesis, where $W_C > 0$, $W_X > 0$, $W_{CC} < 0$, $W_{XX} < 0$, and $W_{CX} \geq 0$. This term may be regarded as the “warm glow” utility from tax. Each of the two components may be common utility functions, such as the Cobb-Douglas⁸ ($U = C^\alpha H^{1-\alpha} + C^\beta X^{1-\beta}$) (refer to Figure B.3 in Appendix B) or the CES ($U = (\alpha C^p + (1-\alpha)H^p)^{1/p} + (\beta C^q + (1-\beta)X^q)^{1/q}$), although there is neither need nor reason to assume any specific utility function at this point.

The property $U_{HX} = 0$ of this family of functions implies no complementarity between leisure and tax paid. If we let $U_{CX} \geq 0$, then why does $U_{HX} = 0$ have to hold? The difference lies in the units in which these goods are measured. Since both tax and consumption are measured in dollars (or any other currency), individuals can easily measure the rate of contribution they make to the society from the income tax paid. One dollar of tax paid is one dollar used toward helping the society. Another way to explain complementarity between consumption and tax is by using inequality aversion. *Ceteris paribus*, the wealthier the individual is (i.e. higher consumption), the more pleasure the individual should derive from sharing an additional dollar of income with others as an act of alleviating inequality. On the

⁸ Now, when tax is zero, the Cobb-Douglas function is reduced to the standard theory form $U = C^\alpha H^{1-\alpha}$. This provides another argument for focusing on this family of functions.

other hand, the connection between tax and leisure is vague. It can be easily argued that someone with greater leisure will derive more utility from every additional *hour* of volunteer work performed, but it is much harder to argue that she will derive more utility from an additional *dollar* of tax paid or charitable contribution made.

The property $U_{HX} = 0$ of this family of utility functions leads to interesting theoretical predictions that are readily testable in the experiment.

4.2 Budget Set

We will now consider the budget set of the maximization problem. There are three goods in the problem: consumption, tax, and leisure. While a typical three-good maximization problem has two choice variables (and the budget constrains the amount of the third variable), leisure is the only choice variable in this problem. The amount of tax paid and the *maximum* amount of consumption allowed depend on leisure. If a worker chooses H hours of leisure, then the amount of tax paid is exactly $t\bar{M} + wt(\bar{T} - H)$ and the maximum consumption allowed is $(1-t)\bar{M} + w(1-t)(\bar{T} - H)$, where w is the wage rate, t is the tax rate, \bar{M} is the taxable nonlabor income⁹, and \bar{T} is the time endowment. H is the only choice variable and falls in the range $[0, \bar{T}]$.

⁹ Nonlabor income is made taxable in this problem to allow an easy test of the income effect as discussed in the next chapter and Lemma 2 in Appendix A.

Graphically, the problem can be represented in a three-dimensional space with leisure, consumption, and tax as the x -, y -, and z -axis respectively.¹⁰ Any point in the space has coordinates (H, C, X) and represents H units of leisure, C units of consumption, and X units of tax. The relationships of each pair of variables are shown in Figures 4.1(a), (b), and (c). These form the three cross-sections of the budget set.

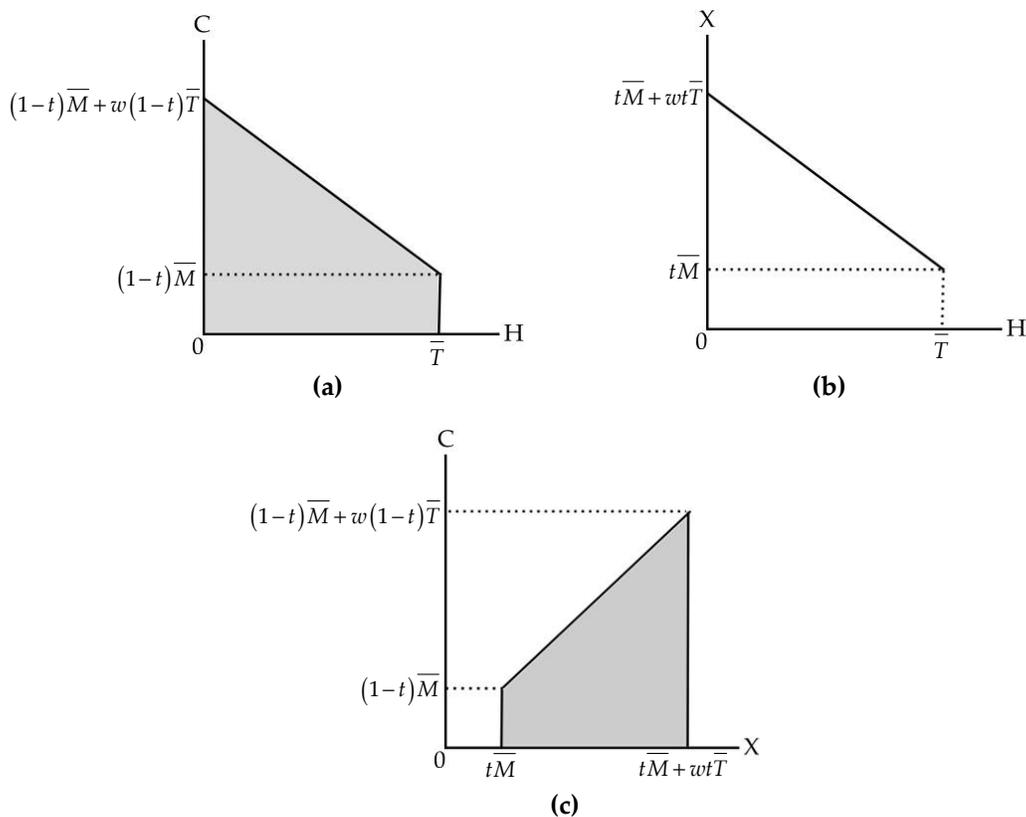


FIGURE 4.1 Cross-sections of the budget set

The budget set can be derived and is shown as the darker-shaded trapezoid in Figure 4.2. The budget set of the problem under the standard theory, which only

¹⁰ Alternatively, both the budget set and the indifference curves can be represented two-dimensionally as in Section 8.2.2, where the amount of tax is not represented pictorially but taken into account in the indifference curves. Here we are interested in a more complete picture of the budget set and the optimization problem.

considers consumption and leisure similar to Figure 4.1(a), is depicted as the lighter-shaded trapezoid in Figure 4.2. As in a typical three-good maximization problem, the utility function is represented as *indifference planes* (Allen 2007). Figure 4.2 shows a cross-section of the indifference plane U_0 tangent to the budget set. The point of tangency gives the amount of leisure (and accordingly, consumption and tax) that maximizes the worker's utility.

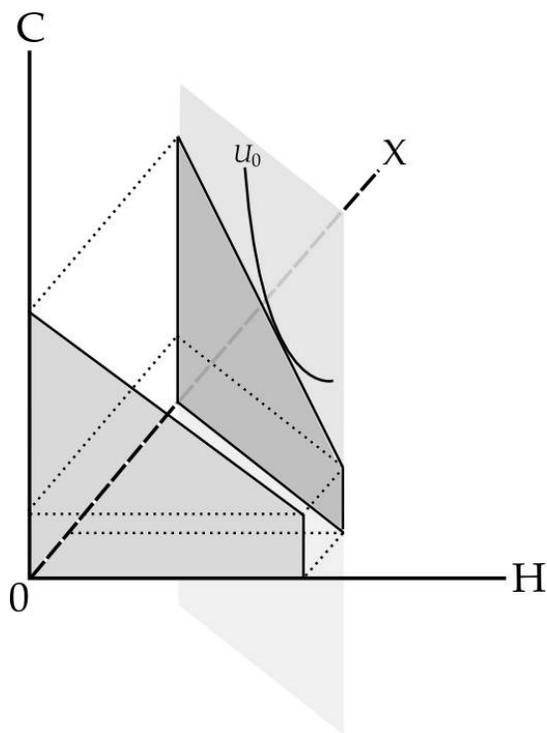


FIGURE 4.2 Budget set and a cross-section of the indifference sphere tangent to the budget set

Figure 4.2 also helps us understand why using the assumption of zero tax utility in the labor-leisure allocation analysis is misleading when in reality the worker enjoys some utility from tax. Under the standard theory, the worker derives zero utility from tax and the indifference plane looks like those in Figure B.1 in Appendix

B.¹¹ This is because at the same levels of consumption and leisure, the worker is indifferent between two different levels of tax. However, under the tax affinity hypothesis, the worker derives some utility from tax and the indifference planes now look like those in Figure B.2 or B.3 in Appendix B, similar to a typical three-good maximization problem. Of course, the actual shape of these indifference planes depends on the specific form of utility function assumed.

The trapezoid shape of the budget set also tells us that we are working with a convex budget set (e.g., Franklin 2002). This is important for the optimization analyses in the next section. Since we assume consistent and strictly convex preferences, the convex budget set immediately implies that there is a unique optimal solution to the maximization problem (e.g., Hewitt and Hanemann 1995).

LEMMA 1 *The budget set of a three-good problem involving consumption, leisure, and tax is convex and there is a unique optimal solution to the maximization problem.*

4.3 Propositions

Using optimization analyses, a number of propositions can be derived, two of which (Propositions 1 and 3) are testable in the experiment. Most of the analyses are based on the most general assumption of diminishing marginal utilities and nonnegative mixed partials, although the additional assumption $U_{HX} = 0$ will be used in certain propositions to yield unambiguous results. All proofs can be found in Appendix A.

¹¹ In fact, the points of tangency of this indifference plane to the two trapezoids in Figure 4.2 would have the same x - and y -coordinates. Thus, solving the two-good problem (i.e. finding the indifference *curve* tangent to the lighter trapezoid) suffices under the standard theory.

The most important and most obvious implication of the tax affinity hypothesis is that individuals would want to work more than under the standard theory. Under the same conditions (wage and tax rate), each additional hour of work gives greater utility under the tax affinity hypothesis, because each individual will be able to afford not only more consumption, but also more tax.

PROPOSITION 1 *An individual produces more labor under the tax affinity hypothesis than under the standard theory.*

Economists and policymakers may be interested in the effects of a change in the wage rate or tax rate on labor supply. The next two sub-sections discuss the impact of such a change under the tax affinity hypothesis and compare the results to those under the standard theory.

4.3.1 Changing the Wage Rate

Utility maximization models have been used extensively by microeconomists in solving resource allocation problems. However, Slutsky-like equations are not always derived for these models. This thesis provides the derivation of Slutsky-like equations for a unique budget set where there is only one choice variable in a three-good world.

PROPOSITION 2 *The Slutsky-like equation of leisure demand for a wage change under the tax affinity hypothesis is:*

$$\frac{\partial H^*}{\partial w} = \frac{1}{D'} [(1-t)U_C + tU_X] + \frac{1}{D'} \left[\begin{array}{l} w(1-t)^2 U_{CC} - (1-t)U_{CH} \\ + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX} \end{array} \right] (\bar{T} - H^*)$$

where

$$D' = w^2 (1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX} < 0$$

The equation of leisure demand for a wage change under the standard theory is:

$$\frac{\partial H^*}{\partial w} = \frac{1}{D} [(1-t)U_c] + \frac{1}{D} [w(1-t)^2 U_{cc} - (1-t)U_{ch}] (\bar{T} - H^*)$$

$$\text{where } D = w^2 (1-t)^2 U_{cc} - 2w(1-t)U_{ch} + U_{hh} < 0$$

In both equations, the first term is the substitution effect and the second term is the income effect of a change in w .

The Slutsky-like equation under the tax affinity hypothesis is significantly different from that under the standard theory due to the additional terms involving tax ($U_x, U_{xx}, U_{cx}, U_{hx}$). The standard theory predicts that the effect of a change in the wage rate only depends on the net wage rate. However, the additional terms in the tax affinity equation imply that the effect of a change in the wage rate must depend not only on the net wage rate, but also on the prevailing tax rate.

PROPOSITION 3 *Under the standard theory, the total effect of a change in the wage rate depends only on the net wage rate. Under the tax affinity hypothesis, the total effect of a change in the wage rate depends on both the wage rate and the tax rate.*

Using the Slutsky-like equations from Proposition 2, we will further study the effect of a change in the wage rate by first breaking it down to the income and substitution effects and subsequently adding these two components together. The next four propositions compare the income, substitution, and total effects of a change in the wage rate under the tax affinity hypothesis to those under the standard theory.

We will discuss these results further in Section 4.4.

PROPOSITION 4 *The relative magnitudes of the substitution effect of a change in the wage rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{hx} = 0$, the substitution effect is greater under the tax affinity hypothesis if*

$$-\frac{2(1-t)}{t} U_{cx} < U_{xx}.$$

PROPOSITION 5 *The relative magnitudes of the income effect of a change in the wage rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{HX} = 0$, the income effect is smaller under the tax affinity hypothesis if and only if*

$$-\frac{2(1-t)}{t}U_{CX} < U_{XX}.$$

PROPOSITION 6 *The difference between the total effect of a change in the wage rate under the tax affinity hypothesis and that under the standard theory is ambiguous.*

PROPOSITION 7 *If $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$, the total effect of a change in the wage rate under the tax affinity hypothesis is more negative (or less positive) than that under the standard theory.*

4.3.2 Changing the Tax Rate

Since the experiment in the thesis involves varying wage rates, we will focus on the propositions in the previous sub-section in discussing the experimental design and results in the subsequent chapters. However, it is interesting to extend the same analyses to varying tax rates to yield the next four propositions.

PROPOSITION 8 *The Slutsky-like equation of leisure demand for a tax change under the tax affinity hypothesis is:*

$$\frac{\partial H^*}{\partial t} = \frac{1}{D'}[-wU_C + wU_X] + \frac{1}{D'} \left[\begin{array}{l} -w(1-t)U_{CC} + U_{CH} \\ +w(1-2t)U_{CX} - U_{HX} + wtU_{XX} \end{array} \right] \left[w(\bar{T} - H^*) + \bar{M} \right]$$

The equation of leisure demand for a tax change under the standard theory is:

$$\frac{\partial H^*}{\partial t} = \frac{1}{D}[-wU_C] + \frac{1}{D}[-w(1-t)U_{CC} + U_{CH}] \left[w(\bar{T} - H^*) + \bar{M} \right]$$

In both equations, the first term is the “substitution effect” and the second term is the “income effect” of a change in t .

PROPOSITION 9 *The relative magnitudes of the substitution effect of a change in the tax rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{HX} = 0$, the substitution effect is smaller under the tax affinity hypothesis if*

$$-\frac{2(1-t)}{t}U_{CX} > U_{XX}.$$

PROPOSITION 10 *The relative magnitudes of the income effect of a change in the tax rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{HX} = 0$, the income effect is smaller under the tax affinity hypothesis if*

$$-\frac{2(1-t)}{t}U_{CX} > U_{XX}.$$

PROPOSITION 11 *The difference between the total effect of a change in the tax rate under the tax affinity hypothesis and that under the standard theory is ambiguous.*

4.4 Income and Substitution Effects

Among the different propositions in Section 4.3.1, Propositions 4 and 5, which compare the substitution and income effects under the standard theory and the tax affinity hypothesis, deserve further discussion. These propositions do not give definite predictions with regard to the differences between the standard theory and the tax affinity hypothesis. As the theory yields ambiguous predictions, empirical tests are needed.

Proposition 4 claims that the difference between the substitution effects of a wage change under the tax affinity hypothesis and under the standard theory is ambiguous. This may seem strange as one would expect a compensated increase in the wage rate to entice an individual to work more under the tax affinity hypothesis than under the standard theory, as the individual is now able to enjoy not only higher consumption, but also higher taxes. However, the ambiguity arises due to the difference in initial points before the wage change, where labor supply is higher under the tax affinity, as predicted by Proposition 1. As an example, consider the following two scenarios:

	Before compensated wage change	After compensated wage change	Change in labor supply
Tax affinity	10.2 hours	10.7 hours	.5 hour
Standard theory	10.0 hours	10.4 hours	.4 hour

TABLE 4.1 Scenario 1 where the substitution effect is larger under tax affinity

	Before compensated wage change	After compensated wage change	Change in labor supply
Tax affinity	10.2 hours	10.7 hours	.5 hour
Standard theory	10.0 hours	10.6 hours	.6 hour

TABLE 4.2 Scenario 2 where the substitution effect is smaller under tax affinity

How are these two scenarios possible? The difference could arise due to the four new terms that appear in the substitution effect under the tax affinity hypothesis but not under the standard theory. The first additional term is U_x , the marginal utility from tax. The higher the marginal utility is, the larger is the substitution effect (Scenario 1) because during a compensated wage increase, tax per worked hour increases and leisure becomes more expensive. Second is U_{CX} , the complementarity between consumption and tax. The higher this complementarity is, the larger is the substitution effect (Scenario 1) because a compensated wage increase, which increases both consumption and tax per labor hour, automatically increases the utility derived from the complementarity and makes leisure more expensive. Third is U_{HX} , the complementarity between leisure and tax. The higher this complementarity is, the smaller is the substitution effect (Scenario 2). As the individual takes less leisure at the initial point, the individual needs to increase the amount of leisure during a wage increase (and thus an increase in the tax per labor

hour) to enjoy higher utility from the complementarity. The last additional term is U_{XX} , the curvature of the marginal utility from tax. The more quickly the marginal utility diminishes, the smaller is the substitution effect (Scenario 2). If the marginal utility diminishes quickly, then after a certain point the individual derives little utility from tax. Since labor supply is higher at the initial point before the wage change, leisure is cheaper under the tax affinity hypothesis and the individual takes more of it during a wage increase as compared to under the standard theory.

One exception to the above is mentioned in the last line of the proposition. If $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$, then regardless of the value of U_X , the substitution effect is always greater under the tax affinity hypothesis.

We can use a similar reasoning to explain Proposition 5. In this case, however, the effect of the magnitude of a variable is not always clear as all the new terms, U_{CX} , U_{HX} , and U_{XX} , appear in both the numerator and the denominator with the same signs. To aid the explanation for this proposition, we refer to the last line of the proposition. If we assume $U_{HX} = 0$, the income effect is smaller under the tax affinity than the standard theory if and only if $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$.

We must then compare the relative magnitudes of U_{CX} and U_{XX} . The stronger U_{CX} is relative to U_{XX} , the more likely the inequality above is valid, implying a smaller income effect under the tax affinity. This is because the complementarity between consumption and tax makes working slightly more favorable despite the

satiety with higher consumption and tax. Conversely, the stronger U_{XX} is relative to U_{CX} , the more likely the income effect is greater under the tax affinity. This is because a strongly diminishing marginal utility of tax makes leisure cheaper faster and since labor supply is higher at the initial point before the wage change, the income effect under the tax affinity is greater than that under the standard theory.

4.5 Utility Functions and the Tax Affinity Hypothesis

We now refer to the two families of utility functions described in Section 4.1 and summarize the results provided by the propositions in this chapter, as seen in Table 4.3.

Utility Function	Changing Wage Rate			Changing Tax Rate		
	SE	IE	Total	SE	IE	Total
$U_{HX} > 0$?	?	?	?	?	?
$U_{HX} = 0$						
$-\frac{2(1-t)}{t}U_{CX} < U_{XX}$	\wedge	\vee	More negative	?	?	?
$-\frac{2(1-t)}{t}U_{CX} > U_{XX}$?	\wedge	?	\vee	\vee	?

TABLE 4.3 Differences between tax affinity hypothesis and standard theory for various utility functions

- \wedge Magnitude of effect is greater under the tax affinity hypothesis
- \vee Magnitude of effect is smaller under the tax affinity hypothesis
- ?

For the rest of the thesis, we will focus on the utility functions in 4.1.2 with the property $U_{HX} = 0$. The if-and-only-if condition in Proposition 5 will be useful in evaluating the experimental data. In particular, if the results show that the income

effect of a wage change under tax affinity is smaller, then under the assumption

$U_{HX} = 0$, the following *must* hold: (1) $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$; (2) the substitution effect

of a wage change under tax affinity is greater; and (3) the total effect of a wage

change on leisure demand is more negative (or less positive) under tax affinity. As

we will see in Chapter 6, these predictions will be helpful in interpreting the results.

