



International Tax Policy Forum

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**INTERNATIONAL TAX POLICY FORUM/
THE URBAN-BROOKINGS TAX POLICY CENTER**

SEMINAR

Who Pays the Corporate Tax in an Open Economy?

December 18, 2007



Tax Policy Center

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International Tax Policy Forum

INTERNATIONAL TAX POLICY FORUM /
URBAN-BROOKINGS TAX POLICY CENTER SEMINAR

Who Pays the Corporate Tax in an Open Economy?

Tuesday, December 18, 2007

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Tax Policy Center

Urban Institute and Brookings Institution



International Tax Policy Forum and
Urban-Brookings Tax Policy Center

Who Pays the Corporate Tax in an Open Economy?

With a Keynote Address by former U.S. Treasury Secretary, Lawrence Summers

Date: Tuesday, December 18, 2007, 8:30 a.m.–1:30 p.m.

Location: Urban Institute, 2100 M St., NW, Washington, DC (entrance on 21st Street)
5th Floor, Katharine Graham Conference Center

This conference considers the distribution of corporate tax burdens in open economies. It is well understood that high corporate taxes may be borne by capital owners in the form of lower after-tax profits, by consumers in the form of higher prices, or by workers in the form of reduced wages. Expanding international trade and investment may change the effects of corporate taxation, with implications for the distribution of the U.S. corporate tax burden.

- 8:15 a.m. **Registration**
- 8:50 a.m. **Introductory Remarks**
John Samuels (GE) and Bill Gale (Brookings)
- 9:00 a.m. **What do we know about who bears the corporate tax burden?**
Moderator: James Hines (Michigan)
Presenter: Alan Auerbach (UC-Berkeley)
- 9:45 am **How does the U.S. government distribute corporate tax burdens?**
Moderator: Alan Auerbach (UC-Berkeley)
Presenter: Alan Viard (AEI)
- 10:15 am **Evidence of the impact of corporate taxation on wages and profits**
Moderator: Glenn Hubbard (Columbia)
Presenters: Mihir Desai (Harvard) and Fritz Foley (Harvard)
Discussant: Kevin Hassett (AEI)
- 11:00-11:15 **Break**
- 11:15 am **Is it time to change the way the U.S. government distributes corporate tax burdens?**
Moderator: Michael Graetz (Yale)
Presenters: Robert Carroll (U.S. Treasury), Eric Toder (Urban Institute),
James Hines (Michigan) and William Randolph (CBO)
- Noon **Luncheon**
- 12:30 pm **Keynote Address:** Lawrence Summers (Harvard)
- 1:15 pm **Adjourn**



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About the International Tax Policy Forum

Founded in 1992, the International Tax Policy Forum is an independent group of 31 major U.S. multinationals with a diverse industry representation. The Forum's mission is to promote research and education on the taxation of multinational companies. Although the Forum is not a lobbying organization, it has testified before the Congressional tax-writing committees on the effects of various tax proposals on U.S. competitiveness. The ITPF also briefs Congressional staff periodically and sponsors public seminars on major international tax policy issues. Most recently, in December 2006, the ITPF co-sponsored a conference on "Tax Havens and Foreign Direct Investment" with the American Enterprise Institute.

On the research front, the Forum has commissioned over 20 papers on international tax policy topics such as the effects of the interest allocation rules on the competitiveness of U.S. firms, the compliance costs of taxing foreign source income, and differences in effective tax rates faced by U.S. domestics and U.S. multinationals (*see* www.ITPF.org).

Members of the Forum meet three times a year in Washington, DC to discuss key international tax policy issues with leading experts in government, academia, and private practice.

PricewaterhouseCoopers LLP serves as staff to the Forum. **John Samuels**, Vice President and Senior Counsel for Tax Policy and Planning with General Electric Company, chairs the Forum. The ITPF's *Board of Academic Advisors* is chaired by Prof. **Glenn Hubbard** (Columbia University) and includes Prof. **James Hines** (University of Michigan) who also directs the ITPF research program, Prof. **Michael Graetz** (Yale), Prof. **Alan Auerbach** (University of California, Berkeley), Prof. **Mihir Desai** (Harvard) and Prof. **Matthew Slaughter** (Dartmouth).