5 EXPERIMENTAL DESIGN

From the mathematical analyses in the previous chapter, there are two main testable hypotheses (Propositions 1 and 3) to be tested in a controlled laboratory experiment. In addition, further tests will be conducted to study the nature of tax affinity and the type of utility function under the tax affinity hypothesis. This chapter discusses the need for a controlled experiment, the experimental design chosen, randomization performed, and ways to minimize any possible biases.

5.1 Need for Experimental Methods

It is important to consider why the experimental route is taken in evaluating the tax affinity hypothesis. There are two main advantages of using an experiment rather than an econometric analysis of field data.

First, panel data on wage, hours worked, and personal characteristics, such as occupation type, gender, age, and education, of all individuals (or randomly selected individuals) in the country over time are not readily available. On the other hand, a

controlled experiment has the clear benefit of being able to generate complete panel data for various treatments (in this case, the presence of tax and/or bonus) at a relatively low cost (Dickinson 1999).

Second, even if the appropriate field data existed for analysis, econometrics has the signal-to-noise ratio problem (Swann 2006) because of the non-experimental character of the data. This occurs when the effects of the focus variables (explanatory variables of interest) are tangled together with the effects of the nuisance variables. In this case, the independent signal in a focus variable (independent of the nuisance variables) has a small variance relative to the noise in the data. This is certainly true in the case of labor supply data, where studying the impact of wage on hours worked or work effort is highly difficult. While a large number of econometric studies have estimated the uncompensated elasticity of labor supply (e.g., Mroz 1987; Blundell and MaCurdy 1999; and Blau and Kahn 2007), there exists a great variation in the results of these studies. A plausible reason for this variation is the aforementioned signal-to-noise ratio problem. There are potentially a large number of nuisance variables in labor-supply decisions, such as demographics, human capital, and family status. The signal-to-noise ratio problem is aggravated by the minimal change in the marginal tax rates for most individuals in the last few years. On the other hand, an experiment allows us to impose drastic “changes” in the tax rates.

To sum, in Swann’s (2006) words:

“Some economic theory has a very fine structure that cannot

really be tested using the rather crude data that we tend to have to work with in applied economics. For example, some theory applies to disaggregated choices by the individual consumer, but we are obliged to test it with crude aggregate data—and it may not apply to aggregate data in a predictable way. With experimental methods, by contrast, we can in principle devise an experiment to test a particular theory, and so collect data that are entirely apposite to the theory in question. [...] probably the greatest strength of experimental economics is its capacity to test economic theory.”

We will now focus on finding the most unbiased and efficient design for the experiment.

5.2 Experiment Instructions

The experiment consisted of one trial round and six actual rounds. All subjects received similar treatments, except that each subject was randomly assigned one of the following four tax rates: 20% (set A), 50% (set B), 60% (set C), and 80% (set D). These four tax rates were chosen so that both pre- and post-tax wages and bonuses were whole numbers. Significantly large tax rates were chosen so that the utility received from paying this significant tax amount, if any, would be easily observed in the labor supply decision. Finally, a large variance in tax rates was employed to test if there would be any observable behavioral differences among groups that were assigned different tax rates. As seen in Table 5.1, the net wage was always the same regardless of the tax rate, which is important in testing the propositions. The codes were randomly assigned to different treatments for identification purposes.

		Standard		Reduced		Bonus	
		Treat- ment 1 (no tax)	Treat- ment 2 (tax)	Treat- ment 3 (no tax)	Treat- ment 4 (tax)	Treat- ment 5 (no tax)	Treat- ment 6 (tax)
Set A	Code	N	L	C	G	J	O
Tax:	Bonus	0	0	0	0	300	375
20%	Wage/circle	8	10	4	5	8	10
Set B	Code	N	A	C	E	J	H
Tax:	Bonus	0	0	0	0	300	600
50%	Wage/circle	8	16	4	8	8	16
Set C	Code	N	B	C	I	J	D
Tax:	Bonus	0	0	0	0	300	750
60%	Wage/circle	8	20	4	10	8	20
Set D	Code	N	K	C	M	J	F
Tax:	Bonus	0	0	0	0	300	1500
80%	Wage/circle	8	40	4	20	8	40

TABLE 5.1 Payoff schedule for different sets and treatments (in cents)

There were three pairs of treatments: Standard, Reduced, and Bonus. In the Standard and Bonus treatments, the net wage/circle¹² was 8 cents. Each subject also received a net bonus of \$3 in the Bonus treatments. In the Reduced treatments, the net wage/circle was 4 cents.

To test Proposition 1, the number of circles shaded in the with-tax treatments (Treatments 2, 4, and 6) would be compared to the corresponding no-tax controls (Treatments 1, 3, and 5). Since the net wage was identical in each pair, the standard theory predicts that the number of circles shaded would be identical in the two cases. On the other hand, Proposition 1 of the tax affinity hypothesis predicts that individuals would work more in the presence of tax.

To test Proposition 3, the change in labor supply when the net wage was reduced

¹² Net wage is defined to be the wage in the no-tax treatments or the *after-tax* wage in the with-tax treatments.

from 8 cents to 4 cents per circle in the with-tax case would be compared to the corresponding change in the no-tax case. According to Proposition 3, the standard theory predicts that the changes in the with-tax and no-tax cases would be identical since the effect of the change is dependent only on the net wage. The tax affinity hypothesis, on the other hand, predicts that the changes would be different because of the different tax rates (0% in the no-tax case and one of 20%, 50%, 60%, or 80% in the with-tax case).

Finally, by comparing the results for the Standard and Bonus pairs, we will study the income effect under tax affinity and draw additional insights into tax affinity. There are two reasons for which we focus on the income effect rather than the substitution effect. First, isolating the income effect can be done much more easily in the laboratory. Providing a bonus to subjects is a simple and acceptable way of simulating the income effect (see Lemma 2 in Appendix A), although the effect of using the term “bonus” may need to be considered. On the other hand, simulating the compensated wage change needed to study the substitution effect is much more complicated, especially for a pen-and-paper experiment. Second, the if-and-only-if condition in Proposition 5 is useful because important inferences can be made by observing the income effect, especially under the reasonable assumption $U_{HX} = 0$.

The experiment was designed to be an intensity experiment (refer to Section 5.3.1). In each round, the subjects were given three minutes to shade as many complete circles as possible. (Refer to Appendix C for a sample sheet containing the circles.) One round was randomly selected as the payoff round and the payoff

received by the subject depends on the number of circles shaded as well as the instructions the subject received in that round, including wage/circle, tax rate, and bonus. All payoffs were funded by the Department of Economics, Wesleyan University.

In this experiment, the tax money collected would be given back to the Department of Economics. To simulate the income tax, it is necessary to emphasize that the money will be used for public benefit. Throughout the experiment, subjects were reminded that “the tax amount deducted will be contributed to a non-profit organization that provides public services.” The ambiguity was necessary to avoid the impact of any personal affiliation or identification with the non-profit.

At the end of the experiment, the subjects were asked to complete a survey, which asked for each subject’s major(s), knowledge of basic economics theory as evidenced by the completion of intro economics courses (ECON 101 or 110), class year, gender, and responses to fifteen statements, which would provide a rough gauge of each subject’s altruistic preferences and perceptions of the income tax.

General instructions for the experiment as well as instructions from select treatments are replicated in Appendix C.

5.3 Design

5.3.1 Intensity Experiment

Testing labor supply in a laboratory setting is not straightforward. Because of limited

resources, it is impracticable to retain subjects in an experiment for hours to simulate their labor supply behavior. On the other hand, giving subjects a choice between four-minute rounds and five-minute rounds is unwise as the difference in the labor “hours” is too small to generate a significant loss in their leisure “hours”.

As a result, an intensity experiment was chosen for the purpose of this thesis. Intensity experiments test the work effort of subjects, i.e. how hard the subjects will work within the given period of time. A leisure choice is a choice to work “less hard” thereby lowering average production, although the subjects must stay until the end of the experiment. Dickinson (1999) conducted the first widely-known intensity experiment, in which he studied both the hours worked (labor hours vs. leisure hours) and the work intensity (on-the-job labor vs. on-the-job leisure).

In Dickinson’s intensity experiment, each subject was asked to type a paragraph as many times as possible within two hours. In this experiment, each subject was asked to shade as many complete circles as possible. This choice of task was made for three reasons. First, the task of shading circles is boring, tiring, and unpleasant. A post-experiment survey result, which will be presented fully in Chapter 6, provides evidence for the subjects’ disagreement to the statement “I enjoyed shading circles” ($p = 0.054$). The unpleasantness of the task is important as it decreases the price of leisure and makes the substitution from (on-the-job) labor to (on-the-job) leisure hours more pronounced. Second, since the time taken to shade one complete circle is extremely short, a small difference in the work effort could translate into a magnified difference in the number of circles shaded. This is appropriate for the short round

period of three minutes each. Third, shading circles is one of the few tasks that can be done in a pen-and-paper setting and is thus appropriate for the thesis considering the time and resource constraints.

While shading circles has a clear advantage over other pen-and-paper tasks, it is not devoid of the problem of consistency like most other pen-and-paper tasks. As was clearly seen in many subjects' work, the quality of the shading deteriorated in the later rounds. This "lower-quality" shading was often less dark and went beyond the boundary of the circles, which was not prohibited in the experimental instruction. In addition, there was strong evidence for learning in each round as can be seen by the changes in the way subjects shaded each circle or in the pattern of the circles shaded. A few subjects even figured out that shading the whole page would be a lot faster than shading individual circles and exhibited this behavior in the later rounds. The lower-quality shading and learning effects overcame the tiredness effects, resulting in positive overall round effects of 5.91 ($p = 0.000$). This implies that, on average, each subject shaded 5.91 circles more in any round than in the preceding round. The positive round effects, however, are not a source of concern as the order of treatments received by each subject was randomized.

5.3.2 Randomization

By applying randomization in the treatment orders, any impact of the round effects exhibited by one subject is canceled out by that exhibited by other subjects in the aggregate data. We can then ignore the impact of the round effects in the statistical

analyses of data, thereby allowing statistical tests that are more powerful than the regression analysis, such as the paired sample t test.

The randomization for one-half of the sample was done by the experimenter's shuffling the six treatments blindfolded. The randomization for the other one-half was done by a simple program made in Microsoft® Excel. Table 5.2 summarizes the average round number in which each treatment appeared, while Table 5.3 summarizes the results from the paired-sample t tests used to investigate if any two treatments appeared in significantly different round numbers. Finally, Table 5.4 compares the order in which with-tax treatments appeared in relation to their respective no-tax control. Comparison of such pairs is used to test the validity of Proposition 1. As can be seen in all tables, there is no statistical evidence that the order of the treatments is nonrandom.

	Treat- ment 1	Treat- ment 2	Treat- ment 3	Treat- ment 4	Treat- ment 5	Treat- ment 6
Average round number	3.54	3.34	3.54	3.91	3.17	3.49
Statistically different from 3.5	No	No	No	No	No	No

TABLE 5.2 Average round number for each treatment

	Treat- ment 1	Treat- ment 2	Treat- ment 3	Treat- ment 4	Treat- ment 5	Treat- ment 6
Treatment 1						
Treatment 2	.73					
Treatment 3	1.00	.64				
Treatment 4	.45	.20	.43			
Treatment 5	.47	.67	.41	.11		
Treatment 6	.87	.70	.90	.31	.48	

TABLE 5.3 p -values of two-sided paired sample t -tests if two treatments appear in different round numbers

Percentage that no-tax treatment appears before tax treatment	Percentage that tax treatment appears before no-tax treatment	Difference in percentages
52%	48%	No (p = 0.63)

TABLE 5.4 *Order of corresponding tax and no-tax treatments*

5.3.3 Tax

The subjects were informed that the tax money would be donated to “a non-profit organization that provides public services.” Thus, although this deduction was named “tax”, the subjects might respond to the deduction differently than they would if it were actual tax money paid to the government. While most people simply pay taxes and let the government choose where the money should be spent, people who donate significantly to charities take a more active role in deciding where the money should be invested in their communities. In addition, individuals may have differing levels of trust in the government and in non-profit organizations, thereby behaving differently when they make payment to these two parties.

In order to minimize these concerns, two measures were taken. First, the non-profit to which the tax proceeds would be donated was chosen by the experimenter and this information was not disclosed to the subjects until the end of the experiment. This should avoid the impact of any personal affiliation or identification with the non-profit. Second, the experiment instructions explicitly encouraged subjects to treat this deduction as the usual income tax deduction:

“You may treat the tax deductions similar to the income tax you pay from your on/off-campus jobs. Tax money is used by the government to fund public services and infrastructures. Tax also has a redistributive feature as it channels some

income from the rich to the poor.”

These statements were repeated for each round in which tax was imposed.

5.3.4 Subjects

The subjects in the experiment were all undergraduate students at Wesleyan University. However, unlike the experiment conducted by Dickinson (1999) and most other economics experiments, subjects of various majors were invited to participate in this experiment, thereby avoiding the possible bias related to using only economics majors (Djanali and Wang 2008). The experiment was conducted in three different locations on campus that attract students from diverse departments and backgrounds: Fisk Hall is home to classes ranging from philosophy to foreign language; Exley Science Center has Pi Café, where students hold meetings and purchase snacks; and Usdan University Center houses students’ mailboxes and dining halls, where all students gather between or after classes. In addition, the advertisement flyer for the experiment explicitly mentioned that “econ and non-econ majors [are] welcome.”

While getting subjects with different majors is clearly desirable, it is acknowledged that undergraduate students may not be ideal subjects for the experiment due to two concerns. First is the concern of generalizability of the experimental results to non-students, which will be discussed in Section 5.5. The second issue is that students are not experienced taxpayers and may not respond to the “tax” in the experiment the way they would had they been more experienced

taxpayers. While the verdict is not unanimous, experimental economists often prefer using undergraduate subjects, both because it is cheaper and because undergraduate students are more malleable, with preferences that are more easily induced by the incentives. This will allow the experimenters to study the impact of such incentives more easily. For further discussion, refer to Swann (2006).

5.4 Addressing Heuristics

Heuristics in decision-making in the presence of taxes are common (e.g., McCaffery and Baron 2004). Pre-experiment interviews conducted with actual taxpayers suggest that some workers may employ heuristics in their labor supply decision. They often “ignore” the income tax and only pay attention to the pre-tax income in making labor supply decisions, such as labor force participation, hours worked, human capital development and pursuing promotions.

For instance, graduating college students may only consider the pre-tax income of their job offers and make decisions solely based on these pre-tax wages. They, either knowingly or otherwise, choose to ignore the different tax rates involved in comparing jobs with significant pay differences or jobs in different countries.

These heuristics are also observed in the payment of other kinds of taxes. Buyers often ignore sales taxes in making their purchasing decisions (Chetty, Looney, and Kroft 2007). Finkelstein (2007) also found that drivers ignored the toll rates in their decision-making when the toll collection was made less salient by using an electronic collection system.

A model often used to describe these heuristics assumes that these decision makers knowingly choose to ignore the tax because the costs involved in calculating the total tax are too high. This model argues that these decision makers are in fact rational through a “rationalizing on a higher level” process (Rubinstein 1998). However, not all heuristics can be modeled this way. Another model assumes that these decision makers *unknowingly* ignore the tax, due to limited memory, limited knowledge, or other reasons. Forgetting the electronically collected toll may be described by this model.

How do these heuristics affect our investigation of the tax affinity hypothesis? The only sensible heuristics would require decisions similar to those implied by tax affinity. Subjects might work more in the with-tax treatments not because they enjoyed paying tax but because the pre-tax wage rates were higher in these treatments. However, all propositions derived in this chapter are based on tax affinity¹³ and the strong support for the tax affinity hypothesis in Chapter 6 indicates that heuristics are not a source of concern.

In addition, the experimental design minimized heuristics in two ways. First, the tax was made highly obvious in the instructions. The instructions for the with-tax rounds included a long paragraph about the tax, which made them easily distinguishable from the no-tax rounds. Second, the tax rates were made sufficiently

¹³ For instance, heuristics-driven decisions will not produce the same income effect predicted by the tax affinity hypothesis.

high in most sets of treatments so that the subjects would consider such large deductions in their decision-making.

In fact, the concern with heuristics provides two additional reasons for which using experimental data is more desirable than using field data in studying the impact of tax affinity. First, the simplicity of the tax “system” in the experiment makes the cost of calculating the tax amount considerably lower than in the actual income tax system, where the total income tax may not always be obvious. Second, heuristics are more likely to develop in the actual tax system where everyone is always expected to pay some portion of the income in tax. Since the subjects paid taxes in some rounds but not in others, heuristics are minimized in the experiment.

5.5 Experimental Design and the Tax Affinity Hypothesis

The final section of this chapter focuses on the generalizability of the experimental results to labor supply decisions and taxpaying behavior. In particular, if the tax affinity hypothesis is supported by the experimental results, does this also apply to real taxpayers in large-scale economies? If so, can the experimental results tell us anything about the quantitative implications of tax affinity?

The problems associated with generalizing results from a small laboratory to a larger, “real” laboratory are present in all experiments, from economics to marketing to natural sciences and engineering. Market research may suggest that a product has a promising future, but the producer may experience a completely different outcome. A prototype semiconductor may work well in the laboratory but less so in

the field. Similarly, extending results from an economics experiment to actual economies must be done with caution.

In particular, one plausible concern about the experimental design is its simplicity in comparison to labor supply decision-making in the economy. The experiment lacks important characteristics present in the actual workforce, such as an allowable range of productivity (one cannot work below a certain level of productivity in order to stay in the job, but also there is finite amount of work available in each period of time), teamwork, family and health conditions, skills, and variety of assignments. Further, the experiment did not allow any career choice and the acquisition of human capital, which is also an unresolved problem in many econometric models on labor supply (Aaron and Pechman 1981).

However, it has been argued that it is in fact this simplicity that highlights the strength of experimental methods in learning about human behavior and evaluating new theories. Friedman and Sunder (1994) argue that it is futile to try to create in an experiment a model that tries to capture all complexities of the real world. Instead, the objective in experimental design should be to try to learn something useful. The right criterion by which to judge the success of an experiment, in their view, is by its impact on understanding. Indeed, an improved understanding of individuals' perception of tax is the goal of this experiment.

Experimental economists refer to the "parallelism precept" (Smith 1982), the assumption that economic propositions that have been tested and found to hold in experimental laboratories will also hold in real economies, although the

extrapolation must be done carefully. In Swann's (2006) words: "If we are prepared to make the leap of faith involved, then experimental results are certainly of value, but must be interpreted with caution."

6 RESULTS

This chapter discusses the results from the experiment conducted. While the main goal of the chapter is to evaluate the validity of the tax affinity hypothesis by looking at the two testable propositions derived in Chapter 4, there are a number of additional results that are useful in providing further insights into tax affinity.

Three sessions of the experiment were conducted. Two were conducted on February 2, 2009, at 2:45pm at Fisk Hall 114 and at 4:15pm at Science Center 109. The last session was conducted on February 20, 2009 at 4:15pm at Usdan 108. A total of 35 subjects participated and the average payoff was \$13.6.

6.1 Descriptive Statistics

This experiment differed from most economics experiments in that it involved students from various departments and backgrounds. Table 6.1 shows the breakdown of the subjects.

Male	16
Female	19
Class of 2009 [†]	9
Class of 2010	10
Class of 2011	7
Class of 2012	9
Economics/Math-Econ majors	4
Non-majors with intro economics	14
Non-majors without intro economics	17
Humanities majors [‡]	9
Natural Science majors [‡]	11
Social Science majors [‡]	15
Undecided	8
Total subjects*	35

TABLE 6.1 *Subjects*

[†] Included one subject who graduated in Dec 2008

[‡] Humanities majors included English, Film Studies, French Studies, Italian Studies, Music, and Romance Studies majors

Natural Science majors included Biology, Mathematics, Mathematics-Economics, Molecular Biology & Biochemistry, and Neuroscience & Behavior majors

Social Science majors included African American Studies, American Studies, Anthropology, College of Social Studies, East Asian Studies, Economics, Feminist Gender & Sexuality Studies, Government, Mathematics-Economics, Psychology, and Sociology majors

* Interdisciplinary and double majors are counted in both groups

The complete data containing the numbers of circles shaded and responses to the post-experiment survey for each subject can be found in Appendix D. The descriptive statistics of the results are shown in Tables 6.2 and 6.3.

	Treat- ment 1	Treat- ment 2	Treat- ment 3	Treat- ment 4	Treat- ment 5	Treat- ment 6
Mean	143.6	149.8	139.2	160.1	137.9	150.9
Median	136	130	137	148	129	140
StdDev	47.1	54.2	46.2	61.1	46.8	45.7

TABLE 6.2 *Number of circles shaded*

	1	2	3	4	5 [†]	6	7	8	9	10	11	12	13	14	15
Mean	3.1	2.5	2.6	3.4	4.0	2.7	2.8	3.4	3.0	4.1	3.8	2.4	4.1	3.8	4.3
Median	3	2	2	3	5	3	3	3	3	4	4	2	4	4	5
StdDev	1.3	1.3	1.3	1.2	2.3	1.0	1.0	1.0	1.1	1.2	1.3	1.2	1.2	1.2	1.2

TABLE 6.3 *Post-Experiment survey response*

[†] 15 subjects have never filed any tax returns and thus did not respond to this statement

6.2 Hypothesis Testing

The data show that the presence of tax affects labor supply in ways predicted by the tax affinity hypothesis. Both main propositions are given significant support by the data.

Five paired sample *t*-tests were conducted on the differences in the numbers of circles shaded in the different treatments. These *t*-tests are summarized in Table 6.4 and the results are shown in Table 6.5. Note that there were four possible tests for Proposition 1 (more labor supply in the with-tax cases for the same net wage), which included one test on each pair of treatments (Standard, Reduced, or Bonus) and a joint test that used data from all pairs.

	Test	Number of pairs
Proposition 1 (Standard)	$H_0: \mu_2 - \mu_1 \leq 0$ $H_A: \mu_2 - \mu_1 > 0$	35
Proposition 1 (Reduced)	$H_0: \mu_4 - \mu_3 \leq 0$ $H_A: \mu_4 - \mu_3 > 0$	35
Proposition 1 (Bonus)	$H_0: \mu_6 - \mu_5 \leq 0$ $H_A: \mu_6 - \mu_5 > 0$	35
Proposition 1 (joint)[†]	$H_0: \mu_T - \mu_0 \leq 0$ $H_A: \mu_T - \mu_0 > 0$	105
Proposition 3	$H_0: (\mu_1 - \mu_3) - (\mu_2 - \mu_4) = 0$ $H_A: (\mu_1 - \mu_3) - (\mu_2 - \mu_4) \neq 0$	35

TABLE 6.4 *Paired sample t-tests conducted on experimental data*

[†] μ_T indicates the mean numbers of circles shaded in the with-tax treatments (Treatments 2, 4, 6) and μ_0 indicates those in the respective control treatments (Treatments 1, 3, 5)

	Average of difference	S.E. of difference	t-statistics	p-value
Proposition 1 (standard)	-6.2	5.3	-1.18	.123
Proposition 1 (reduced)	-20.9	7.0	-3.01	.002
Proposition 1 (bonus)	-13.0	6.5	-2.02	.026
Proposition 1 (joint)	-13.4	3.6	-3.69	.000
Proposition 3	14.7	8.4	1.75	.089

TABLE 6.5 *Results of paired sample t-tests*

6.2.1 Proposition 1

When all 105 pairs (three pairs of data per subject) were used in the joint test, there is evidence for Proposition 1 at the .1% significance level. When the pairs were tested separately, one test (Reduced) showed evidence for Proposition 1 at the 1% significance, one (Bonus) at the 5% significance, and one (Standard) did not show statistically significant evidence, although its direction followed the prediction.

The strong results in the joint test as well as two out of three separate tests imply that even when the net wage was the same, the subjects worked significantly more in the presence of tax. This contradicts the standard theory's prediction that individuals would provide the same amount of labor at the same net wage.

The effect of tax affinity was strongest when the net wage was low (Treatment 3 vs. Treatment 4). This is because more labor is required to afford more tax when wage is lower, implying that the income effect is greater under the tax affinity hypothesis at low incomes. However, tax affinity is also stronger in the presence of bonus (Treatment 5 vs. Treatment 6) than in the absence of bonus (Treatment 1 vs. Treatment 2), which here implies that the income effect is smaller under the tax affinity hypothesis at high incomes.

While the income effect *per se* may account for the stronger tax affinity at low and high incomes as will be discussed in Section 6.3, there is another plausible reason for the stronger tax affinity in the presence of bonus. Although the bonus was taxable in this experiment, the word “bonus” implies an almost undeserved amount of money, especially compared to the income earned through hard work of shading circles. The recipient may feel fortunate and better off than others, and the recipient’s inequality aversion may reinforce tax affinity. More experiments and tests are needed in future work, perhaps by giving varying amounts of the bonus in different rounds, in order to further assess the possibility of this “bonus effect.”

6.2.2 Proposition 3

Proposition 3 claims that if workers receive some utility from tax, the total effect of a change in the wage rate should depend not only on the net wage rate, but also on the tax rate. The data show support for the proposition at the 10% significance level. In fact, while we observe a small, statistically insignificant decrease in work effort from Treatment 1 (standard wage, no tax) to Treatment 3 (reduced wage, no tax), we see a large, statistically significant *increase* in work effort from Treatment 2 (standard wage, with tax) to Treatment 4 (reduced wage, with tax). The results are summarized in Table 6.6.

	Average of difference	S.E. of difference	t-stat	p-value
Treatment 3—Treatment 1	-4.3	7.2	-0.60	.276
Treatment 4—Treatment 2	10.4	6.6	1.58	.062

TABLE 6.6 Differences when wage is reduced without and with tax

6.2.3 Robustness Checks

To evaluate the robustness of these results, the sign test and the Wilcoxon signed-ranks test were conducted on the above propositions. The tests are briefly explained below, but for a more complete discussion of the tests, refer to DeGroot (1989).

In the sign test, the difference between the with-tax treatment and the corresponding no-tax control treatment (or the difference between the changes in each pair of treatments in testing Proposition 3) was measured and the number of pairs for which this difference was positive was counted. The decision to accept or reject H_0 was then based solely on this number of positive differences. In this test, the n pairs represented n Bernoulli trials, for each of which there was probability p that the number of circles shaded was greater in the with-tax treatment. Thus, we tested:

$$\begin{aligned}H_0 &: p \leq 1/2 \\H_1 &: p > 1/2\end{aligned}$$

The Wilcoxon signed-ranks test is a multi-step test where, like the sign test, the differences between the two treatments, D_1, \dots, D_n were first measured. Then, the absolute values $|D_1|, \dots, |D_n|$ were arranged in order from the smallest absolute value to the largest. Each absolute value $|D_i|$ was assigned a rank corresponding to its position in the ordering. The smallest absolute value was assigned the rank 1 and the largest was assigned the rank n . Next, each of the ranks $1, \dots, n$ was assigned either a plus or minus sign, depending on the sign of the original difference D_i . Finally, these ranks were summed to give the statistic W . In this test, D_1, \dots, D_n were assumed to be independent and identically distributed, and form a random sample from a

continuous distribution symmetric to the point θ . Using either a statistical package or normal approximation, we then tested:

$$H_0 : \theta \leq 0$$

$$H_1 : \theta > 0$$

These tests are less powerful than the paired-sample t -tests and so the p -values in these tests are higher. However, most tests are significant and the results are broadly supportive of the propositions. The results are summarized in Table 6.7.

	Sign test		Wilcoxon test	
	Positive pairs	p-value	W	p-value
Proposition 1 (Standard)	18/35	.633	-92	.227
Proposition 1 (Reduced)	9/35	.003	-331	.003
Proposition 1 (Bonus)	11/35	.020	-262	.013
Proposition 1 (joint)	38/105	.002	-2090	.000
Proposition 3	21/35	.155	148	.104

TABLE 6.7 Results of sign test and Wilcoxon signed-ranks test

As another robustness check, an unpaired two-sample t -test was conducted to compare the *ratio* values, as defined below, between the group of subjects who received the 20% tax rate and the others who received higher tax rates. *ratio* is defined to be the average of the percentage difference in the number of circles shaded between the with-tax treatment and the corresponding no-tax control. The simple formula for *ratio* is:

$$ratio = \frac{\left(\frac{x_2 - x_1}{x_1}\right) + \left(\frac{x_4 - x_3}{x_3}\right) + \left(\frac{x_6 - x_5}{x_5}\right)}{3}$$

where x_i denotes the number of circles shaded in treatment i . *ratio* can be regarded

as a proxy for tax affinity; the more positive the *ratio* is for a subject, the more tax affinity the subject exhibited. As predicted, the subjects who received the higher tax rates exhibited greater tax affinity at the 5% significance level. The result of the *t*-test can be found in Table 6.8.

	Average of difference	S.E. of difference	t-stat	p-value
High taxes (50%, 60%, 80%) vs. low tax (20%)	.102	.047	2.19	.019

TABLE 6.8 *Differences in ratios between subjects who received high taxes and low tax*

It is tempting to use these results to yield further insights into tax affinity, such as to estimate the labor supply elasticity with respect to tax rates. However, this study is deferred to future research with experiments specifically designed to measure this elasticity. In this experiment, each subject was only assigned one tax rate and thus comparing the *ratio* values from different tax rates means comparing the values from different subjects. The difference in the *ratio* values for the different tax groups may then be caused by personal differences, rather than the impact of the tax rate itself. In future experiments that aim to measure the elasticity, the same subject should receive various tax rates and the *ratio* value for each of the tax rates may then be calculated and compared.

6.3 Income and Substitution Effects

6.3.1 Income Effect

The most direct observation on the income effect can be made by comparing the changes in labor supply when a bonus was given in both with- and no-tax cases (Treatment 6 vs. Treatment 2 and Treatment 5 vs. Treatment 1). The results of the t -tests are found in Table 6.9.

	Average of difference	S.E. of difference	t-stat	p-value
Treatment 5—Treatment 1	-5.7	7.0	-0.81	.212
Treatment 6—Treatment 2	1.2	6.1	0.19	.425

TABLE 6.9 *Differences when bonus is introduced without and with tax*

When a net bonus of \$3 was introduced, which is equal to 37.5 circles or 26% of the average payoff, there was an average decrease of 5.7 circles or 3.9% of effort from the initial level in the no-tax case and a minute increase of effort from its initial level in the with-tax case. While neither of these changes is statistically significant, several observations can be made from the point estimates. First, the income effect is consistent with the standard theory's predictions in the no-tax case, where the introduction of a bonus decreased labor supply.¹⁴ Second, the slight increase in the presence of a bonus under tax affinity is slightly puzzling. While the unexpected

¹⁴ As assumed in Chapter 4, $U_{CH} > 0$ and so leisure is a normal good under the standard theory.

sign¹⁵ may well be due to sampling errors, the inequality aversion due to the bonus may also play a part. For the rest of the analysis, however, we will assume this “bonus effect” to be small since its amount is only one-quarter of the payoff.

The data suggest that the income effect on leisure demand is less positive (or even negative) at high incomes under the tax affinity. From Proposition 5, under the assumption $U_{HX} = 0$, the smaller income effect under the tax affinity hypothesis implies that $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$ at high incomes.

Now we will look at the income effect when the wage rate is changed. This can be done by comparing the changes in the labor supply when the wage was reduced in both with- and no-tax cases (Treatment 4 vs. Treatment 2 and Treatment 3 vs. Treatment 1). The results are given in Table 6.6 in the previous section.

Separating the income and substitution effects of this wage change is impossible without further information. However, very striking observations can be made about the two cases. In the no-tax case, the substitution effect overcame the income effect and as a result, the 50% wage decrease resulted in an average decrease of 4.3 circles or 3.0% of work effort from the initial level. In the with-tax case, the income effect overcame the substitution effect and the same 50% wage decrease resulted in a statistically-significant *increase* of 10.4 circles or 6.9% of work effort from its initial level. Since substitution effect is always negative, the significant increase of work

¹⁵ An interesting aspect of the tax affinity hypothesis is that leisure may be an inferior good even under the standard assumption $U_{CH} > 0$ (see Lemma 3 in Appendix A). However, this can be considered unlikely.

effort under tax affinity must then be attributed to a large income effect at low incomes.

From Proposition 5, if we make the assumption $U_{HX} = 0$, the much larger income effect under the tax affinity hypothesis implies that $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$ at low incomes.

Summarizing the previous two results, we have $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$ at high wages and $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$ at low wages. This implies that if U_{CX} becomes more positive as wage rises ($\partial U_{CX}/\partial w > 0$) and/or U_{XX} becomes less negative as wage rises ($\partial U_{XX}/\partial w > 0$). However,

$$\frac{\partial U_{CX}}{\partial w} = U_{CCX}(1-t)(\bar{T}-H) + U_{CXX}t(\bar{T}-H) < 0$$

since $U_{CC} < 0$, $U_{XX} < 0$, and $U_{CX} > 0$. Thus, this implies that

$$\frac{\partial U_{XX}}{\partial w} = U_{CXX}(1-t)(\bar{T}-H) + U_{XXX}t(\bar{T}-H) > 0$$

and since $U_{CXX} < 0$, we have $U_{XXX} > 0$. Note that a function with Cobb-Douglas

components $(U = C^\alpha H^{1-\alpha} + C^\beta X^{1-\beta})$ or CES components

$(U = (\alpha C^p + (1-\alpha)H^p)^{1/p} + (\beta C^q + (1-\beta)X^q)^{1/q})$ would fit this criterion.

6.3.2 Substitution Effect

While there was no specific test conducted to study the substitution effect, we can again compare the changes in the labor supply when the wage is reduced with and without tax (Treatment 4 vs. Treatment 2 and Treatment 3 vs. Treatment 1), whose results are given in Table 6.6.

The significant increase in work effort in the with-tax case implies that not only is the income effect higher under tax affinity, but also the substitution effect is smaller.

From the last line of the proof of Proposition 4, we then know that

$-\frac{2(1-t)}{t}U_{CX} \gg U_{XX}$ at low wages. The strongly negative U_{XX} at low wages does not

violate the prediction made in the previous section that $U_{XXX} > 0$. As income

increases, we predict that $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$ as U_{XX} becomes less negative. The

above result follows the prediction made in the previous section.

6.3.3 Total Effect

By summing the income and substitution effects and as predicted by Proposition 7, the total change in the demand for leisure is more negative (i.e. greater labor supply during a wage increase) under the tax affinity hypothesis than under the standard theory at high levels of income .

At low levels of income, as shown in the data with statistical significance, the total effect is less positive (i.e. greater labor supply during a wage decrease) under the tax affinity hypothesis than under the standard theory.

These results, which will be helpful in drawing the labor supply curves in the next section, are summarized in Table 6.10.

	Standard theory			Tax affinity hypothesis		
	Substitution Effect	Income Effect	Total Effect	Substitution Effect	Income Effect	Total Effect
Low income	-	+	-	-	+	+
High income	-	+	+	-	+	-

TABLE 6.10 *Summary of effects of a wage change based on experimental results*
The size of the sign represents the magnitude of the effect

6.4 Labor Supply Curves

From the results in the previous sections, the data suggest that under the tax affinity hypothesis, the following occurs:

- (1) Labor supply is always higher than under the standard theory, implying that the tax affinity curve is to the right of that of the standard theory.
- (2) The difference between labor supply under the tax affinity hypothesis and the standard theory is higher for low-income and high-income groups, implying that the spread between the two curves widens as the wage goes up or down.
- (3) The total effect of a change in the wage on leisure demand is more positive at low wages, implying that the slope of the labor supply curve under the tax affinity hypothesis is more positive at low wages.
- (4) The total effect of a change in the wage on leisure demand is more negative at high wages, implying that the slope of the labor supply curve under the tax affinity hypothesis is more negative (or less positive) at high wages.

Using these results, two sketches of the predicted labor supply curve under the tax affinity hypothesis are derived. In Figure 6.1(a), the labor supply curve is assumed to be positively sloping, whereas in Figure 6.1(b), the curve is assumed to be backward bending.

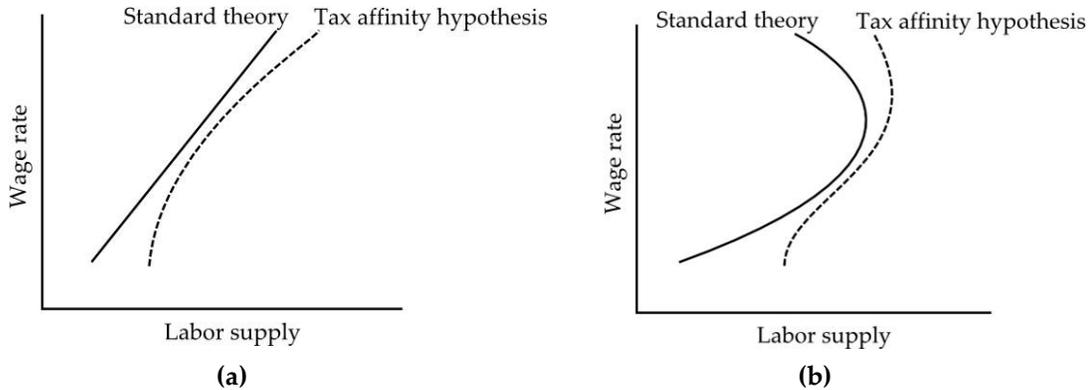


FIGURE 6.1 *Predicted labor supply under the tax affinity hypothesis*

6.4.1 Impact on High- and Low-Income Workers

We observe that tax affinity has the greatest impact on those with lower and higher wages. This may be confusing at first as we expect low-wage earners to have an extremely high marginal utility of consumption. However, the marginal utility of tax is also very high at such low levels of tax paid¹⁶ and its impact on the labor supply decision is significant as supported by the experimental data. It is worth repeating that this is not a problem of choice between consumption and tax (in which case the worker would prefer to keep the money to first feed her own family before helping others), but rather a problem of choice between leisure and income, which includes consumption and tax.

¹⁶ In fact, if we assume the function with Cobb-Douglas components, $MU_X \rightarrow +\infty$ as $X \rightarrow 0^+$.

To explain this observation, we consider the general form of utility function $U = V(C, H) + W(C, X)$. The labor supply decision under the standard theory maximizes utility of the function $U = V(C, H)$. Under tax affinity, individuals want to work more because of the additional warm glow utility $W(C, X)$ that makes leisure more expensive. At low wages and thus low taxes, $U_X = W_X$ is high and leisure becomes much more expensive under tax affinity, encouraging greater labor supply. At high wages, both U_C and U_X are low because of the diminishing feature of these marginal utilities, but it could be that the marginal utility of consumption diminishes more quickly than the marginal utility of tax. As a result, the impact of U_X on the labor supply decision is magnified at very high income levels.

These findings are in line with the predictions in Table 3.1 in Section 3.4. In fact, the pro-social theories discussed in Chapter 3 provide intuitive explanations for these findings. For the low-wage earners, the opportunity to contribute the first few dollars to the society through the income tax yields high utility because of an increased sense of altruism, independence, and self-identity. Since they may have benefited significantly from government-funded public goods or received welfare, they also appreciate the opportunity to reciprocate the favor to the government and other taxpayers. The high-wage earners, on the other hand, exhibit a greater impact of tax affinity for different reasons. Since the impact of working an additional

“hour”¹⁷ is high on the amount of tax paid, these individuals are encouraged to work more to obtain greater warm glow, which is dependent on the amount of tax paid. Their inequality aversion also drives them to enjoy more tax as a means of sharing their income and minimizing inequality.

The finding that tax affinity has the greatest impact on the high- and low-income groups finds support in parallel studies on charitable giving and econometric studies on labor supply.