ITPF Mission Statement

The primary purpose of the Forum is to promote research and education on U.S. taxation of income from cross-border investment. To this end, the Forum sponsors research and conferences on international tax issues and meets periodically with academic and government experts. The Forum does not take positions on specific legislative proposals.



About the Tax Policy Center

TPC Quick Facts

- TPC scholars have testified before Congress 56 times since 2002
- More than 2,000 news articles and editorials have cited TPC since 2002
- TPC has produced more than 1,000 distribution and revenue tables
- The TPC web site has an average of 5,310 visitors a day, or one visitor every 16

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The Tax Policy Center (TPC), a joint venture of the Urban Institute and the Brookings Institution, opened its doors in April 2002 with the goal of improving tax policy and, ultimately, Americans' quality of life and economic security. To that end, TPC provides objective, timely, and accessible information to help policymakers, journalists, interested laypeople, and academics identify and evaluate current and emerging tax policy options. Our work reflects the belief that better information, rigorous analysis, and fresh ideas injected at key points in the policy debate can forestall bad policies and reinforce good ones. The Center combines top national experts in tax, expenditure, and budget policy, and microsimulation modeling to concentrate on four overarching areas critical to future debate:

Fair, simple, and efficient taxation: Virtually everyone agrees that taxes should be simple, fair, and efficient. Disagreement arises over how to define and achieve those objectives. TPC quantifies trade-offs among these goals and searches for reforms that increase simplicity, equity, and efficiency.

Social policy in the tax code: Over the past decade, much of social policy has shifted from direct expenditures to tax subsidies. A full assessment of this shift as well as tax progressivity, marriage penalties, and related issues requires consideration of both tax and spending programs. TPC is evaluating this revolution in tax and social policy.

Long-term implications of tax and budget choices: Long-term projections paint a constrained picture of the nation's fiscal prospects because of unfunded public obligations related to rising health care costs and the retirement of the baby boomer generation. TPC examines the implications of current policies and proposed tax changes for future generations.

State tax issues: State and local taxes play important roles in assisting low- and moderate-income families, attracting business development, and affecting the cyclical properties of the economy, and they serve as a laboratory for different approaches to resolving tax and fiscal issues. TPC builds on lengthy traditions at the Urban Institute and the Brookings Institution in examining state issues.

TPC communicates its research on our popular website, www.taxpolicycenter.org, which *Forbes* named one of the top five sites in the tax field, and through an electronic newsletter that reaches more than 3,000 subscribers with information on TPC events and publications. In October 2007, the Center initiated a tax and budget policy blog called TaxVox, www.taxvox.org, to better communicate TPC research and analysis and encourage discussion of key issues in the tax policy debate.

Abstract

This paper reviews what we know from economic theory and evidence about who bears the burden of the corporate income tax. Among the lessons from the recent literature are:

1. For a variety of reasons, shareholders may bear a certain portion of the corporate tax burden. In the short run, they may be unable to shift taxes on corporate capital. Even in the long run, they may be unable to shift taxes attributable to a discount on "old" capital, taxes on rents, or taxes that simply reduce the advantages of corporate ownership. Thus, the distribution of share ownership remains empirically quite relevant to corporate tax incidence analysis, though attributing ownership is itself a challenging exercise.
2. One-dimensional incidence analysis – distributing the corporate tax burden over a representative cross-section of the population – can be relatively uninformative about who bears the corporate tax burden, because it misses the element timing.
3. It is more meaningful to analyze the incidence of corporate tax changes than of the corporate tax in its entirety, because different components of the tax have different incidence and incidence relates to the path of the economy over time, not just in a single year.

JEL Nos. H22, H25

Keywords: incidence, Harberger model, capitalization

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**Who Bears the Corporate Tax?
A Review of What We Know**

Alan J. Auerbach
University of California, Berkeley and NBER

September 2005

This paper was presented at the NBER's Tax Policy and the Economy conference, held on September 15, 2005 in Washington. I am grateful to Jim Poterba, Mihir Desai, Dharmmika Dharmapala, Joel Slemrod, and conference participants for comments on earlier drafts.