6.4.2 Evidence from Charitable Giving

The tax affinity hypothesis states that individuals derive pleasure from paying tax due to pro-social motivation. Pro-social motivation has also been shown to drive charitable contributions (e.g., Smith, Kehoe, and Cremer 1995). It can then be argued that any tax affinity behavior exhibited in labor supply decisions should mirror the observed behavior on warm glow giving.¹⁸

Investigating data of charitable giving made in the last decade, Brooks (2007) reported that “the two most generous groups in America are the rich and the working poor, [while] the middle class give the least,” which is in line with our analyses of tax affinity. He also found that low-income people enjoy giving more because “they are more likely to need charity or know someone who needs charity,” which further supports the reciprocity theory in taxpaying.

¹⁷ For high-income earners, this additional “hour” may translate into new discoveries or new business ventures.

¹⁸ Some differences between the two include the voluntary nature of charitable giving and the more direct impact of charitable contributions on target groups. However, these differences do not limit us from studying the pro-social motivation of the different income groups.

Using data of charitable deductions in individual income tax returns from the IRS¹⁹, we see that high- and low-income individuals (based on AGI) contribute a greater percentage of their income to charities, as shown in Figure 6.2. The same pattern is also observed in IRS data from the 1950s (refer to Figure 2.1 in Clotfelter 1985). In fact, the contributions of the wealthy were even more pronounced, with the highest-income group giving more than 12% in the 1950s–1970s and more than 10% in the 1980s.

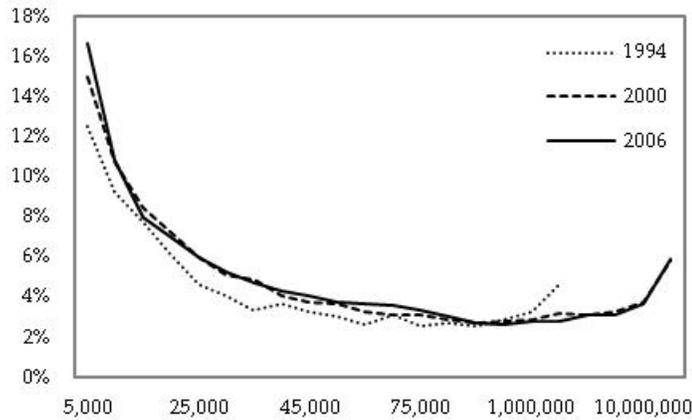


FIGURE 6.2 Charitable contributions as a percentage of income against AGI
 AGIs are not adjusted for inflation
 Breakdown of data for AGIs above \$1,000,000 is not available for 1994

Economists have investigated the causes of the inverted U-shaped relation between giving and income (e.g., McClelland and Brooks 2004) but disagreed on their findings. James and Sharpe (2007) argued that donations made by low-income individuals are mostly religious donations, but this explanation fails to explain the U-shaped relation between *nonreligious* giving and income.

¹⁹ It is acknowledged that the net-of-tax price of giving is lower for the high-income individuals due to their higher marginal tax rates, but the inverted U-shaped relationship remains after the different prices are accounted for (Brooks 2007).

The impact of various pro-social theories on tax affinity summarized in Table 3.1 may well explain the U-shaped curve of charitable giving, but testing the validity of this relationship is beyond the scope of this thesis. However, the pattern of charitable giving parallels the greater impact of tax affinity on the high- and low-income groups, confirming the robustness of our findings.

6.4.3 Evidence from Labor Supply

While the labor supply curves in Figure 6.1 are for a fixed tax rate, the greater tax affinity exhibited by the low-income and high-income groups implies that these extreme groups show the most deviation from the standard theory when tax rates are changed. This finds support in a study by Ashworth and Ulph (1981) that used data from the U.K. The results of this study are replicated in Table 6.11.

Changes	Income Quintile					Total
	1	2	3	4	5	
7% tax rise	+0.1%	-0.5%	-1.0%	-0.9%	-0.8%	-1.2%
15% tax rise	+0.3%	-1.1%	-2.3%	-2.6%	-2.1%	-2.9%

TABLE 6.11 *The effects of tax rate changes on prime age male labor supply in the U.K.*

The tax increase generally had a negative impact on labor supply during the period when the data were taken. This does not violate the prediction of the tax affinity hypothesis. As has been emphasized, the tax affinity hypothesis does not preclude the likely possibility that people would prefer increasing their own consumption than paying tax to the government ($MU_C > MU_X$). The tax increase

makes consumption lower, and although utility from tax is higher, total utility from the wage is lower, leading to cheaper leisure.

However, a more interesting finding is that the increase in tax has the most negative impact on labor supply on the middle-income workers. While the authors correctly argued that the income effect may account for the positive impact on labor supply of the low-income workers, they fail to explain the smaller impact of the tax increase on the high-income group. The tax affinity hypothesis fills this gap by suggesting that the less negative impact on both the low- and high-income workers is due to greater tax affinity exhibited by these workers.

Referring to the empirical data found in Tables 2.2 and 2.3, how do we explain the positive wage elasticity and the smaller income elasticity when taxes are accounted for? First, the smaller income elasticity implies a smaller income effect when the income tax is accounted for. If $U_{HX} = 0$, then by Proposition 5, this implies

that $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$, and by Proposition 7, the inequality implies a more

negative total effect in leisure demand of a wage change. A more negative leisure demand is equivalent to a more positive wage elasticity, which is in line with the empirical data. Thus, the tax affinity hypothesis may well explain the discrepancies found between the two types of studies. In addition, since the elasticities are based on an average worker, this also implies that an average worker earns a relatively “high” income in our current framework, as is required for the above inequality to occur.

6.4 Post-Experiment Survey

This section discusses the findings from the post-experiment survey. Because responses to the survey statements are self-reported, their usefulness is limited and these results are used only to complement the main results discussed earlier.

In the survey, the subjects were asked to indicate their agreement with each of 15 statements, with 5 being strongly agree and 1 strongly disagree. For the descriptive statistics of the responses, refer to Table 6.3. The 15 statements are:

1. I could guess the intent of this experiment
2. I varied my effort in the different rounds depending on the payoff rates
3. I enjoyed shading circles
4. I hate paying taxes
5. I was honest in the last tax return forms that I filed
[Subjects who have never filed any tax returns ($n = 15$) were asked to leave this question blank.]
6. Most people are honest in reporting their incomes
7. I am familiar with how the government spends my tax money
8. I disagree with how the government spends my tax money
9. I am familiar with the U.S. income tax system
10. The rich should be taxed more
11. The poor should be taxed less
12. The poor do not do enough to escape poverty
13. The income gap between the rich and the poor is unreasonable
14. I donate money to charities and/or volunteer
15. I enjoy seeing others happy

The first tests on the survey results examined the possibility of correlation in the responses to each pair of statements. Table 6.12 summarizes the results of this analysis. The results are not at all surprising. For example, individuals who were honest in reporting their incomes were those who believed that others are also

honest and who showed more agreement with the way the government spends the tax money. (Both provide further evidence for the reciprocity theory.) More interestingly, individuals who did not believe that the poor do not do enough to escape poverty were more likely to believe that the rich should be taxed more, the poor should be taxed less, and the income gap is unreasonable. These same people were also more likely to donate to charities and enjoy seeing others happy.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1															
2	**														
3															
4															
5	*		**												
6					*										
7			**												
8				**	*										
9	* _					*									
10						**									
11						***				***					
12		**								***	*				
13										***	***	**			
14			*							*		***	**		
15			**							**	*	***	***	***	

TABLE 6.12 Matrix of results of two-sided Pearson's correlation tests on survey responses
 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; underlined asterisks indicate negative correlations

We now focus on certain correlations that involve the responses to Statement 4, "I hate paying taxes." The responses may serve as a proxy for the subjects' tax affinity. Since the economic intuition is clear to predict the sign for each correlation, one-sided correlation tests were performed and the results are presented in Table 6.13.

Statement	6	7	8	9	10	11	12	13	14	15
Correlation	-.13	-.15	.34	-.05	-.27	-.09	.22	-.06	-.20	-.16
p-value	.23	.19	.02	.38	.06	.31	.10	.37	.13	.19

TABLE 6.13 Correlations between responses to Statement 4 and other statements

Although most of the correlations are insignificant, tax affinity is positively correlated, as predicted, with the belief that other taxpayers are honest (reciprocity theory), familiarity and agreement with how the government spends the money (reciprocity theory), the belief that the rich should be taxed more and the poor should be taxed less (inequality aversion), the belief that the poor have done enough to escape poverty (reciprocity theory), the belief that the income gap is unreasonable (inequality aversion), the likelihood to contribute to charities/volunteer (impure altruism) and the likelihood to enjoy seeing others happy (pure altruism).

By using the survey results, we can also investigate the links between subjects' responses to the survey and their behavior during the experiment. Unpaired two-sample *t*-tests were conducted to compare *ratio* values, as defined in Section 6.2.1, across subjects with different levels of agreement to the statements.

These tests produced two significant findings. First, subjects who agreed (answering 4 or 5) with Statement 9, "I am familiar with the U.S. income tax system," were significantly more likely to exhibit higher tax affinity at the 1% significance level. This is in line with the prediction made in Chapter 2 that the complexity of the tax system and unfamiliarity with the system lessen tax affinity. In addition, economics majors were less likely to exhibit tax affinity attitudes. This is in line with past research suggesting that economics students tend to be more selfish and less

cooperative (see, for example, Frank, Gilovich, and Regan 1993). The results are found in Tables 6.14 and 6.15.

	Average of difference	S.E. of difference	t-stat	p-value
Agree (4, 5) to Statement 9 vs. disagree (1, 2, 3) to Statement 9	.140	.056	2.52	.009

TABLE 6.14 Differences in ratios between subjects who agreed to Statement 9 and those who disagreed

	Average of difference	S.E. of difference	t-stat	p-value
Econ vs. non-econ majors	.118	.087	1.35	.094

TABLE 6.15 Differences in ratios between economics and non-economics majors

6.5 Results and the Tax Affinity Hypothesis

This chapter presents and discusses the results from the experiment with two aims: to investigate the tax affinity hypothesis and to investigate further the structure of this tax affinity.

The experimental data show strong support for the tax affinity hypothesis. The joint test for Proposition 1 is significant at the .1% level, while two out of the three separate tests show statistically significant support for the hypothesis. Proposition 3 also receives significant support from the data. Additional tests confirm the robustness of these results. Unpaired two-sample *t*-tests confirm the prediction that subjects who were assigned higher tax rates would exhibit greater tax affinity. The same applies to subjects who are more familiar with the income tax system and who do not major in economics.

Further analyses of the data yield deeper insights into tax affinity. The impact of tax affinity is found to be greatest for low-income and high-income individuals, as sketched in Figure 6.1. This prediction receives empirical support from labor supply and charitable contribution data. By studying the self-reported answers from the post-experiment survey, we have also looked at the various factors that may affect the degree of tax affinity. These results show that the pro-social behavior theories described in Chapter 3 provide a strong foundation for the tax affinity hypothesis.

In addition to the evidence from history, polls, and econometric studies discussed in Chapter 2, the tax affinity hypothesis also receives strong support from the laboratory. The hypothesis thus deserves further attention as it has far-reaching impacts. The next two chapters discuss these potential impacts. Chapter 7 discusses the implications of the tax affinity hypothesis in real economies and proposes several tax policy suggestions. Chapter 8 discusses the possible extensions of tax affinity in other areas of economics.

7 APPLICATIONS

This chapter explores some of the possible policy implications of the tax affinity hypothesis and proposes a number of actionable suggestions on current income tax policies to reflect a more complete understanding of the taxpayers' behavior.

We have investigated, both on empirical and theoretical grounds, the impact of a change in the wage or the tax rate on labor supply. The standard theory would consider an increase in tax to be identical to an equivalent decrease in wage (Ramsey 1927). For instance, the standard theory predicts that for a worker earning \$10 an hour, an increase in tax from 20% to 40% has the same impact as a decrease in wage from \$10 to \$7.5 an hour while maintaining the same tax rate. However, we are now aware that this should not be the case.

Under the tax affinity hypothesis, the impact of the two changes may be significantly different. In the second change, where the wage is reduced, both consumption per hour worked and tax per hour worked are reduced. If the necessary assumptions in Proposition 7 are met, then the impact of the wage change

will be less positive on leisure demand than predicted by the standard theory. If the standard theory predicts the wage change from \$10 to \$7.5 will cause the worker to decrease an hour of work per week, then the tax affinity hypothesis predicts a smaller decrease (or even an increase) in the number of hours worked per week. This is consistent with the empirical data in Tables 2.1 and 2.2. However, even under the same assumptions, according to Proposition 11, the tax affinity hypothesis cannot give any definite predictions when the tax rate is increased.

The revised understanding of the labor supply decision in the presence of the income tax is reflected in Figure 6.1. High-income and low-income individuals are predicted to exhibit a greater impact of tax affinity in their labor supply decision. Setting fairness issues aside, the tax policy that is least hurtful for the economy will then be one that taxes the high- and low-income workers more heavily *than the standard theory would suggest*.²⁰ Of course, this may not be feasible as it is highly inequitable; almost 70% of the experiment subjects believe that the poor should be taxed less, not more, and some argue that the middle-income group is in fact not taxed enough (Fox 2001), which is corroborated by survey results (e.g., Gallup poll in 2002).

²⁰ The tax affinity hypothesis only suggests that high- and low-income individuals have a less elastic labor supply than the standard theory would suggest. It does not suggest that these individuals have a less elastic labor supply than the middle class. Similarly, the suggestion here is in comparison to what the standard theory would suggest and should not be regarded as a stand-alone suggestion.

Also, note that the labor supply curves in Figure 6.1 assume a fixed tax rate. Although the slope of the tax affinity curve shows that the labor supply of the high-income individuals is less elastic to changing *wages* under tax affinity, it does not say anything about the elasticity to changing *tax rates*.

As demonstrated by the Slutsky-like equation of leisure demand for a tax change (Proposition 8), the only definite way to make the total effect of a tax change smaller under the tax affinity hypothesis is by increasing U_x . Thus, a more relevant suggestion for the public policy is to emphasize the benefits of tax for the middle-income individuals to reinforce tax affinity within this group. This includes putting more consideration on the middle class in tax policy debates, rather than merely focusing on the top marginal rate for the richest and tax credits for the least well-off.

There is a general need for public policy to leverage citizens' tax affinity to reduce any distortions caused by taxes, while at the same time maintaining the size of the government. Both objectives can be achieved by increasing the transparency of government spending and emphasizing visible taxes. Experimental and econometric studies have shown that individuals evade fewer taxes if they have the opportunity to vote on tax measures (e.g., Pommerehne and Weck-Hannemann 1996; Alm, McClelland, and Schulze 1999; Torgler, Schaltegger and Schaffner 2003), indicating that citizens' political participation may increase tax affinity, while ensuring the accountability of the government. However, polls have shown that there is much work to be done in this area. The 1999 America Unplugged survey found that 67 percent of respondents felt that "government generally pursues its own agenda" and 64 percent felt "distant and disconnected from government" (cited in Bostrom 2005).

The tax affinity hypothesis underscores the need for a fairer tax system. Research has shown that people may be motivated to work hard to report accurately and pay what they owe if they believe that the laws and their application are fair in terms of

the distribution of tax payments, the ways taxes are spent, and the process of tax reporting and paying (see Carroll 1992; Kinder and Sears 1985; Tyler 1990). Achieving a completely fair tax system is difficult, if not impossible, since different taxpayers have differing opinions about what is considered fair (Davies 1986; Slemrod and Bakija 2000). However, simple gestures such as paying interest to taxpayers who overwithhold may encourage a sense of fairness and trust in the government's intentions (Carroll 1992), and ultimately increase tax affinity through reciprocity.

Referring to the concerns about the income tax system described in Chapter 2, the tax affinity hypothesis adds weight to the case for a reform that simplifies the tax code and increases the transparency of the system. This is supported by the analysis of responses to the post-survey experiment. Concerns about the income tax, such as its complexity and the difficulty of enforcement, can be resolved by implementing more systematic tax policies with a minimum of loopholes, exemptions, and other preferences. This may be taken to the extreme as proposed in Hall and Rabushka's (1995) Flat Tax and Feige's (2000) Automated Payment Transaction proposals.

In addition, since individuals exhibit greater tax affinity than firms as suggested by findings from TRA 1986, it may be necessary to reduce hidden taxes, primarily the corporate income tax. After all, higher corporate tax payments are passed on to individuals either in the form of lower wages, lower returns to investment, or higher consumer prices (Slemrod and Bakija 2000), although the exact incidence of the corporate tax must be further studied to resolve the issue of fairness. This suggestion

is contrary to that proposed in previous behavioral public finance research, which relied on heuristics and biases in tax (e.g., McCaffery and Baron 2004).

However, small reform efforts may be all that is needed. For instance, by removing deductions for charitable contributions, the government sends a powerful signal to taxpayers that paying the income tax is a charitable act and that the government is an effective agent in allocating public resources. There is evidence that tax has been used as a substitute for charity (e.g., Eckel, Grossman, and Johnston 2004; Djanali and Wang 2008) and Brooks (2007) finds that “people who believe it is the government’s job to make incomes more equal are far less likely to give their money away [to charities]” indicating that people treat tax and charities as substitutes. The government needs to emphasize its roles in reallocating the tax money and further encourage taxpayers to treat the income tax as a contribution to the society. Eliminating deductions for charitable contributions and similar deductions also has the benefits of simplifying the tax codes and encouraging fairness (Slemrod and Bakija 2000). After all, only an estimated 10% of all charitable deductions are directed at the poor (Reich 2007).

The IRS and the government also need to improve the citizens’ taxpaying experience to help maximize the procedural utility received by taxpayers (refer to Benz 2007). There is evidence suggesting that individuals care about how they are treated by tax authorities and that there is less evasion and avoidance when tax collectors deal with citizens respectfully (Feld and Frey 2002; Frey and Feld 2002). Unfortunately, the IRS is still viewed unfavorably by the public; in fact, the IRS was

the only government agency that was voted “unfavorable” or “highly unfavorable” by more than half of the respondents in the Roper Gfk-NOP poll in 2001 (cited in Bowman 2008). The 2000 Fox News/Opinion Dynamics poll even went further by reporting that the majority of the respondents preferred a root canal over an IRS audit (cited in Bowman 2008). To improve the taxpaying experience, reallocation of budget from tax compliance to bettering IRS’ customer service may be useful.

The final two suggestions are somewhat more radical but deserve further attention in light of the tax affinity hypothesis. The first is derived from the income tax system in Europe. Amy (2007) argued that, despite the high tax rates, Europeans have a much more positive view of taxes than Americans because the connection between taxes and public programs in Europe is much clearer. The typical European gets universal health care, free university education, paid maternity and paternity leaves, clean and efficient public transportation, and retirement security for their taxes. Amy hypothesized that if the U.S. income tax were made significantly higher, then the social and economic benefits of the tax would be more noticeable and Americans would see the connections between taxes and government benefits more clearly. Of course, one important concern is that many people prefer smaller government with smaller taxes. The 2006 Fox News/Opinion Dynamics poll found that 52 percent favored “a smaller government with fewer services,” while only 34 percent favored “a larger government with many services” (cited in Bowman 2008). Increasing the income tax significantly without considering the opinions of these people may result in undesirable consequences.

The final suggestion proposes making the income tax more “voluntary.” A striking difference between taxes and typical charitable contributions is that taxes are imposed by laws. While many people understand the benefits that tax money brings to the society, being forced to pay these taxes may reduce significantly any utility they receive from taxpaying. One could argue that the warm glow utility obtained from donating to charities arises because it feels good to *voluntarily* share with others. As an analogy, most, if not all, individuals are reluctant to get robbed even by a needy person, although the same individuals donate regularly to the poor and other charities. Radical ideas of making taxes voluntary or allowing people to give donations to the government have been suggested²¹, but a simple gesture such as reducing audits may go a long way in making taxes more “voluntary” and hence more desirable.

²¹ Former Arkansas Governor Mike Huckabee set up a “Tax Me More Fund,” a voluntary fund for people who felt that they were not taxed enough. At last report, the fund had raised \$1,900 and “a coupon to an exercise center.” The limited success was most likely due to the political allusion of the fund. However, a serious donor wrote, “As I approach retirement age, being part of a caring society is important to me.”