INTRODUCTION

Who bears the corporate income tax? The answer to this question is important to our understanding of the distribution of tax burdens, but it has been elusive. In his classic series of analyses of the incidence of the U.S. tax system, Pechman (e.g., 1985) provided alternative scenarios with different assumptions about the incidence of the corporate tax, reflecting his uncertainty about which assumption was best. (He did not do this for the individual income tax.) Distributional analyses provided by U.S. government agencies have, on most occasions, simply ignored the corporate tax. Thus, the Tax Reform Act of 1986, which was estimated to reduce individual income taxes and increase corporate income taxes, could illogically be characterized as being revenue-neutral while providing a tax cut for each income class of a nine-class breakdown.¹

This episode illustrates why it is important to understand the incidence of the corporate tax. Although the tax accounts for a small share of federal revenues, *changes* in the corporate income tax and its associated revenues have often been a significant part of revenue legislation. Moreover, because its incidence is often perceived to fall on the affluent, assignment of the corporate tax burden can have a significant impact on the assessed progressivity of the tax system as a whole.

The most evident difficulty in assigning the corporate tax burden is that, unlike most taxes, there is no guidance given by statutory incidence. While we may start with a working assumption that individual income taxes or sales taxes are borne by the people who are legally liable for them, for example, there is no comparable assumption for the corporation income tax,

¹ U.S. Joint Committee on Taxation (1986, Table 1). This approach was hardly without its critics. See, for example, Feldstein (1988), who also took issue with Pechman's methodology and developed one particular way of allocating the corporate tax changes of TRA86 based on the distribution of real capital income.

given the cardinal rule of incidence analysis that only individuals can bear the burden of taxation and that all tax burdens should be traced back to individuals. Thus, we must rely on deeper assumptions from the start; and, with corporations increasingly becoming multinational enterprises, the individuals at risk of bearing the U.S. corporate tax burden clearly include those beyond our own national borders.

This paper reviews what we know from economic theory and evidence about the burden of the corporate income tax. While the ultimate incidence of the tax remains somewhat unresolved, there have been many advances over the years in our thinking about how to assign the corporate tax burden; we don't have all the answers, but we do have a much better idea where to look for them. I begin with some basic facts about the corporate income tax, and then move to the evolution of thought about its burden, starting from a fairly simple approach based on the ownership of corporate shares. After considering Harberger's (1962) landmark contribution, I then discuss a variety of important issues absent from that analysis, including dynamics, investment incentives, corporate financial policy, risk, imperfect competition, the choice of organizational form, international capital flows, and managerial incentives. My focus is on the federal corporate income tax. States, too, impose corporate income taxes, but the incidence of these taxes is also influenced by additional factors, notably the degree of capital mobility across states and the formulas states use to apportion income according to the location of sales, assets and employment, so that tracing the incidence would lead me too far astray from my main task.²

² For further discussion, see McLure (1980) and Gordon and Wilson (1986).

CORPORATE TAXATION IN THE UNITED STATES

The U.S. corporate income tax, in fiscal year 2004, accounted for 10 percent of federal revenues, or 1.6 percent of GDP. Figure 1 provides these two measures annually since 1962. From the figure, it is obvious that corporate revenues have declined over time as a share of revenues and of GDP. The ratios move closely together, consistent with the fact that revenues have been relatively stable as a share of GDP. The corporate tax today is far less important than in the 1960s, when it regularly accounted for more than 20 percent of revenue. Very recently, there has been concern that corporations have used increasingly aggressive strategies to limit tax liabilities. While these concerns may be valid, they are not responsible for the sharp decline in the importance of the corporate tax shown in Figure 1. Discounting year-to-year movements and cyclical fluctuations in this volatile stream of revenue induced by the volatility of corporate profits themselves, there is little trend over the past two decades. Looking back over the decline that occurred between the 1960s and the 1980s, Auerbach and Poterba (1987) assigned a significant share to changes in tax policy, but found other factors, such as changes in corporate financial policy, to be important as well.

Corporations vary enormously in size. While most corporations are relatively small, the preponderance of corporate income tax revenue comes from large corporations. In 2001, for example, 0.04 percent of all corporations, those with assets above \$2.5 billion, accounted for 62 percent of all corporate income taxes (Treubert 2004, Table 1).