8 EXTENSIONS

The tax affinity model can potentially be extended into areas as diverse as homeownership and personal savings to investigate how tax affinity impacts home purchasing and intertemporal consumption decisions. In this chapter, we will focus on two areas, tax compliance and female labor force participation, to study how the tax affinity hypothesis impacts the analyses in these areas.

8.1 Income Tax Evasion

Tax compliance issues are widespread and are of general interest (e.g., Papp and Takáts 2008). The IRS (2006) estimated the federal tax gap, the difference between the amount of tax that taxpayers should pay and the amount that is paid voluntarily and on time, to reach US\$345 billion or 16.3% of total revenues in 2001. In light of this reality, a vast literature has been dedicated to the study of tax evasion. After Allingham and Sandmo (1972) presented the first theoretical analysis of income tax evasion in their seminal paper, numerous changes to their model have been

suggested. In this section, we will introduce tax affinity into the model and study its impact on tax evasion. We will first review Allingham and Sandmo's (A-S) model and then highlight changes to the model when tax affinity is considered.

8.1.1 Allingham-Sandmo Model

Consider an individual with actual income I^A that is exogenously given and is known by the taxpayer but not by the government's tax collector. Tax is levied at a constant rate, θ , on declared income, I^D , which is the taxpayer's decision variable. However, with some probability p the taxpayer will be subjected to investigation by the tax authorities, who will then get to know the exact amount of her actual income. If this happens, the taxpayer will have to pay tax on the undeclared amount, $I^A - I^D$, at a penalty rate π which is higher than θ . We assume conformity of the risk-averse taxpayer's behavior to the Von Neumann-Morgenstern axioms for behavior under uncertainty.

A-S solved the expected utility maximization problem below.²²

$$\text{Max}_{I^D} E[U] = (1-p)U(I^A - \theta I^D) + pU(I^A - \theta I^D - \pi(I^A - I^D))$$

The comparative static results derived provide unambiguous results for the two parameters of the model: an increase in the penalty rate and in the probability of detection both increase the actual income declared. However, the model does not predict any clear-cut impact of changes in actual income or the tax rate.

²² The notation has been changed to be consistent with the rest of this thesis.

8.1.2 Tax Affinity Model

Under tax affinity, each taxpayer now derives utility from the tax paid and thus takes this utility into consideration when making the tax compliance decision. The utility maximization problem becomes:

$$\text{Max}_{I^D} E[U] = (1-p)U(I^A - \theta I^D, \theta I^D) + pU(I^A - \theta I^D - \pi(I^A - I^D), \theta I^D)$$

where each utility function consists of not only consumption, but also tax. For simplicity, we assume that the taxpayer only derives utility from the tax that she voluntarily pays and that she does not derive any utility from the penalty that she has to pay if she is caught cheating.²³ However, the results that follow still hold even without this assumption.

We obtain first-order and second-order conditions respectively:

$$\begin{aligned} \frac{\partial E[U]}{\partial I^D} &= -\theta(1-p)U_c(Y) + \theta(1-p)U_x(Y) - (\theta - \pi)pU_c(Z) + \theta pU_x(Z) = 0 \\ D' &= \frac{\partial^2 E[U]}{\partial I^{D^2}} = \theta^2(1-p)U_{cc}(Y) - 2\theta^2(1-p)U_{cx}(Y) + \theta^2(1-p)U_{xx}(Y) \\ &\quad + (\theta - \pi)^2 pU_{cc}(Z) - 2\theta(\theta - \pi)pU_{cx}(Z) + \theta^2 pU_{xx}(Z) < 0 \end{aligned}$$

where for notational convenience we define:

$$\begin{aligned} Y &= (I^A - \theta I^D, I^D) \\ Z &= (I^A - \theta I^D - \pi(I^A - I^D), \theta I^D) \end{aligned}$$

The result from the A-S model that guarantees an interior solution also applies to this alternative model.

²³ This assumption is made to avoid the perverse result that people might underreport their income in the hopes that they get caught and have to pay more in taxes.

By invoking the Implicit Function Theorem on the first-order condition and differentiating it with respect to the different variables, we can find comparative statics of interest and compare them to those obtained from the A-S model.

First, we will study the comparative static $\partial(I^D/I^A)/\partial I^A$, i.e. how the fraction of the actual income declared varies as actual income changes. Under the tax affinity hypothesis, this comparative static can be evaluated to be:

$$\begin{aligned} \frac{\partial(I^D/I^A)}{\partial I^A} &= \frac{1}{I^{A^2}} \left(\frac{\partial I^D}{\partial I^A} I^A - I^D \right) \\ &= \frac{1}{W^2} \frac{1}{D'} \left[\begin{array}{l} \theta(1-p)I^A U_{CC}(Y) - (\theta-\pi)(1-\pi)pI^A U_{CC}(Z) - \theta^2(1-p)I^D U_{CC}(Y) \\ -(\theta-\pi)^2 pI^D U_{CC}(Z) - \theta(1-p)I^A U_{CT}(Y) - (1-\pi)\theta pI^A U_{CT}(Z) \\ +2\theta^2(1-p)I^D U_{CT}(Y) - \theta^2(1-p)I^D U_{TT}(Y) + 2\theta(\theta-\pi)pI^D U_{CT}(Z) \\ -\theta^2 pI^D U_{TT}(Z) \end{array} \right] \end{aligned}$$

Letting D be the second-order condition of the utility maximization problem in the A-S model, the same comparative static in the A-S model:²⁴

$$\frac{\partial(I^D/I^A)}{\partial I^A} = \frac{1}{W^2} \frac{1}{D} \left[\begin{array}{l} \theta(1-p)I^A U_{CC}(Y) - (\theta-\pi)(1-\pi)pI^A U_{CC}(Z) \\ -\theta^2(1-p)I^D U_{CC}(Y) - (\theta-\pi)^2 pI^D U_{CC}(Z) \end{array} \right]$$

The signs of the derivatives in both the A-S and the tax affinity models are ambiguous. The result in the A-S model can be simplified by substituting the first-order condition and expressed in terms of relative risk aversion. However, we cannot apply the same simplification to the tax affinity model because of the additional terms, including the mixed partials. This should not be too surprising. While the A-S model is a mere lottery of two outcomes of consumption, the tax

²⁴ All notation from the A-S model has been changed slightly to follow that under tax affinity.

affinity model is much more complex because now the individual also derives utility from the very tax that the individual wants to evade.

Second, we will study the comparative static $\partial I^D/\partial \theta$, i.e. how the income declared varies as the interest rate changes. Under tax affinity, this comparative static is:

$$\frac{\partial I^D}{\partial \theta} = \frac{1}{D'} \left[(1-p)U_c(Y) + pU_c(Z) - (1-p)U_x(Y) - pU_x(Z) \right] - \frac{I^D}{D'} \left[\theta(1-p)U_{cc}(Y) - 2\theta(1-p)U_{cx}(Y) + \theta(1-p)U_{xx}(Y) \right] + (\theta - \pi)pU_{cc}(Z) - (2\theta - \pi)pU_{cx}(Z) + \theta pU_{xx}(Z)$$

In the A-S model, this comparative static is:

$$\frac{\partial I^D}{\partial \theta} = \frac{1}{D} \left[(1-p)U_c(Y) + pU_c(Z) \right] - \frac{I^D}{D} \left[\theta(1-p)U_{cc}(Y) + (\theta - \pi)pU_{cc}(Z) \right]$$

We cannot sign the comparative statics, but in both models, we can regard the two terms as the substitution effect and income effect respectively. In the A-S model, which reflects the standard theory, the substitution effect is unambiguously negative because an increase in the tax rate makes it more profitable to evade taxes on the margin. Under the tax affinity hypothesis, the sign of the substitution effect is less negative because the individual also derives marginal utility from tax. Thus, evasion of the income tax on the margin brings in more utility for the individual from higher consumption but also less utility from lower tax paid. The sign of the income effect in the A-S model is ambiguous and the additional utility terms involving tax under tax affinity do not change this ambiguity.

Third, we will compare the comparative static $\partial I^D / \partial \pi$, i.e. how the income declared varies as the penalty rate changes. Under the tax affinity hypothesis, this comparative static is:

$$\frac{\partial I^D}{\partial \pi} = \frac{1}{D'} \left[-pU_c(Z) - (\theta - \pi)(I^A - I^D)pU_{cc}(Z) + \theta(I^A - I^D)pU_{cx}(Z) \right]$$

In the A-S model, this comparative static is evaluated to be:

$$\frac{\partial I^D}{\partial \pi} = \frac{1}{D} \left[-pU_c(Z) - (\theta - \pi)(I^A - I^D)pU_{cc}(Z) \right]$$

In both models, the positive comparative statics imply that an increase in the penalty rate will always increase the amount of income declared. If we assume that $D' \leq D$, the comparative static is less positive under tax affinity, implying that the deterrent effect of the penalty rate is smaller under tax affinity.

Finally, we will compare the comparative static $\partial I^D / \partial p$, i.e. how the income declared varies as the probability of fraud detection changes. Under the tax affinity hypothesis, this comparative static is:

$$\frac{\partial I^D}{\partial p} = \frac{1}{D'} \left[-\theta U_c(Y) + (\theta - \pi)U_c(Z) + \theta U_x(Y) - \theta U_x(Z) \right]$$

In the A-S model, this comparative static is evaluated to be:

$$\frac{\partial I^D}{\partial \pi} = \frac{1}{D} \left[-\theta U_c(Y) + (\theta - \pi)U_c(Z) \right]$$

Again, in both models, the comparative statics are positive, implying that an increase in the probability of detection will always increase the amount of income declared. If we assume that $D' \leq D$, the comparative static is less positive under tax affinity

because $U_{CX} > 0$ and thus $U_X(Y) > U_X(Z)$. This implies that the deterrent effect of a higher detection probability is smaller under tax affinity.

8.1.3 Assumption and Policy Implications

If $D' \leq D$, it has been found that the deterrent effect of a higher penalty rate and a higher detection probability is smaller under tax affinity. If $D' > D$, the difference between the A-S model and the tax affinity model becomes unclear.

We will study $D' - D$ to investigate the likelihood of the assumption.

$$\begin{aligned}
 D' - D &= -2\theta^2(1-p)U_{CX}(Y) - 2\theta(\theta - \pi)pU_{CX}(Z) + \theta^2(1-p)U_{XX}(Y) + \theta^2pU_{XX}(Z) \\
 &= -2\theta^2U_{CX}(Y) + 2\theta^2pU_{CX}(Y) - 2\theta^2pU_{CX}(Z) + 2\theta\pi pU_{CX}(Z) \\
 &\quad + \theta^2(1-p)U_{XX}(Y) + \theta^2pU_{XX}(Z) \\
 &= -2\theta^2U_{CX}(Y) + 2\theta^2p[U_{CX}(Y) - U_{CX}(Z)] + \theta^2(1-p)U_{XX}(Y) + \theta^2pU_{XX}(Z) \\
 &\quad + 2\theta\pi pU_{CX}(Z)
 \end{aligned}$$

All terms in the above are negative, except $2\theta\pi pU_{CX}(Z)$. Since this term is the only term that contains π , we may infer that for a sufficiently low π , the initial assumption $D' \leq D$ is justified and the previous findings about the deterrent effects are applicable.

The lower deterrent effects of tax compliance parameters under the tax affinity hypothesis suggests that there is less need for fraudulent detection and other costly compliance measures than suggested by the standard theory. The budget can then be reallocated to implementing the right reform and ensuring better taxpaying experience to enhance tax affinity. Keeping in mind that the assumptions are

debatable and that the A-S model itself is a simplified model of the tax evasion decision, the findings here are preliminary and further work is needed.

8.2 Female Labor Force Participation

There is a wide literature on women's participation in the workforce. The models used are similar to those used to study labor supply of prime age males, but the focus is on labor force participation rather than hours of work. The basic model in understanding female labor force participation is based on the reservation wage theory. In the simplest form of job-search model proposed by McCall (1970) and Mortensen (1970), an individual accepts an employment offer only if it exceeds her reservation wage.

Burtless and Hausman (1978) and Hausman (1980), however, argued that the reservation wage theory is incomplete as it fails to account for the presence of fixed costs and other nonconvexities. Therefore, we will study the model described in these studies, here referred to as the Hausman model, and consider how tax affinity impacts the model's predictions.

8.2.1 Hausman Model

Burtless-Hausman and Hausman argued that fixed costs and other nonconvexities in the budget set may lead to a non-unique reservation wage. The labor force participation model is therefore extended to consider wage and hour combinations rather than wages alone. The complete budget set must be considered and the

reservation wage theory is replaced by a utility comparison theory. The basic issue is that the essentially local reservation wage theory, which only considers what happens in the neighborhood of zero hours, is insufficient in the presence of fixed costs and other nonconvexities.

We will work with two-good diagrams of hours supplied and consumption. The slope of the budget set is the normalized wage $w = \tilde{w}/p$ and the intercept is $y = \tilde{y}/p$ where \tilde{w} and \tilde{y} are the after-tax market wage and nonlabor income with the price p of the composite consumption good as the numeraire. Note that in the Hausman model, the standard theory of zero utility from tax is assumed.

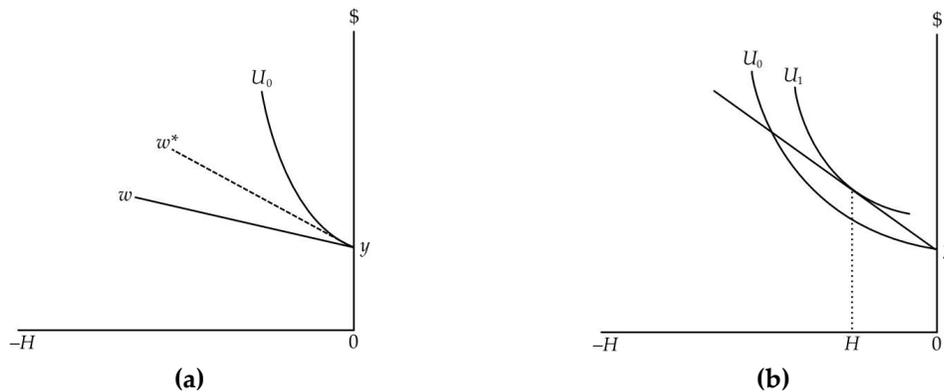


FIGURE 8.1 Work hours and consumption with a convex budget set

In Figure 8.1(a), the indifference curve through zero hours corresponds to a utility maximum with net market wage w . As the market wage rises, there exists a net wage w^* where the budget line is tangent to the indifference curve at zero hours. The net market wage w^* corresponds to the reservation wage because for any $w' \geq w^*$, desired hours of work H' that maximizes utility will exceed zero hours. This is in line with the reservation wage theory.

In Figure 8.1(b), as the market wage rises beyond w^* , zero hours can no longer correspond to a utility maximum. A higher indifference curve U_1 will be tangent to the budget line. Preferred hours of work $H > 0$ are then determined by the tangency of U_1 and the budget line. This is an application of utility comparison theory, where the maximum utility U_1 is compared to utility at zero hours of work U_0 .

Now we consider the case where the budget set is nonconvex. A negative income tax or the Aid to Families with Dependent Children (AFDC) program creates a nonconvex two-segment budget set. These policies cause the effective tax rate to be higher when the work hours are lower. For a more complete discussion of the impact of these policies on the budget set, refer to Hausman (1980).

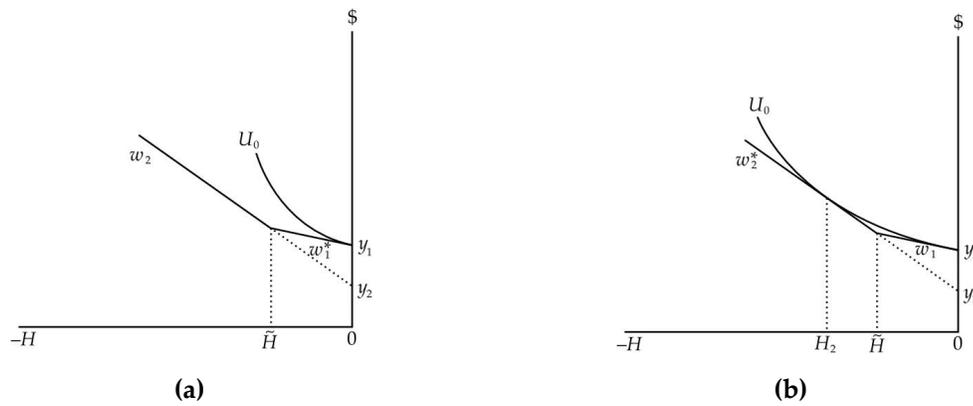


FIGURE 8.2 Work hours and consumption with a nonconvex budget set

The nonconvex budget set is shown in Figure 8.2(a). Similar to before, as the market wage rises, the net wage on the first segment w_1 increases until tangency with the indifference curve U_0 is achieved for some w_1^* . Then for all net wages $w_1' \geq w_1^*$, the individual will choose to participate in the labor market.

However, the essentially local theory of the reservation wage can lead to an error as Figure 8.2(b) demonstrates. As the market wage rises, the initial tangency with the indifference curve through zero hours occurs on the second segment of the budget set at H_2 hours. Thus, there may exist a lower market wage than the one corresponding to w_1^* that will induce labor force participation. This net wage w_2^* arises from the nonconvexity of the problem. However, the individual may receive the net wage w_2 only if she works greater than breakeven hours \tilde{H} . Thus, the net wage and hours worked must be considered jointly.

8.2.2 Tax Affinity Model

The use of graphical representation under the tax affinity hypothesis is tricky because the individual receives utility from three goods: leisure, consumption, and tax. A logical way of extending the Hausman model is by adding a third axis representing the utility of tax, as in Section 4.2, but it will be hard to perform a direct comparison between the tax affinity model and the Hausman model.

A better method is to build in the utility from the income tax into the previous two-dimensional model. This is possible because the amount of tax paid is dependent on the leisure hours. The smaller the leisure hours, the greater the income earned and tax paid. For every coordinate in the two-dimensional space, we can find the utility derived from all three goods.

Figure 8.3 demonstrates the two-dimensional representation of the tax affinity model, where U_0^X represents an indifference curve under tax affinity. Since the

individual derives utility from tax, the amount of consumption needed to achieve the same utility as the zero-leisure utility is less under tax affinity. The MRS is lower under the tax affinity hypothesis than under the standard theory everywhere, including at zero leisure. The indifference curve through this point will then be tangent to a budget constraint with a lower wage under tax affinity.

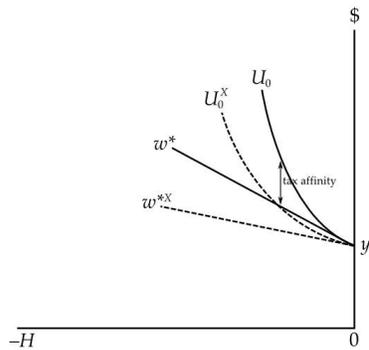


FIGURE 8.3 *A convex budget set under tax affinity*

The reservation wage when the budget set is convex is thus lower under the tax affinity hypothesis. This is in line with the economic intuition that because a prospective worker will derive utility not only from consumption but also from the income tax paid, she will be willing to work at a lower wage than the standard theory predicts.

The same analysis applies to the nonconvex case, although now both “reservation wages”²⁵ must be considered. The same analysis above implies that the first reservation wage must be lower under tax affinity. The second reservation wage is the wage when the indifference curve tangent to the second segment of the budget

²⁵ The term “reservation wage” is borrowed from the reservation wage theory for the convex budget set, keeping in mind that the interpretation is slightly different.

constraint passes through the zero leisure point y_1 . For the same w_1 , it is clear that the second reservation wage is also lower under tax affinity as demonstrated in Figure 8.4.

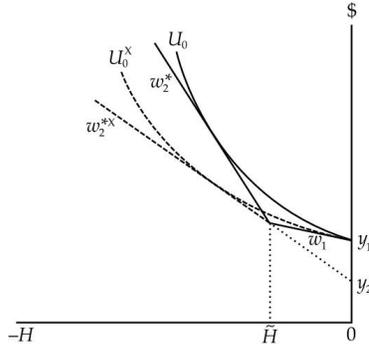


FIGURE 8.4 A nonconvex budget set under tax affinity with fixed w_1

However, for prospective female workers who consider working at marginally acceptable wages, the w_1 will be lower under the tax affinity hypothesis. In this case, the effect of tax affinity on the second “reservation wage” is ambiguous. The two possibilities are illustrated in Figures 8.5(a) and (b).

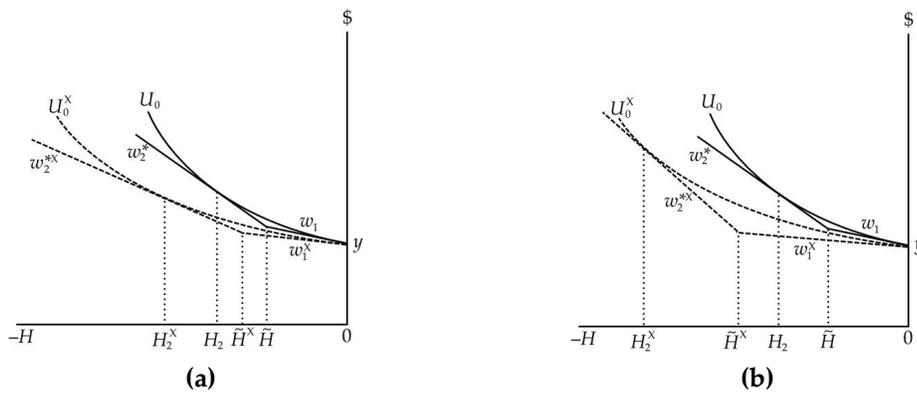


FIGURE 8.5 A nonconvex budget set under tax affinity with lower w_1

Because the first “reservation wage” is lower under the tax affinity hypothesis, the breakeven hours, \tilde{H}^x , are higher. In Figure 8.5(a), the increase in breakeven

hours is not considerable that the slope of w_2^X is still lower than w_2 , implying that the second “reservation wage” is also lower under tax affinity. In Figure 8.5(b), the increase in breakeven hours is much more pronounced such that the slope of w_2^X is now higher than w_2 , implying a higher second “reservation wage.”

8.2.3 Policy Implications

The tax affinity model suggests that the reservation wage for labor force participation is lower than that predicted by the standard theory when the budget set is convex. With a nonconvex budget set, the first “reservation wage” is always lower, but when a female worker intends to work beyond the breakeven hours, the second “reservation wage” may be higher under the tax affinity hypothesis.

If the objective of the policy is to encourage female labor force participation, then the impact of tax affinity can be intensified through appropriate tax reforms and improvement of taxpaying experience. In addition, the use of tax money for public programs that target women, such as subsidized childcare and female-oriented programming on public television, sends a positive signal and will be reciprocated by prospective female workers. Alternatively, as the analysis suggests, lowering the breakeven point in the case of a nonconvex budget set also lowers the second “reservation wage,” although this is not always feasible depending on the policy design.

9 CONCLUSION

This thesis attempted to answer two main questions: do people derive utility from paying tax and if so, what is the impact of this tax affinity?

Evidence for the tax affinity hypothesis was presented based on history, surveys, field data, and experimental data. Americans' support of the income tax has always been correlated with their support for the government. The high tax rates during World War II were accepted by virtually all citizens regardless of their income level, occupations, and political affiliations. Respondents to polls also indicated their support for the tax system and willingness to pay taxes accordingly. Empirically, the tax affinity hypothesis may explain the differences in the labor elasticities of prime age males when the income tax is accounted for. Studies on the Tax Reform Act of 1986 also found negligible impact of the reform on individual decisions, such as homeownership and personal savings, but more significant impact on corporate decisions. These inconsistencies are found to be in line with the prediction of the tax affinity hypothesis.

The data from the controlled experiment also show significant support for the hypothesis, as can be seen by the statistically significant evidence for both testable propositions, Propositions 1 and 3. As predicted, tax affinity was exhibited more greatly when tax rates were higher. In addition, the suggested income and substitution effects of a wage change under the main assumptions $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$ are reaffirmed by empirical data. Finally, while only based on self-reported survey answers, there is some evidence for the reasons for tax affinity. This confirms the role of the four main theories discussed, pure altruism, inequality aversion, reciprocity, and self-identity theories, on the tax affinity hypothesis.

A major part of the thesis studied the impact of the tax affinity hypothesis. It is found that the difference in the income effects of a wage change between the tax affinity hypothesis and the standard theory gets smaller as income increases, while the difference in the substitution effects gets larger. Adding these two effects together, the total effect of a wage change becomes more negative under the tax affinity hypothesis as income increases. At a certain point, the main assumptions of $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$ become valid and the total effect under the hypothesis is more negative than that under the standard theory.

The experimental results also suggest that the impact of tax affinity is greatest for the high- and low-income population, which is reaffirmed by empirical evidence from labor supply and charitable contributions. This leads to preliminary suggestions for tax policies, including a reconsideration of the income tax

progressivity and an emphasis on the middle-income population in tax policy debates. The tax affinity hypothesis also emphasizes the need for an effective tax reform that treats the concerns of complexity, difficulty of enforcement, unfairness, and adverse economic impact. A simpler tax system may increase the taxpayers' tax affinity. By eliminating tax deductions for charitable contributions, the government also sends the signal that tax and charity may be regarded as substitutes. Other suggestions for the tax policy include emphasizing visible taxes, raising taxes to magnify the social benefits of tax, and improving the IRS customer service.

The tax affinity model can be extended to other economic models. In this thesis, the tax affinity hypothesis is applied to income tax evasion and female labor force participation models. The tax affinity hypothesis predicts that tax evasion decision does not only depend on the risk aversion. It suggests a smaller substitution effect on tax evasion of a higher tax rate and a smaller deterrent effect of a higher penalty rate or a higher detection probability than predicted by the standard model. The tax affinity hypothesis also predicts a lower reservation wage for female labor force participation, although the difference of the second "reservation wage" for the case of the nonconvex budget set between the tax affinity and the standard models is ambiguous.

There are several directions that future work on the hypothesis might take. First, the findings in this thesis need to be confirmed with more empirical data, not only from prime age males, but also other groups of current and prospective workers. More experiments may need to be conducted to study the income and substitution

effects at various levels of income. More complexities of real economies may be incorporated in future experiments, such as by introducing team work or progressive taxes. Theoretical and experimental approaches are also needed to further study the effect of a change in the tax rate when the wage rate is kept constant, which has been shown in this thesis to have an ambiguous sign. Finally, unorthodox tax systems such as voluntary taxes may be tested in the laboratory to further investigate tax affinity and yield results useful for public policy.

Bringing the results from this thesis and future work to the policy field requires additional care. There are a number of assumptions, both implicitly and explicitly stated in this thesis and virtually all studies on labor supply, which may not hold in the actual economy. It is generally assumed that workers have the flexibility to pick the amount of labor supply desired, but in reality they are often constrained by the job contracts and personal circumstances. Empirical studies of regulatory systems have observed pro-social tendencies in the interactions between individuals and the public policy (e.g., Bardach and Kagan 1982; Braithwaite 1985). However, public attitudes toward tax vary across time, regions, and countries, and this may impact taxpayers' pro-social interpretation of the tax system accordingly. A careful study of the demographics and public opinion needs to be conducted before changes suggested by the tax affinity hypothesis are implemented.

While economists have implicitly assumed that individuals derive zero utility from income taxes in labor-leisure allocation models, the tax affinity hypothesis suggests otherwise. Evidence for the tax affinity hypothesis suggests a need to

consider the utility from tax in future economic and policy analyses. If it is useful to assume zero tax utility to simplify an economic model, then it may be necessary to explicitly state such an assumption.

This thesis also contributes to the study of resource allocation by solving a unique utility maximization problem. While the problem involves three goods (consumption, leisure, and tax), leisure is the only choice variable, and the amount of tax paid and the maximum amount of consumption allowed depend on it. The analyses used in solving this problem and the derivation of the Slutsky-like equations may be applied to similar problems. A consumer's decision problem facing bundled products common in marketing techniques, such as free gifts with purchase, may be solved using the techniques suggested in this thesis.

We have investigated the reasons and evidence for the tax affinity hypothesis and studied its impact, applications, and extensions. While more work needs to be done on the hypothesis, we have at least come to an answer to the question that the thesis title asks: do we really hate paying taxes?

Apparently not.

A PROOFS

This section provides mathematical proofs of all propositions in Chapter 4 as well as Lemmas 2 and 3.

PROPOSITION 1

An individual produces more labor under the tax affinity hypothesis than under the standard theory.

Proof

Consider the individual's utility maximization problem with the constraints built in such that there is only one choice variable, H .

$$\text{Max}_H U = U(C(H), H, X(H)) = U\left((1-t)\bar{M} + w(1-t)(\bar{T} - H), H, t\bar{M} + wt(\bar{T} - H)\right)$$

where H = leisure, C = consumption, X = tax, w = wage rate, \bar{M} = taxable nonlabor income, and \bar{T} = time endowment.

$$\frac{\partial U}{\partial H} = U_C(-w(1-t)) + U_H + U_X(-wt) = 0$$

$$\Rightarrow U_H = w(1-t)U_C + wtU_X$$

The individual produces labor up to the point where the marginal benefits obtained from an additional hour of working, which comprise utility from consumption and utility from tax, equal the marginal cost of giving up an additional hour of leisure.

The existence and uniqueness of such a point is guaranteed by Lemma 1.

Under the standard theory, $U_X = 0$, and thus the equation above is reduced to

$$w(1-t)U_C = U_H.$$

Therefore, U_H is smaller and thus, the value of H that satisfies this equality under the standard theory is higher than that under the tax affinity hypothesis.

An individual therefore enjoys less leisure and produces more labor under the tax affinity hypothesis. ■

PROPOSITION 2

The Slutsky-like equation of leisure demand for a wage change under the tax affinity hypothesis is:

$$\frac{\partial H^*}{\partial w} = \frac{1}{D'}[(1-t)U_C + tU_X] + \frac{1}{D'}\left[w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX}\right](\bar{T} - H^*)$$

where $D' = w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2 U_{XX} < 0$

The equation of leisure demand for a wage change under the standard theory is:

$$\frac{\partial H^*}{\partial w} = \frac{1}{D}[(1-t)U_C] + \frac{1}{D}\left[w(1-t)^2 U_{CC} - (1-t)U_{CH}\right](\bar{T} - H^*)$$

where $D = w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} < 0$

In both equations, the first term is the substitution effect and the second term is the income effect of a change in w .

Proof

We will derive the Slutsky-like equations under the tax affinity hypothesis.

From the proof of Proposition 1, we obtain:

$$-w(1-t)U_C + U_H - wtU_X = 0$$

$$\Rightarrow -(w-wt)U_C\left((1-t)\bar{M} + (w-wt)(\bar{T} - H^*), H^*, t\bar{M} + wt(\bar{T} - H^*)\right) + U_H\left((1-t)\bar{M} + (w-wt)(\bar{T} - H^*), H^*, t\bar{M} + wt(\bar{T} - H^*)\right) - wtU_X\left((1-t)\bar{M} + (w-wt)(\bar{T} - H^*), H^*, t\bar{M} + wt(\bar{T} - H^*)\right) = 0$$

$$\frac{\partial^2 U}{\partial H^2} < 0 \Rightarrow \begin{bmatrix} -(w-wt) & 1 & -wt \end{bmatrix} \begin{bmatrix} U_{CC} & U_{CH} & U_{CX} \\ U_{CH} & U_{HH} & U_{HX} \\ U_{CX} & U_{HX} & U_{XX} \end{bmatrix} \begin{bmatrix} -(w-wt) \\ 1 \\ -wt \end{bmatrix} < 0$$

We can apply the Implicit Function Theorem.

There exists a unique implicit function $H^* = H(w)$ such that:

$$-(w-wt)U_C\left((1-t)\bar{M}+(w-wt)(\bar{T}-H(w)),H(w),t\bar{M}+wt(\bar{T}-H(w))\right)+U_H\left((1-t)\bar{M}+(w-wt)(\bar{T}-H(w)),H(w),t\bar{M}+wt(\bar{T}-H(w))\right) \\ -wtU_X\left((1-t)\bar{M}+(w-wt)(\bar{T}-H(w)),H(w),t\bar{M}+wt(\bar{T}-H(w))\right)\equiv 0$$

for some neighborhood of w_0 .

We then take the total derivative of the above identity with respect to w .

$$-(1-t)U_C-(w-wt)\left(U_{CC}\left((1-t)(\bar{T}-H^*)-(w-wt)\frac{\partial H^*}{\partial w}\right)+U_{CH}\frac{\partial H^*}{\partial w}+U_{CX}\left(t(\bar{T}-H^*)-wt\frac{\partial H^*}{\partial w}\right)\right) \\ +U_{CH}\left((1-t)(\bar{T}-H^*)-(w-wt)\frac{\partial H^*}{\partial w}\right)+U_{HH}\frac{\partial H^*}{\partial w}+U_{HX}\left(t(\bar{T}-H^*)-wt\frac{\partial H^*}{\partial w}\right) \\ -tU_X-wt\left(U_{CX}\left((1-t)(\bar{T}-H^*)-(w-wt)\frac{\partial H^*}{\partial w}\right)+U_{HX}\frac{\partial H^*}{\partial w}+U_{XX}\left(t(\bar{T}-H^*)-wt\frac{\partial H^*}{\partial w}\right)\right)=0$$

Grouping the terms, we have:

$$\frac{\partial H^*}{\partial w} = \frac{(1-t)U_C + tU_X + \left(w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX}\right)(\bar{T}-H^*)}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX}}$$

Under the standard theory, $U_X = U_{CX} = U_{HX} = U_{XX} = 0$, and thus the formula above is reduced to:

$$\frac{\partial H^*}{\partial w} = \frac{(1-t)U_C + \left(w(1-t)^2 U_{CC} - (1-t)U_{CH}\right)(\bar{T}-H^*)}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}}$$

We have thus derived the Slutsky-like equation.

Next, we solve the dual problem of expenditure minimization to achieve a fixed level of utility, \bar{U} , to isolate the substitution effect under the tax affinity hypothesis.

$$\text{Min } \mathcal{L} = \frac{C}{w(1-t)} + H + \frac{X(C)}{wt} + \lambda(\bar{U} - U(C, H, X(C)))$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = \bar{U} - U(C, H, X(C)) = 0 \Rightarrow U(C, H, X(C)) = \bar{U}$$

$$\frac{\partial \mathcal{L}}{\partial C} = \frac{1}{w(1-t)} - \lambda^* U_C(C^*, H^*, X^*) - \frac{t}{1-t} \lambda^* U_X(C^*, H^*, X^*) = 0 \Rightarrow \lambda^* = \frac{1}{w(1-t) \left(U_C + \frac{t}{1-t} U_X \right)}$$

$$\frac{\partial \mathcal{L}}{\partial H} = 1 - \lambda^* U_H(C^*, H^*, X^*) = 0 \Rightarrow \lambda^* = \frac{1}{U_H}$$

We can apply the Implicit Function Theorem.

There exist unique implicit functions $\lambda^* = \lambda(w)$, $C^* = C(w)$, $H^* = H(w)$, $X^* = X(w)$ such that:

$$\frac{\partial \mathcal{L}}{\partial \lambda} = \bar{U} - U(C(w), H(w), X(C(w))) \equiv 0$$

$$\frac{\partial \mathcal{L}}{\partial C} = \frac{1}{w(1-t)} - \lambda(w) U_C(C(w), H(w), X(C(w))) - \frac{t}{1-t} \lambda(w) U_X(C(w), H(w), X(C(w))) \equiv 0$$

$$\frac{\partial \mathcal{L}}{\partial H} = 1 - \lambda(w) U_H(C(w), H(w), X(C(w))) \equiv 0$$

for some neighborhood of w_0 .

We take the total derivatives of the previous identities with respect to w .

$$\begin{bmatrix} 0 & -U_C - \frac{t}{1-t}U_X & -U_H \\ -U_C - \frac{t}{1-t}U_X & -\lambda U_{CC} - 2\lambda\left(\frac{t}{1-t}\right)U_{CX} - \lambda\left(\frac{t}{1-t}\right)^2 U_{XX} & -\lambda U_{CH} - \lambda\left(\frac{t}{1-t}\right)U_{HX} \\ -U_H & -\lambda U_{CH} - \lambda\left(\frac{t}{1-t}\right)U_{HX} & -\lambda U_{HH} \end{bmatrix} \begin{bmatrix} \frac{\partial \lambda^*}{\partial w} \\ \frac{\partial C^*}{\partial w} \\ \frac{\partial H^*}{\partial w} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \frac{1}{(1-t)w^2}$$

By Cramer's Rule,

$$\left(\frac{\partial H^*}{\partial w}\right)^c = \frac{\begin{vmatrix} 0 & -U_C - \frac{t}{1-t}U_X & 0 \\ -U_C - \frac{t}{1-t}U_X & -\lambda U_{CC} - 2\lambda\left(\frac{t}{1-t}\right)U_{CX} - \lambda\left(\frac{t}{1-t}\right)^2 U_{XX} & \frac{1}{(1-t)w^2} \\ -U_H & -\lambda U_{CH} - \lambda\left(\frac{t}{1-t}\right)U_{HX} & 0 \end{vmatrix}}{\begin{vmatrix} 0 & -U_C - \frac{t}{1-t}U_X & -U_H \\ -U_C - \frac{t}{1-t}U_X & -\lambda U_{CC} - 2\lambda\left(\frac{t}{1-t}\right)U_{CX} - \lambda\left(\frac{t}{1-t}\right)^2 U_{XX} & -\lambda U_{CH} - \lambda\left(\frac{t}{1-t}\right)U_{HX} \\ -U_H & -\lambda U_{CH} - \lambda\left(\frac{t}{1-t}\right)U_{HX} & -\lambda U_{HH} \end{vmatrix}}$$

$$\left(\frac{\partial H^*}{\partial w}\right)^c = \frac{(1-t)U_C + tU_X}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX}}$$

taking into account that $\lambda^* = \frac{1}{U_H} = \frac{1}{w(1-t)\left(U_C + \frac{t}{1-t}U_X\right)}$.

Under the standard theory, $U_X = U_{CX} = U_{HX} = U_{XX} = 0$, and the formula above is reduced to:

$$\left(\frac{\partial H^*}{\partial w}\right)^c = \frac{(1-t)U_C}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}}$$

We have thus separately derived the compensated demand term of the Slutsky equation, i.e. the substitution effect of a change in wage. We thereby conclude that the total effect derived earlier can be divided into its substitution and income effects to produce the Slutsky-like equation as desired. ■

PROPOSITION 3

Under the standard theory, the total effect of a change in the wage rate depends only on the net wage rate. Under the tax affinity hypothesis, the total effect of a change in the wage rate depends on both the wage rate and the tax rate.

Proof

We first consider the Slutsky-like equation for the standard theory.

Let $\frac{w}{1-t}$ be the before-tax wage rate and t be the tax rate, $t \neq 0$.