Simple economic theories tend to distinguish between corporate and non-corporate enterprises, but there are many entity types with hybrid characteristics. Perhaps most relevant to the current discussion are S corporations, which share many of the legal attributes of traditional

C corporations³ (perhaps the most important being limited liability), but have their income taxed directly to individual owners, as is the case for non-corporate ownership structures. When thinking of the incidence of the corporate tax, we treat S corporations as part of the non-corporate sector, although the ability of an entity to choose between C- and S-corporation forms has clear implications for the incidence of additional taxes on C corporations. The importance of S-corporation status has grown steadily over the years. As of 1986, about one-fourth of all U.S. corporations were S corporations; by 1997, this share had risen to more than half (Luttrell, 2005, Figure A).⁴ In 2001, S corporations accounted for almost a quarter of before-tax corporate profits (Treubert 2004, Figure B).

For various types of business, including sole proprietorships and partnerships as well as S corporations, income from the business is assigned to the business's individual owners and then aggregated with the other incomes of these owners and subject to the individual income tax. The incomes of C corporations, by contrast, are subject to a distinct tax on corporate income that treats the corporation as an entity subject to taxation. Shareholder income from C corporations in the form of dividends and capital gains is then subject to additional taxation under the individual income tax.

AN INITIAL APPROACH TO CORPORATE TAX INCIDENCE

Perhaps the simplest and oldest theory of corporate tax incidence is that the tax falls on corporate shareholders in proportion to their ownership. This theory may be implicit in the

³ The letters S and C stand for the corresponding subchapters of Chapter 1 of the Internal Revenue Code.

⁴ An alternative to the S corporation that also provides limited liability and pass-through tax treatment is the Limited Liability Company (LLC). LLCs offer more flexibility than S corporations in some dimensions, notably in not restricting the number of investors. They, too, have also grown in importance in recent years, although as of 2002 S corporations accounted for considerably more net income (\$183.5 billion) than did LLCs (\$48.6 billion). See, respectively, Luttrell (2005, Figure C) and Wheeler and Parsons (2004, Figure 1).

minds of those who view the corporate tax as very progressive, for individual share ownership is highly concentrated among higher income individuals. In 2001, for example, 90 percent of families in the top income decile held stock (either directly, or indirectly through mutual funds or retirement accounts), with a median value among those holding stock of \$248 thousand. For the population as a whole, 52 percent held stock, with a median holding of just \$34 thousand (Aizcorbe et al. 2003, Table 6), and with the fraction holding stock rising steadily with income.

But even this simple method of assigning the burden of the corporate tax is not so simply applied. First, a corporation may have both preferred and common shares, and more than one class of common shares, each category of shares conferring different rights to the corporation's income. If an increase in the rate of corporate taxation reduces a corporation's after-tax income, it is not always clear how much of this reduction will be borne by different categories of shareholders. Indeed, this ambiguity is one of the reasons why S-corporation status is available only for corporations with one class of shares – to assign income to shareholders we must have a clearly defined way of doing so.

Second, even where the assignment of income is clear, not all shareholders are individuals. Table 1 provides a breakdown of the ownership of U.S. corporate equity at the end of 2004. Households owned less than half of all equity directly, with substantial fractions held by various institutions and financial intermediaries. Ownership through mutual funds, the second-largest ownership category, is not a major issue, because tax provisions allow the pass-through of income directly to individual owners of mutual fund shares. But the other major class of institutional owners, nonprofit institutions and retirement funds, poses a more difficult problem.⁵

⁵ This problem applies not only to these institutions' direct holdings of corporate equity, but also to their indirect holdings via mutual funds.

Among pension funds, we may distinguish one category, defined-contribution plans and other tax-sheltered vehicles, for which the accounts are owned by beneficiaries. For these accounts, it is natural to treat the individual beneficiaries as the ultimate owners of shares held in the funds. But for the remaining assets, held in the funds of defined-benefit plans, the assignment of ownership is less obvious. For private-sector defined-benefit plans, the first thought might be to assign the assets in these funds to the corporations that maintain them (and hence ultimately to the shareholders of those corporations), because the corporations are using the pension funds to meet pension liabilities. According to this line of reasoning, any fluctuations in the fund balances attributable to changes in corporate income taxation will require offsetting contributions by the corporations; hence the shareholders of these corporations bear the burden of these changes. But this reasoning breaks down if pension liabilities are responsive to the health of the pension fund, either because of influences on the relative bargaining power of employers and employees, or because of the ability of employers to "put" pension liabilities to the Public Benefit Guaranty Corporation (PBGC) at a cost lower than the actuarial pension liability.⁶ In this case, a portion of the pension fund really "belongs" to employees⁷, but the breakdown between employers and employees is an empirical issue on which there is little evidence. A similar ambiguity arises with respect to public-sector defined-benefit plans, with taxpayers assuming the role taken by shareholders in the case of private-sector plans.