Note that the net wage rate in this case is w .

$$\begin{aligned} \frac{\partial H^*}{\partial \left(\frac{w}{1-t}\right)} &= \frac{(1-t)U_C}{\left(\frac{w}{1-t}\right)^2 (1-t)^2 U_{CC} - 2\left(\frac{w}{1-t}\right)(1-t)U_{CH} + U_{HH}} + \frac{\left(\left(\frac{w}{1-t}\right)(1-t)^2 U_{CC} - (1-t)U_{CH}\right)}{\left(\frac{w}{1-t}\right)^2 (1-t)^2 U_{CC} - 2\left(\frac{w}{1-t}\right)(1-t)U_{CH} + U_{HH}} (\bar{T} - H^*) \\ &= (1-t) \left(\frac{U_C}{w^2 U_{CC} - 2wU_{CH} + U_{HH}} + \frac{(U_{CC} - U_{CH})}{w^2 U_{CC} - 2wU_{CH} + U_{HH}} (\bar{T} - H^*) \right) \end{aligned}$$

And thus,

$$\begin{aligned} \frac{\partial H^*}{\partial w} &= \frac{\partial H^*}{\partial \left(\frac{w}{1-t}\right)} \frac{\partial \left(\frac{w}{1-t}\right)}{\partial w} = \frac{1}{1-t} \frac{\partial H^*}{\partial \left(\frac{w}{1-t}\right)} \\ &= \frac{U_C}{w^2 U_{CC} - 2wU_{CH} + U_{HH}} + \frac{(wU_{CC} - U_{CH})}{w^2 U_{CC} - 2wU_{CH} + U_{HH}} (\bar{T} - H^*) \end{aligned}$$

Next, consider the case where the tax rate is 0 and the wage rate is w .

$$\frac{\partial H^*}{\partial w} = \frac{U_C}{w^2 U_{CC} - 2w U_{CH} + U_{HH}} + \frac{(w U_{CC} - U_{CH})}{w^2 U_{CC} - 2w U_{CH} + U_{HH}} (\bar{T} - H^*)$$

Since the values of $\frac{\partial H^*}{\partial w}$ are the same in both cases, we conclude that, under the standard theory, the total effect of a change in the wage rate depends only on the net wage rate.

We will now consider the same two cases under the tax affinity hypothesis and obtain the result that even if the net wage rate is the same, the value of $\frac{\partial H^*}{\partial w}$ also depends on the tax rate.

Consider first the case where $\frac{w}{1-t}$ is the before-tax wage rate and t is the tax rate, $t \neq 0$.

$$\begin{aligned} \frac{\partial H^*}{\partial \left(\frac{w}{1-t}\right)} &= \frac{(1-t)U_C + tU_X}{\left(\frac{w}{1-t}\right)^2 (1-t)^2 U_{CC} - 2\left(\frac{w}{1-t}\right)(1-t)U_{CH} + U_{HH} + 2\left(\frac{w}{1-t}\right)^2 t(1-t)U_{CX} - 2\left(\frac{w}{1-t}\right)tU_{HX} + \left(\frac{w}{1-t}\right)^2 t^2 U_{XX}} \\ &+ \frac{\left(\left(\frac{w}{1-t}\right)(1-t)^2 U_{CC} - (1-t)U_{CH} + 2\left(\frac{w}{1-t}\right)t(1-t)U_{CX} - tU_{HX} + \left(\frac{w}{1-t}\right)t^2 U_{XX}\right)}{\left(\frac{w}{1-t}\right)^2 (1-t)^2 U_{CC} - 2\left(\frac{w}{1-t}\right)(1-t)U_{CH} + U_{HH} + 2\left(\frac{w}{1-t}\right)^2 t(1-t)U_{CX} - 2\left(\frac{w}{1-t}\right)tU_{HX} + \left(\frac{w}{1-t}\right)^2 t^2 U_{XX}} (\bar{T} - H^*) \end{aligned}$$

$$\frac{\partial H^*}{\partial \left(\frac{w}{1-t}\right)} = \frac{(1-t)U_C + tU_X}{w^2U_{CC} - 2wU_{CH} + U_{HH} + 2\left(\frac{w^2t}{1-t}\right)U_{CX} - 2\left(\frac{wt}{1-t}\right)U_{HX} + \left(\frac{wt}{1-t}\right)^2 U_{XX}} + \frac{\left(w(1-t)U_{CC} - (1-t)U_{CH} + 2wtU_{CX} - tU_{HX} + w\left(\frac{t^2}{1-t}\right)U_{XX}\right)}{w^2U_{CC} - 2wU_{CH} + U_{HH} + 2\left(\frac{w^2t}{1-t}\right)U_{CX} - 2\left(\frac{wt}{1-t}\right)U_{HX} + \left(\frac{wt}{1-t}\right)^2 U_{XX}}$$

And thus,

$$\frac{\partial H^*}{\partial w} = \frac{1}{1-t} \frac{\partial H^*}{\partial \left(\frac{w}{1-t}\right)} = \frac{U_C + \left(\frac{t}{1-t}\right)U_X}{w^2U_{CC} - 2wU_{CH} + U_{HH} + 2\left(\frac{w^2t}{1-t}\right)U_{CX} - 2\left(\frac{wt}{1-t}\right)U_{HX} + \left(\frac{wt}{1-t}\right)^2 U_{XX}} + \frac{\left(wU_{CC} - U_{CH} + 2\left(\frac{wt}{1-t}\right)U_{CX} - \left(\frac{t}{1-t}\right)U_{HX} + w\left(\frac{t}{1-t}\right)^2 U_{XX}\right)}{w^2U_{CC} - 2wU_{CH} + U_{HH} + 2\left(\frac{w^2t}{1-t}\right)U_{CX} - 2\left(\frac{wt}{1-t}\right)U_{HX} + \left(\frac{wt}{1-t}\right)^2 U_{XX}}$$

But when tax rate is 0, the result obtained under the tax affinity hypothesis is the same as that under the standard theory,

$$\text{i.e. } \frac{\partial H^*}{\partial w} = \frac{U_C}{w^2U_{CC} - 2wU_{CH} + U_{HH}} + \frac{(wU_{CC} - U_{CH})}{w^2U_{CC} - 2wU_{CH} + U_{HH}} (\bar{T} - H^*)$$

Thus, under the tax affinity hypothesis, the total effect of a change in the wage rate depends on both the wage rate and the tax rate. ■

PROPOSITION 4

The relative magnitudes of the substitution effect of a change in the wage rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{HX} = 0$, the substitution effect is greater under the tax affinity hypothesis if $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$.

Proof

From the Slutsky-like equations in Proposition 2, the substitution effect under the tax affinity hypothesis is greater (more negative) than that under the standard theory if and only if:

$$\frac{(1-t)U_C + tU_X}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX}} < \frac{(1-t)U_C}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}}$$

$$\Leftrightarrow ((1-t)U_C + tU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) <$$

$$\left((1-t)U_C \right) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX} \right)$$

$$\Leftrightarrow (tU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) < \left((1-t)U_C \right) \left(2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX} \right)$$

$$\Leftrightarrow (tU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) - 2w^2t(1-t)^2 U_C U_{CX} + 2wt(1-t)U_C U_{HX} - w^2t^2(1-t)U_C U_{XX} < 0$$

Note that all terms in the above inequality are negative, except $2wt(1-t)U_C U_{HX} - w^2t^2(1-t)U_C U_{XX}$. Thus, without further information, we cannot sign the left-hand side of the inequality, implying that the difference between the substitution effects under the tax affinity and the standard theory is ambiguous.

However, note that if $U_{HX} = 0$, the inequality reduces to:

$$(tU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) - 2w^2t(1-t)^2 U_C U_{CX} - w^2t^2(1-t)U_C U_{XX} < 0$$

$$\Leftrightarrow (tU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) - w^2t(1-t)U_C \left[2(1-t)U_{CX} + tU_{XX} \right] < 0$$

The left-hand side of the above inequality is negative if (but not only if):

$$2(1-t)U_{CX} + tU_{XX} > 0$$

$$\Leftrightarrow -\frac{2(1-t)}{t}U_{CX} < U_{XX}$$

which implies that if $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$, the substitution effect is greater under the tax affinity.

Note that it is not an if-and-only-if statement, and thus the converse may not be true. ■

PROPOSITION 5

The relative magnitudes of the income effect of a change in the wage rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{HX} = 0$, the income effect is smaller under the tax affinity hypothesis if and only if $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$.

Proof

From the Slutsky-like equations in Proposition 2, the income effect under the tax affinity hypothesis is smaller than that under the standard theory if and only if:

$$\frac{w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX}}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX}} < \frac{w(1-t)^2 U_{CC} - (1-t)U_{CH}}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}}$$

$$\Leftrightarrow \left(w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX} \right) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) < \left(w(1-t)^2 U_{CC} - (1-t)U_{CH} \right) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX} \right)$$

$$\Leftrightarrow \left(2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX} \right) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) < \left(w(1-t)^2 U_{CC} - (1-t)U_{CH} \right) \left(2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX} \right)$$

$$\Leftrightarrow -2w^2 t(1-t)^2 U_{CH} U_{CX} + 2wt(1-t)U_{CX} U_{HH} + w^2 t(1-t)^2 U_{CC} U_{HX} - tU_{HH} U_{HX} - w^2 t^2 (1-t)U_{CH} U_{XX} + wt^2 U_{HH} U_{XX} < 0$$

Note that the first three terms in the inequality are negative, but the last three, $-tU_{HH} U_{HX} - w^2 t^2 (1-t)U_{CH} U_{XX} + wt^2 U_{HH} U_{XX}$, are positive. Thus, without further information, we cannot sign the left-hand side of the inequality, implying that the difference between the substitution effects under the tax affinity and the standard theory is ambiguous.

However, note that if $U_{HX} = 0$, the inequality reduces to:

$$-2w^2t(1-t)^2 U_{CH}U_{CX} + 2wt(1-t)U_{CX}U_{HH} - w^2t^2(1-t)U_{CH}U_{XX} + wt^2U_{HH}U_{XX} < 0$$

$$\Leftrightarrow \left[-w^2t(1-t)U_{CH} + wtU_{HH} \right] \left[2(1-t)U_{CX} + tU_{XX} \right] < 0$$

$$\Leftrightarrow 2(1-t)U_{CX} + tU_{XX} > 0$$

$$\Leftrightarrow -\frac{2(1-t)}{t}U_{CX} < U_{XX}$$

which implies that if $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$, the income effect is smaller under the tax affinity.

Since the inequality is a part of an if-and-only-if condition, the converse is also true: if $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$, the income effect is greater under the tax affinity. ■

PROPOSITION 6

The relative magnitudes the total effect of a change in the wage rate under the tax affinity hypothesis and that under the standard theory is ambiguous.

Proof

According to the Slutsky equation, the total effect of the change is an addition of the substitution effect and the income effect of the change. The proposition thus follows immediately from Propositions 4 and 5. ■

PROPOSITION 7

If $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} < U_{XX}$, the total effect of a change in the wage rate under the tax affinity hypothesis is more negative (or less positive) than that under the standard theory.

Proof

The proposition follows immediately from the last lines of Propositions 4 and 5. ■

PROPOSITION 8

The Slutsky-like equation of leisure demand for a tax change under the tax affinity hypothesis is:

$$\frac{\partial H^*}{\partial t} = \frac{1}{D'}[-wU_C + wU_X] + \frac{1}{D'}[-w(1-t)U_{CC} + U_{CH} + w(1-2t)U_{CX} - U_{HX} + wtU_{XX}] \left[w(\bar{T} - H^*) + \bar{M} \right]$$

The equation of leisure demand for a tax change under the standard theory is:

$$\frac{\partial H^*}{\partial t} = \frac{1}{D}[-wU_C] + \frac{1}{D}[-w(1-t)U_{CC} + U_{CH}] \left[w(\bar{T} - H^*) + \bar{M} \right]$$

In both equations, the first term is the “substitution effect” and the second term is the “income effect” of a change in t .

Proof

The proof is similar to that for Proposition 2, except that derivatives are taken with respect to t . Note that \bar{M} now appears in the Slutsky-like equations. This makes sense as nonlabor income is taxable.

We observe that the “substitution effect” is positive under the standard theory (higher tax implies lower wage, which makes leisure cheaper) but the sign is ambiguous under the tax affinity hypothesis. The ambiguous sign does not violate the norm for a Slutsky equation because here an increase in t increases the price of leisure with regard to tax but decreases the price of leisure with regard to consumption. Hence, the sign will depend upon the relative magnitudes of U_C and U_X .

Similarly, the “income effect” is negative under the standard theory (higher tax implies lower wage, which makes it necessary to work more to compensate for the lost income) but the sign is ambiguous under the tax affinity hypothesis. ■

PROPOSITION 9

The relative magnitudes of the substitution effect of a change in the tax rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{HX} = 0$, the substitution effect is smaller under the tax affinity hypothesis if $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$.

Proof

From the Slutsky-like equations in Proposition 8, the substitution effect under the tax affinity hypothesis is smaller (less positive) than that under the standard theory if and only if:

$$\frac{-wU_C + wU_X}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX}} < \frac{-wU_C}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}}$$

$$\Leftrightarrow (-wU_C + wU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) <$$

$$(-wU_C) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX} \right)$$

$$\Leftrightarrow (wU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) < (-wU_C) \left(2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX} \right)$$

$$\Leftrightarrow (wU_X) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) + 2w^3t(1-t)U_C U_{CX} - 2w^2tU_C U_{HX} + w^3t^2U_C U_{XX} < 0$$

Note that all terms in the above inequality are negative, except $2w^3t(1-t)U_C U_{CX}$. Thus, without further information, we cannot sign the left-hand side of the inequality, implying that the difference between the substitution effects under the tax affinity and the standard theory is ambiguous.

However, note that if $U_{HX} = 0$, the inequality reduces to:

$$(wU_X)\left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}\right) + 2w^3t(1-t)U_C U_{CX} + w^3t^2U_C U_{XX} < 0$$

$$\Leftrightarrow (wU_X)\left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}\right) + w^3tU_C \left[2(1-t)U_{CX} + tU_{XX}\right] < 0$$

The left-hand side of the above inequality is negative if (but not only if):

$$2(1-t)U_{CX} + tU_{XX} < 0$$

$$\Leftrightarrow -\frac{2(1-t)}{t}U_{CX} > U_{XX}$$

which implies that if $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$, the substitution effect is smaller under the tax affinity.

Note that it is not an if-and-only-if statement, and thus the converse may not be true. ■

PROPOSITION 10

The relative magnitudes of the income effect of a change in the tax rate under the tax affinity hypothesis and that under the standard theory is ambiguous. However, if $U_{HX} = 0$, the income effect is smaller under the tax affinity hypothesis if $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$.

Proof

From the Slutsky-like equations in Proposition 8, the income effect under the tax affinity hypothesis is smaller (less negative) than that under the standard theory if and only if:

$$\frac{(-w(1-t)U_{CC} + U_{CH} + w(1-2t)U_{CX} - U_{HX} + wtU_{XX})}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX}} > \frac{(-w(1-t)U_{CC} + U_{CH})}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}}$$

$$\frac{-w(1-t)U_{CC} + U_{CH} + w(1-2t)U_{CX} - U_{HX} + wtU_{XX}}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX}} > \frac{-w(1-t)U_{CC} + U_{CH}}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH}}$$

$$\Leftrightarrow (-w(1-t)U_{CC} + U_{CH} + w(1-2t)U_{CX} - U_{HX} + wtU_{XX}) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) > (-w(1-t)U_{CC} + U_{CH}) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX} \right)$$

$$\Leftrightarrow (w(1-2t)U_{CX} - U_{HX} + wtU_{XX}) \left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} \right) > (-w(1-t)U_{CC} + U_{CH}) \left(2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX} \right)$$

$$\Leftrightarrow w^3(1-t)^2 U_{CC}U_{CX} - w^2(1-t)(1+t)U_{CC}U_{HX} + w^3t(1-t)U_{CC}U_{XX} - 2w^2(1-t)^2 U_{CH}U_{CX} + 2wU_{CH}U_{HX} - w^2t(2-t)U_{CH}U_{XX} + w(1-2t)U_{CX}U_{HH} - U_{HH}U_{HX} + wtU_{HH}U_{XX} > 0$$

Note that the three terms involving U_{CX} in the inequality are negative, and the rest are positive. Thus, without further information, we cannot sign the left-hand side of the inequality, implying that the difference between the substitution effects under the tax affinity and the standard theory is ambiguous.

However, note that if $U_{HX} = 0$, the inequality reduces to:

$$w^3(1-t)^2 U_{CC} U_{CX} + w^3 t(1-t) U_{CC} U_{XX} - 2w^2(1-t)^2 U_{CH} U_{CX} - w^2 t(2-t) U_{CH} U_{XX} + w(1-2t) U_{CX} U_{HH} + wt U_{HH} U_{XX} > 0$$

$$\Leftrightarrow w^3(1-t) U_{CC} [(1-t) U_{CX} + t U_{XX}] - w^2 U_{CH} [2(1-t)^2 U_{CX} + t(2-t) U_{XX}] + w U_{HH} [(1-2t) U_{CX} + t U_{XX}] > 0$$

However, if $-\frac{2(1-t)}{t} U_{CX} > U_{XX}$, i.e. $2(1-t) U_{CX} + t U_{XX} < 0$, we get the following three inequalities:

- (1) $\Rightarrow (1-t) U_{CX} + t U_{XX} < 2(1-t) U_{CX} + t U_{XX} < 0$
 $\Rightarrow w^3(1-t) U_{CC} [(1-t) U_{CX} + t U_{XX}] > 0$
- (2) $\Rightarrow 2(1-t)^2 U_{CX} + t(1-t) U_{XX} < 0$
 $\Rightarrow 2(1-t)^2 U_{CX} + t(2-t) U_{XX} < 2(1-t)^2 U_{CX} + t(1-t) U_{XX} < 0$
 $\Rightarrow -w^2 U_{CH} [2(1-t)^2 U_{CX} + t(2-t) U_{XX}] > 0$
- (3) $\Rightarrow (1-t) U_{CX} + t U_{XX} < 0$
 $\Rightarrow (1-2t) U_{CX} + t U_{XX} < (1-t) U_{CX} + t U_{XX} < 0$
 $\Rightarrow w U_{HH} [(1-2t) U_{CX} + t U_{XX}] > 0$

which implies that if $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$, all the terms in the initial inequality are positive, and thus, income effect is smaller under the tax affinity.

Note that it is not an if-and-only-if statement, and thus the converse may not be true. ■

PROPOSITION 11

The relative magnitudes of the total effect of a change in the tax rate under the tax affinity hypothesis and that under the standard theory is ambiguous.

Proof

According to the Slutsky equation, the total effect of the change is an addition of the substitution effect and the income effect of the change. The proposition thus follows immediately from Propositions 9 and 10.

Even if $U_{HX} = 0$ and $-\frac{2(1-t)}{t}U_{CX} > U_{XX}$, the total effect of the change remains ambiguous because the substitution effect is less positive and the income effect is less negative under the tax affinity hypothesis according to the last lines of Propositions 9 and 10. ■

LEMMA 2

The income effect of the Slutsky-like equations for a wage change is equal to $\frac{\partial H}{\partial \bar{M}}(\bar{T} - H)$. Thus, changing the nonlabor income, while keeping the wage constant, produces the income effect of an equivalent wage change.

Proof

We will prove for the case under the tax affinity hypothesis and the result for the standard theory follows immediately by removing all utility terms involving tax.

We will perform the same analysis as in the proof of Proposition 2, but here we take the total derivative with respect to \bar{M} to yield:

$$\frac{\partial H^*}{\partial \bar{M}} = \frac{w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX}}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX}}$$

Thus,

$$\frac{\partial H^*}{\partial \bar{M}}(\bar{T} - H) = \frac{w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX}}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX}}(\bar{T} - H)$$

which is the income effect of an equivalent wage change.

This is useful because we can simulate the income effect of a wage change by changing the nonlabor income (e.g., providing a bonus) while keeping the wage constant. ■

LEMMA 3

Leisure may be an inferior good under the tax affinity hypothesis.

Proof

This is a multi-step proof. First we prove that:

$$0 \leq U_{CX} < -\frac{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} - 2wtU_{HX} + w^2t^2U_{XX}}{2w^2t(1-t)}$$

$0 \leq U_{CX}$ from the assumption.

From Proposition 2, the substitution effect is given by

$$\frac{(1-t)U_C + tU_X}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2t(1-t)U_{CX} - 2wtU_{HX} + w^2t^2U_{XX}}$$

Note that the numerator is positive and all terms in the denominator, except $2w^2t(1-t)U_{CX}$, are negative.

Since the substitution effect in a Slutsky equation has to be negative, the denominator has to be negative, and thus:

$$2w^2t(1-t)U_{CX} < -\left(w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + -2wtU_{HX} + w^2t^2U_{XX}\right)$$

$$U_{CX} < -\frac{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + -2wtU_{HX} + w^2t^2U_{XX}}{2w^2t(1-t)}$$

as desired.