For the remaining tax-exempt entities – nonprofit institutions such as universities and foundations – there are no owners to which incidence can be assigned. Presumably, the incidence of corporate taxes that reduce the income of such entities is borne in some measure by beneficiaries (through reduced services), donors (through increased contributions), employees

⁶ The 2005 PBGC takeover of some of United Airlines' pension plans is a recent example.

⁷ See Bulow and Scholes (1983) for further discussion.

(through reduced compensation), and perhaps others with more indirect connections, such as vendors. As with the division of "ownership" for defined-benefit pension plans, how the burden of reduced non-profit funds would be borne is an issue on which there is little evidence.

Another category of shareholders not represented in Table 1 (because their holdings are netted out) is corporations themselves. The assignment issue is not a problem; if corporation A owns shares in corporation B, then the portion of B's corporate tax we allocate to A can be attributed back to A's shareholders. But the tax burden will be different because of the additional level of corporate ownership. Corporations receive a deduction from taxable income of only 70 percent of dividends received, meaning that such dividends face an effective tax rate of 10.5 percent (30 percent of the current corporate tax rate of 35 percent); there is no deduction for inter-corporate capital gains. Thus, the corporate tax burden on shareholders' income increases as that income passes through additional corporations.

It would be an interesting exercise to confront each of the assignment problems just discussed and trace all corporate income taxes back to individual taxpayers, to determine the incidence pattern implied by the "simple" approach of assigning corporate taxes to shareholders. That this has not been done probably reflects both the difficulty of the exercise and the fact that the shareholder-incidence method has been perceived to have little theoretical credibility. But, as discussed below, incidence has a dynamic dimension that is often ignored. Even if shareholders eventually shift some, most or even the entire corporate tax burden to others, this shifting need not occur immediately. To the extent that adjustment takes time, some of the corporate tax may indeed be borne by shareholders, and so the exercise just outlined would remain useful. Indeed, other considerations discussed below indicate that shareholders may be unable to shift the tax even in the long run.

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Once we move beyond the assignment of the corporate tax burden based on information about direct or indirect corporate ownership, an economic model is needed. Only with such a model can we estimate how the corporate tax affects the real incomes of different groups in the population through its impact on factor returns and product prices. In one of the most influential papers ever written in the field of public finance, Harberger (1962) followed this strategy, analyzing the incidence of the corporation income tax using a two-sector general equilibrium model. Harberger's contribution has had a lasting impact on incidence analysis and provides a useful benchmark against which to compare subsequent developments in the literature.

THE HARBERGER MODEL

Grouping all production in the U.S. economy into two sectors according to whether production was predominantly carried out by corporate or non-corporate businesses, Harberger characterized the corporate tax as an additional tax levied on capital income originating in the corporate sector, layered on top of the individual income tax collected on capital income from both sectors. He then estimated incidence through the changes in factor prices and product prices that would result from a small increase in the corporate tax.

Harberger's main conclusion is probably the most familiar aspect of the paper. In particular, under reasonable assumptions regarding the two sectors' production elasticities of substitution and consumers' elasticity of substitution between the two sectors' products, Harberger showed that the corporate income tax was borne fully by owners of capital, economy-wide. This finding has two important elements. First, capital bears the entire tax; it is not shifted to labor or consumers, the other potential victims in the model. Second, it is *all* capital, not just corporate capital, that bears the tax. Thus, if corporate capital accounts for 25 percent of the economy's capital, its individual owners will bear 25 percent of corporate taxes; the other 75

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percent will be shifted to owners of non-corporate capital. Intuitively, the lower after-tax return that would be available in the corporate sector because of the higher tax burden drives capital into the non-corporate sector, pushing down the available non-corporate return and allowing the corporate return to recover. In equilibrium, the after-tax returns in the two sectors must be equal, and Harberger estimates that this new equilibrium level of after-tax returns will be lower by just the amount consistent with capital bearing the entire corporate tax.

Harberger's conclusion, which probably remains the most commonly held view on corporate tax incidence, indicated that the corporate tax was less progressive than under the shareholder-incidence assumption, because shareholders as a group (at least in 1962, when pension funds accounted for a much smaller ownership share) were more affluent than owners of capital as a whole, a large share of which is owner-occupied housing. But aggregate capital ownership is more concentrated among higher income individuals than consumption or labor income, and so the corporate income tax could still be seen as contributing to tax progressivity.

Another message of Harberger's work, though, was that the corporate income tax distorted the allocation of capital between corporate and non-corporate uses in a way that an overall capital income tax did not. If the incidence of the two taxes were the same, then, the only "contribution" of the corporate tax was gratuitous deadweight loss. Indeed, the subsequent optimal taxation literature supported the notion that taxes that distort production decisions are to be eschewed when sufficient other tax instruments are available (Diamond and Mirrlees 1971). Thus, Harberger's analysis has also lent support to the view that corporate tax is not a necessary or desirable component of an efficient, progressive tax system.

Harberger's analysis spawned a vast literature over several years that extended and challenged his initial results. The simplicity of Harberger's technique – comparative static

analysis of small changes in a two-sector model – proved not to be a major source of concern given that similar findings resulted from analysis using a multi-sector computable general equilibrium model (Shoven 1976). But Harberger's analysis also relied on several more important simplifying assumptions. Two assumptions already mentioned are (1) that the corporate tax can be viewed as an add-on tax on capital income originating in the corporate sector, and (2) that production in a particular sector must be exclusively either corporate or non-corporate. Other key assumptions include: (1) free mobility of factors across sectors, (2) fixed economy-wide factor supplies, (3) competitive markets and constant returns to scale, implying that all corporate profits represent normal returns to capital, (4) a closed economy, (5) no risk, and (6) no differences in spending patterns among individuals and between individuals and government. All of these assumptions have been examined in the literature.

DYNAMICS

Even if the Harberger model paints an accurate picture of the long-run effects of the corporate tax, few would argue that these effects are observed immediately. Labor, and especially capital, cannot freely shift from one sector of production to another. While computers can be moved from one office to another, it is considerably more difficult to turn a nuclear power plant into a tractor. Thus, it is probably more reasonable to think of the shifts predicted by the Harberger model as occurring over time, with some capital moving right away and other capital shifting more gradually, for example, as capital in the corporate sector wears out and is replaced by different types of capital in the non-corporate sector. It is tempting to view this as simply a transition phenomenon, i.e., that the incidence is temporarily at variance with Harberger's predictions but consistent with them in the long run. But the period of transition may be long, and its influence on incidence is immediate and quite important.

Figure 2 illustrates the impact of gradual adjustment of capital to an increase in the corporate tax, under the assumptions that the economy is in long-run equilibrium at date 0 and there is an unexpected introduction of a corporate tax at date 1. Initially, the economy-wide rate of return, both before-tax and after-tax, is r_0 . At date 1, the tax is imposed after capital allocation has been fixed, so there can be no change in the before-tax returns in either sector – as capital is in fixed supply in the corporate sector, it must absorb the entire tax through a lower after-tax return. Over time, as capital shifts from the corporate sector to the non-corporate sector, the before-tax return in the corporate sector rises and the after-tax return in the non-corporate sector falls, with the after-tax returns in the corporate and non-corporate sectors, r_{net} and r_{nc} , respectively, gradually coming together at a new equilibrium value of r_2 . According to Harberger's analysis, the economy-wide decline in the net return to capital from r_0 to r_2 , multiplied by the capital stock, will roughly equal the tax revenue collected in the long run.

What is the incidence of the corporate tax in this instance? In terms of returns to capital, the impact is felt initially by corporate capital and then spreads to all capital. But, in terms of capital owners, the answer is quite different with respect to timing. The distinction is due to *capitalization* – the reflection in asset values of anticipated differences in returns to capital. While capital and the returns to capital adjust slowly, asset values and asset returns adjust instantaneously. Because investors will demand the same after-tax rate of return on corporate and non-corporate assets, corporate assets must drop in value, relative to non-corporate assets, by an amount roughly equal in present value to the gap between the returns r_{nc} and r_{net} . Thereafter, investors in corporate and non-corporate assets will receive equal rates of return at every point in time. What will this rate of return be? The answer depends on the technology of adjustment.