Next, we prove that if leisure is a normal good, then $0 \leq U_{CX} < -\frac{w(1-t)^2 U_{CC} - (1-t)U_{CH} - tU_{HX} + wt^2U_{XX}}{2wt(1-t)}$.

Again, $0 \leq U_{CX}$ from the assumption.

From Proposition 2, the income effect is given by:

$$\frac{\left(w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX}\right)}{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} + 2w^2 t(1-t)U_{CX} - 2wtU_{HX} + w^2 t^2 U_{XX}} (\bar{T} - H^*)$$

Note that from Lemma 1, the denominator is negative, while all the terms in the numerator, except $2wt(1-t)U_{CX}$, are negative.

Since the income effect in a Slutsky equation for a normal good is positive, the numerator has to be negative, and thus:

$$w(1-t)^2 U_{CC} - (1-t)U_{CH} + 2wt(1-t)U_{CX} - tU_{HX} + wt^2 U_{XX} < 0$$

$$2wt(1-t)U_{CX} < -\left(w(1-t)^2 U_{CC} - (1-t)U_{CH} - tU_{HX} + wt^2 U_{XX}\right)$$

$$U_{CX} < -\frac{w(1-t)^2 U_{CC} - (1-t)U_{CH} - tU_{HX} + wt^2 U_{XX}}{2wt(1-t)}$$

as desired.

From the previous two results, leisure may be an inferior good if and only if:

$$\frac{-w(1-t)^2 U_{CC} + (1-t)U_{CH} + tU_{HX} + wt^2 U_{XX}}{2wt(1-t)} < U_{CX} < -\frac{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} - 2wtU_{HX} + w^2 t^2 U_{XX}}{2w^2 t(1-t)}$$

But there are values of U_{CX} for which the above is valid because:

$$\begin{aligned} & -\frac{w(1-t)^2 U_{CC} - (1-t)U_{CH} - tU_{HX} + wt^2 U_{XX}}{2wt(1-t)} = -\frac{w^2(1-t)^2 U_{CC} - w(1-t)U_{CH} - wtU_{HX} + w^2 t^2 U_{XX}}{2w^2 t(1-t)} \\ & = -\frac{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} - 2wtU_{HX} + w^2 t^2 U_{XX}}{2w^2 t(1-t)} - \frac{w(1-t)U_{CH} - U_{HH} + wtU_{HX}}{2w^2 t(1-t)} \\ & < -\frac{w^2(1-t)^2 U_{CC} - 2w(1-t)U_{CH} + U_{HH} - 2wtU_{HX} + w^2 t^2 U_{XX}}{2w^2 t(1-t)} \end{aligned}$$

■

B

SAMPLE INDIFFERENCE PLANES

Sample indifference planes generated using the Cobb-Douglas functions.

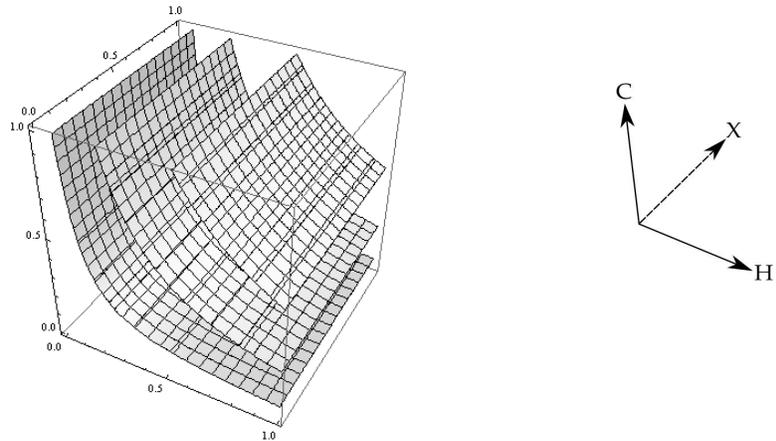


FIGURE B.1 Standard theory
 $U(C,H,X) = C^{1/2}H^{1/2}X^{1/2}$

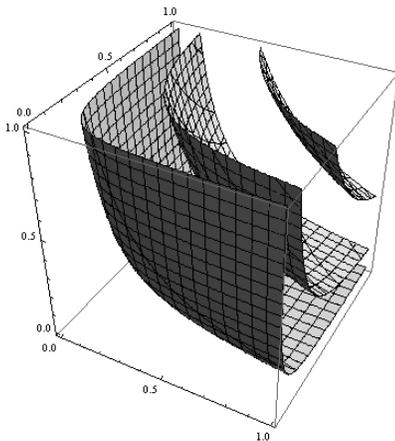


FIGURE B.2 Tax affinity hypothesis; $U_{HX} > 0$
 $U(C,H,X) = C^{1/3}H^{1/3}X^{1/3}$

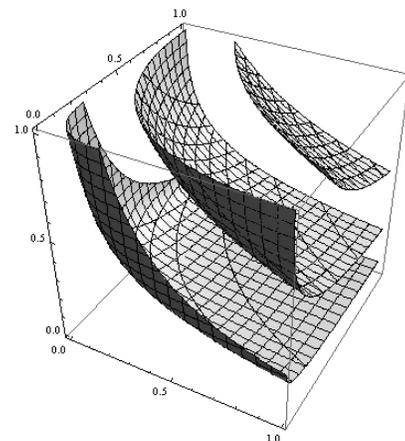


FIGURE B.3 Tax affinity hypothesis; $U_{HX} = 0$
 $U(C,H,X) = C^{1/2}H^{1/2}X^{1/2} + C^{1/2}X^{1/2}$

C EXPERIMENTAL INSTRUCTIONS

Only four (A, E, I, and N) of the twelve available treatments are reproduced here. Please contact the author (idjanali@wesleyan.edu) for copies of the other treatments.

Consent

Thank you for your participation in this experiment, conducted for an Honors Thesis in Economics.

In this study, you will complete a set of pen-and-paper tasks, which involve shading small circles. There are minimal risks involved and you may stop participating at any time, although payment can only be given if you complete all required tasks. Your data remain anonymous and confidential. When the tasks are done, you will be asked to complete a post-experiment survey. The experiment will take roughly 30 minutes. A debrief e-mail will be sent to your e-mail address once all sessions of the experiment have been conducted.

If you agree to participate in this experiment, please complete the fields below:

Name:

E-mail:

Signature:

If you study the following instructions carefully, you can, depending on your performance and the set of treatments you receive, earn a considerable amount of cash.

This experiment consists of 6 rounds. In each round of this experiment, you will be asked to shade as many circles as you can within 3 minutes. You must use the pen provided by the experimenter. Please refer to the board for examples of acceptable and unacceptable shading. Circles that are not completely shaded will not be counted.

Your payoff will depend on the number of circles you shade. In each round, you will be informed of the pay/circle. In addition, in some rounds, there may be bonuses and/or tax deductions. Your payoff will be determined as follows:
Payoff = ((# of circles shaded * pay/circle) + bonus) * (1 – tax rate)

You may treat the tax deductions similar to the income tax you pay from your on/off-campus jobs. Tax money is used by the government to fund public services and infrastructures. Tax also has a redistributive feature as it channels some income from the rich to the poor. For the purpose of this experiment, the tax amount deducted will be contributed to a non-profit organization that provides public services. This organization has been chosen by the experimenter and will be revealed to you in the debrief e-mail.

Only one round will be selected as the payoff round, which means that all payment for all participants will be based on this particular round. You will NOT receive any payment based on your performance in other rounds. The payoff round will be randomly determined after all rounds have been completed. You are suggested to treat every round equally, as if that round determines your payoff.

These instructions are solely for your private information. You are prohibited to communicate with other participants during the experiment. Should you have any questions at any point, please raise your hand. Do not turn over the pages until instructed to do so.

Round ____

Treatment A

If this round is selected to be the payoff round, you will be paid 16 cents for every complete circle you shade. However, the total payment will be deducted for a 50% tax. The after-tax income will be paid to you.

You may treat this tax similar to the income tax you pay from your on/off-campus jobs. Tax money is used by the government to fund public services and infrastructures. Tax also has a redistributive feature as it channels some income from the rich to the poor. For the purpose of this experiment, the tax amount deducted will be contributed to a non-profit organization that provides public services. This organization has been chosen by the experimenter and will be revealed to you in the debrief e-mail.

You have 3 minutes for this round.

DO NOT TURN OVER THE PAGE UNTIL INSTRUCTED TO DO SO.

Round ____

Treatment F

If this round is selected to be the payoff round, you will be paid 40 cents for every complete circle you shade. In addition, you will receive a fixed bonus of \$15. However, the total payment (including the bonus) will be deducted for an 80% tax. The after-tax income will be paid to you.

You may treat this tax similar to the income tax you pay from your on/off-campus jobs. Tax money is used by the government to fund public services and infrastructures. Tax also has a redistributive feature as it channels some income from the rich to the poor. For the purpose of this experiment, the tax amount deducted will be contributed to a non-profit organization that provides public services. This organization has been chosen by the experimenter and will be revealed to you in the debrief e-mail.

You have 3 minutes for this round.

DO NOT TURN OVER THE PAGE UNTIL INSTRUCTED TO DO SO.

Round ____

Treatment I

If this round is selected to be the payoff round, you will be paid 10 cents for every complete circle you shade. However, the total payment will be deducted for a 60% tax. The after-tax income will be paid to you.

You may treat this tax similar to the income tax you pay from your on/off-campus jobs. Tax money is used by the government to fund public services and infrastructures. Tax also has a redistributive feature as it channels some income from the rich to the poor. For the purpose of this experiment, the tax amount deducted will be contributed to a non-profit organization that provides public services. This organization has been chosen by the experimenter and will be revealed to you in the debrief e-mail.

You have 3 minutes for this round.

DO NOT TURN OVER THE PAGE UNTIL INSTRUCTED TO DO SO.

Round ____

Treatment N

If this round is selected to be the payoff round, you will be paid 8 cents for every complete circle you shade. There is no tax in this round.

You have 3 minutes for this round.

DO NOT TURN OVER THE PAGE UNTIL INSTRUCTED TO DO SO.

Post-Experiment Survey

Subject No: ____

Thank you for completing all six rounds. While your payoff is being calculated, please answer the following questions. You are asked to answer all of them to the best of your knowledge, unless otherwise noted. Note that all data remain anonymous and confidential.

Major(s): _____

Have taken ECON101 or ECON110: Yes / No

Class Year: _____

Gender: _____

Please shade a number that represents the extent to which you agree with each statement. 1: strongly disagree – 5: strongly agree

1. I could guess the intent of this experiment. ① ② ③ ④ ⑤
2. I varied my effort in the different rounds depending on the payoff rates. ① ② ③ ④ ⑤
3. I enjoyed shading circles. ① ② ③ ④ ⑤
4. I hate paying taxes. ① ② ③ ④ ⑤
5. I was honest in the last tax return forms that I filed.
(Do not shade any number if you have never filed one.) ① ② ③ ④ ⑤
6. Most people are honest in reporting their incomes. ① ② ③ ④ ⑤
7. I am familiar with how the government spends my tax money. ① ② ③ ④ ⑤
8. I disagree with how the government spends my tax money. ① ② ③ ④ ⑤
9. I am familiar with the U.S. income tax system. ① ② ③ ④ ⑤
10. The rich should be taxed more. ① ② ③ ④ ⑤
11. The poor should be taxed less. ① ② ③ ④ ⑤
12. The poor do not do enough to escape poverty. ① ② ③ ④ ⑤
13. The income gap between the rich and the poor is unreasonable. ① ② ③ ④ ⑤
14. I donate money to charities and/or volunteer. ① ② ③ ④ ⑤
15. I enjoy seeing others happy. ① ② ③ ④ ⑤

D

SUBJECTS & DATA

Subject	Tax	T1	Order	T2	Order	T3	Order	T4	Order	T5	Order	T6	Order
1	20%	106	6	101	1	98	2	105	3	108	4	113	5
2	50%	136	4	140	1	137	6	148	5	128	3	128	2
3	20%	170	6	160	2	150	4	160	5	130	3	140	1
4	20%	95	6	71	1	90	4	91	3	80	2	110	5
5	20%	94	1	82	3	0	5	85	6	94	4	91	2
6	80%	150	3	220	6	205	5	230	4	130	1	140	2
7	50%	110	1	130	3	130	2	170	6	150	5	155	4
8	20%	200	6	208	1	206	2	178	3	190	4	250	5
9	50%	110	4	117	2	125	6	120	3	107	1	121	5
10	50%	144	3	126	5	150	6	115	1	138	2	150	4
11	60%	114	1	106	5	102	4	112	2	129	6	121	3
12	60%	62	5	57	2	66	1	101	6	74	4	62	3
13	20%	206	3	220	4	191	1	192	5	191	2	229	6

Subject	Tax	T1	Order	T2	Order	T3	Order	T4	Order	T5	Order	T6	Order
14	20%	180	2	190	3	250	5	280	6	215	4	129	1
15	80%	174	4	126	3	92	2	160	5	78	1	151	6
16	80%	119	6	112	1	146	5	148	4	110	2	177	3
17	80%	217	6	270	1	185	5	259	2	218	4	220	3
18	20%	140	6	130	4	137	2	127	3	132	1	117	5
19	20%	112	3	106	5	122	6	100	2	68	1	121	4
20	60%	120	5	100	2	140	6	95	3	94	4	93	1
21	80%	140	6	128	1	160	4	177	5	106	2	140	3
22	60%	245	6	176	3	182	2	240	1	180	5	140	4
23	60%	121	3	110	1	159	4	204	6	190	5	108	2
24	60%	288	5	284	3	155	1	305	6	169	2	225	4
25	60%	139	3	135	5	127	2	86	1	119	6	110	4
26	50%	113	6	118	4	166	3	179	2	132	1	185	5
27	80%	97	1	142	5	108	6	109	4	122	3	140	2
28	80%	130	3	100	4	116	2	142	6	109	1	181	5
29	80%	173	3	184	5	128	1	131	6	186	2	154	4
30	50%	163	1	202	6	210	4	283	5	275	3	248	2
31	50%	104	1	128	5	114	3	96	4	106	6	124	2
32	50%	108	1	177	5	99	2	147	6	110	3	152	4
33	50%	177	2	216	5	124	3	186	1	144	6	191	4
34	50%	159	1	209	5	162	6	220	3	189	2	208	4
35	80%	109	1	161	5	141	2	124	4	126	6	159	3
AVERAGE		143.57	3.54	149.77	3.34	139.23	3.54	160.14	3.91	137.91	3.17	150.94	3.49
STDEV		47.06	1.98	54.15	1.70	46.21	1.75	61.07	1.72	46.78	1.71	45.68	1.40

Note: T1–T6 denote the numbers of circles shaded in Treatment 1–Treatment 6 respectively
Order denotes the round number in which the treatment appeared in the subject’s set of instruction

Subject	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Gdr	Intro	Class	Major
1	1	3	5	3	NA	5	3	3	3	5	2	1	5	4	5	1	0	2009	BIO
2	5	1	2	2	5	3	4	2	4	4	4	2	4	5	3	1	1	2011	CSS
3	4	1	2	3	NA	3	3	4	2	5	4	3	5	2	4	1	1	2012	Undecided
4	3	3	1	5	NA	2	3	2	1	5	5	3	4	3	4	0	1	2012	Undecided
5	5	5	5	3	3	1	3	3	3	5	5	4	3	4	5	0	0	2009	MB&B
6	4	1	1	3	5	3	3	3	2	4	3	1	3	3	3	0	1	2011	BIO
7	3	2	4	1	5	3	4	2	3	5	4	3	4	5	5	1	1	2010	NS&B, PSYC
8	4	2	2	2	5	3	1	2	1	5	5	1	2	5	5	0	0	2009	NS&B
9	4	3	2	5	3	3	2	5	3	4	3	2	3	4	4	0	1	2009	MECO, EAST
10	5	4	2	5	5	2	2	4	2	5	5	5	5	3	1	1	1	2009	MECO, EAST
11	3	4	3	5	NA	2	3	5	3	5	5	1	5	4	5	0	0	2011	AFAM
12	5	4	2	4	5	3	2	3	4	5	5	1	5	2	5	0	1	2011	SOC
13	4	4	4	2	4	2	3	4	4	4	2	2	4	5	5	1	0	2012	MB&B, FREN
14	3	1	2	3	NA	3	4	4	2	4	4	2	5	4	5	0	0	2009	ANTH
15	1	1	5	3	1	2	5	5	5	5	5	1	5	5	5	0	0	2010	EAST
16	4	4	1	4	5	2	2	3	2	4	4	1	5	5	5	0	0	2009	BIO, ENGL
17	1	1	1	5	NA	2	1	5	5	5	5	2	5	5	5	0	1	2010	ECON, PSYC
18	4	5	5	5	NA	3	4	4	2	4	4	3	3	4	5	0	1	2011	FILM
19	2	4	3	4	5	3	3	4	5	2	5	4	5	3	5	1	0	2011	FILM, MUSC
20	3	3	3	5	NA	4	3	3	2	1	1	3	4	5	5	1	0	2012	Undecided
21	2	2	1	4	NA	4	2	2	4	1	1	5	1	1	1	1	0	2012	Undecided
22	2	1	2	3	5	4	3	2	3	4	3	2	5	5	5	0	1	2009	PSYC
23	3	1	3	1	NA	4	2	4	2	4	4	2	5	5	5	0	0	2012	Undecided
24	3	3	2	5	1	4	3	5	2	1	1	5	1	1	1	0	1	2010	ENGL
25	5	4	1	3	5	4	3	3	2	3	4	4	5	2	4	1	1	2010	MECO
26	4	3	2	2	NA	3	2	3	3	5	3	2	5	3	4	1	1	2012	Undecided
27	2	2	5	2	NA	2	2	3	3	4	4	3	4	3	4	1	1	2012	Undecided

Subject	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Gdr	Intro	Class	Major
28	4	3	2	2	NA	2	5	2	5	4	3	3	2	4	4	1	1	2012	Undecided
29	2	2	2	5	5	3	3	3	3	4	2	3	4	5	5	1	0	2011	MUSC
30	1	1	4	5	1	1	2	4	4	4	4	2	4	4	5	0	0	2009	FREN, MUSC
31	1	2	2	3	NA	3	2	3	3	5	5	2	3	2	3	1	0	2010	MATH
32	4	1	1	3	5	2	1	5	4	5	5	1	5	4	5	0	0	2010	AMST
33	2	4	3	3	5	3	3	4	3	4	4	3	4	5	4	1	1	2010	FGSS
34	4	1	4	3	NA	2	4	4	3	5	5	1	5	5	5	0	0	2010	PSYC, RMST
35	3	2	3	4	2	1	4	2	4	4	4	2	5	5	5	0	1	2010	GOVT, ITAL
AVG	3.14	2.51	2.63	3.43	4.00	2.74	2.83	3.40	3.03	4.09	3.77	2.43	4.06	3.83	4.26	0.46	0.51		
STDEV	1.29	1.31	1.33	1.24	2.32	0.95	1.01	1.03	1.10	1.17	1.26	1.22	1.19	1.25	1.20	0.51	0.51		

Note: Q1–Q15 denote the response to the post-experiment survey statements 1–15 respectively (1 = strongly disagree; 5 = strongly agree)

Gdr denotes gender (1 = male; 0 = female)

Intro denotes intro economics class (1 = have taken ECON 101 or 110; 0 = have not taken)

Majors' abbreviations are as follows:

AFAM	African American Studies	GOVT	Government
AMST	American Studies	ITAL	Italian Studies
ANTH	Anthropology	MATH	Mathematics
BIO	Biology	MB&B	Molecular Biology & Biochemistry
CSS	College of Social Studies	MECO	Mathematics-Economics
EAST	East Asian Studies	MUSC	Music
ECON	Economics	NS&B	Neuroscience & Behavior
ENGL	English	PSYC	Psychology
FGSS	Feminist, Gender, and Sexuality Studies	RMST	Romance Studies
FILM	Film Studies	SOC	Sociology
FREN	French Studies		

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