Under the *q*-theory of investment envisioned by Tobin (1969) and developed by Hayashi (1982),

Summers (1981) and others, the surge in demand for non-corporate capital will temporarily increase the full cost of installed capital in that sector, driving up non-corporate asset prices relative to replacement cost. This, in turn, will reduce the asset-based return on non-corporate capital – and hence corporate capital as well – below r_{nc} during the adjustment process.

We have, then, a pattern of incidence that must be characterized not only in terms of rates of return to capital, but also asset values. The corporate tax introduced at date 1 will be borne partially by current owners of corporate capital, through an initial drop in asset values, and partially by future investors in corporate and non-corporate capital, through lower rates of return. The total burden borne by these three groups as a whole will exceed the total burden of the tax, because initial owners of non-corporate capital will gain from an increase in asset values.⁸ The allocation of the burden among these groups will depend on the adjustment technology. If adjustment is instantaneous, Harberger's analysis applies and the burden will fall entirely on future capital owners. If adjustment occurs at a glacial pace, then virtually the entire burden will be borne by existing corporate shareholders.

The distinction between changes in asset values and changes in asset returns is important, even if all investors hold the same portfolio of corporate and non-corporate assets, because the timing of incidence differs. Whereas lower asset returns occur over time, changes in asset values occur immediately. This distinction can be best understood in a generational context. For older asset holders who have accumulated capital and have short planning horizons, the change in asset values will be most relevant. For younger individuals who have accumulated little wealth but have longer planning horizons, the change in the rate of return will matter more. Thus, we can think of the different components of the corporate income tax burden in generational terms: a

⁸ Indeed, one can consider additional groups of winners and losers from gradual adjustment to changes in the corporate tax burden. For example, Goolsbee (2003) finds that workers in industries that produce capital goods experience an increase in wages in response to tax-induced increases in investment demand.

reduction in asset values that primarily hits the old, and a reduction in rates of return that primarily hits the young.

The pattern of incidence would be different for an anticipated increase in the corporate tax rate as adjustment would begin as soon as the future tax increase became known, leading to a smaller initial decline in corporate asset values and more of the burden being shifted to new investors. Thus, prior announcement of a corporate tax increase could be used to cushion the burden on existing asset owners, but, if one moves beyond a world of fixed factor supplies, it would affect economic efficiency as well: tax-induced reductions in rates of return distort saving and investment decisions, while unexpected drops in asset values do not.

A final caveat should be issued here regarding the distinction between share ownership and exposure to fluctuations in share prices. With the growing use of stock options and other financial derivatives, it has become easier and cheaper over time to hedge all or some risks associated with stock price fluctuations. In theory, one could use derivatives to hedge the risks of tax changes, shifting the burden onto counterparties to the derivative transactions. While this is unlikely an important issue at present, the pace of financial innovation suggests that it may become one in the future.

Two important conclusions so far are (1) that it is misleading to allocate the burden of a corporate tax increase to all capital, even if that result holds in the long run after capital has completely adjusted, and (2) that it is difficult to convey the incidence story in a one-dimensional breakdown of households, say by wealth, income, or asset ownership: the generational incidence pattern is extremely important as well.

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INVESTMENT PROVISIONS

The corporate income tax is not simply a uniform tax on economic income originating in the corporate sector. The deviations in the tax base from economic income, in turn, affect the incidence of the corporate tax itself. One deviation relates to investment provisions. A second, discussed in the following section, involves the deductibility of corporate interest payments.

As modeled by Harberger, the base of the corporate income tax equals income from all corporate capital. In particular, income from capital goods of different vintages is taxed at the same rate. In reality, capital goods of different ages receive different treatment, even though they are subject to the same statutory corporate tax rate, because of differences in depreciation provisions. This is true not only if the law has changed over time (in which case different vintages would be written off according to different schedules), but even if the law has remained constant, for depreciation allowances do not track the actual economic depreciation of assets. Given that an asset's income equals its gross returns less depreciation, depreciation allowances that fall short of economic depreciation lead to a tax base greater than income, and allowances in excess of economic depreciation lead to a narrower tax base.

Having depreciation allowances smaller or larger than economic depreciation simply leads to effective tax rates higher or lower than the statutory corporate tax rate. But allowances that follow a different pattern over time than economic depreciation can also induce differences in the relative treatment of new and existing assets. This distinction is illustrated in Figure 3, which depicts various potential depreciation schedules for an asset that decays at 10 percent per year. Economic depreciation for such an asset would follow the declining-balance method, starting with a 10-percent deduction in the first year of ownership and following the pattern labeled "economic." A proportionate reduction in each year's allowances would result in the

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pattern labeled “reduced.” Following economic depreciation, but based on historic cost rather than current cost, would lead instead to the pattern labeled “historic cost,” starting at the same point as the original schedule but falling faster as prices rise. An historic-cost schedule allowing faster write-off, perhaps to compensate for the erosion of allowances due to inflation⁹, might look like the pattern labeled “historic cost, accelerated.” Such a depreciation schedule is accelerated relative to economic depreciation both by historic cost accounting and explicit acceleration.

With accelerated depreciation schedules, new assets are more attractive than old ones of the same productivity because they convey future depreciation allowances that are higher in present value. Prior to 1986, an additional distinction was provided by the investment tax credit, which was received upon an asset’s purchase but not available to capital already owned. The overall impact of such investment provisions on the value of capital can be assessed using the expression:

$$(1) \quad V_{old} = V_{new}(1 - k - \tau_{new} + \tau_{old}),$$

where V_{new} is the value of a new unit of capital, V_{old} is the value of an existing unit of equally productive capital, k is the investment tax credit, τ is the corporate tax rate, $V_{new}z_{new}$ is the present value of depreciation allowances for the unit of new capital¹⁰, and $V_{new}z_{old}$ is the present value of depreciation allowances for the unit of existing capital. For economic depreciation, $k = 0$ and $z_{new} = z_{old}$, so $V_{old} = V_{new}$. But typically $V_{old} < V_{new}$. Calculations in Auerbach (1983) found that the ratio V_{old}/V_{new} fell to around 0.8 for corporate fixed capital after the Economic Recovery Act

⁹ This, indeed, was the approach taken by the Tax Reform Act of 1986, which sought to provide depreciation allowances equal in present value to economic depreciation but based on historic cost.

¹⁰ z_{new} is the present value of allowances per dollar of new capital.

of 1981, due to the combination of high inflation, accelerated depreciation, and the investment tax credit. The Tax Reform Act of 1986 reduced this discount substantially by lowering the corporate tax rate (which reduces the importance of differences in depreciation allowances), and eliminating the investment tax credit, with the drop in inflation over the same period working in the same direction. Auerbach (1996) estimated a comparable value for the mid-1990s of greater than 0.9.

What impact does this old-capital discount have on the incidence of the corporate tax?

The discount,

$$(2) \quad (V_{new} - V_{old})/V_{new} = k + \tau(z_{new} - z_{old}),$$

reflects the fact that old capital’s tax base is broader than new capital’s. An increase in the corporate tax rate, therefore, increases the discount by $(z_{new} - z_{old})$ per each unit tax increase. This differential increase represents a levy on existing capital – a portion of future corporate taxes that are immediately capitalized into the value of existing assets. The incidence of this capitalized portion should be on existing shareholders, with only the remaining future corporate taxes relevant for the incidence analysis already carried out.¹¹

But, recall that this previous analysis also called for a division of the corporate income tax into components, with some future corporate tax revenues capitalized into the value of existing corporate assets, and the remaining revenues spread among future capital owners as envisioned by the Harberger model. Thus, we now have layers of decomposition. Because capital is slow to adjust, a portion of any corporate income tax increase will be borne by existing shareholders. Of the remaining portion, an additional piece will also be borne by shareholders,

¹¹ Auerbach, Gokhale and Kotlikoff (1991) provide estimates of the impact of this adjustment on the generational incidence of taxation.

in the form of a "surcharge" on existing assets that does not affect the incentives to accumulate capital within the corporate sector.

Using expression (2), one can also estimate the incidence of other changes in the tax structure. For example, an increase in corporate tax collections accomplished through a reduction in the generosity of depreciation allowances (a reduction in $z_{(wv)}$) or a reduction in the investment tax credit, k , will reduce the old-capital discount. Thus, the effective increase in the corporate tax on new capital will be higher than is reflected in future corporate tax collections, for a portion of these collections will go to provide a *windfall* to existing capital.

There have been few attempts in the literature to consider the combined capitalization effects of corporate tax changes attributable to gradual capital-stock adjustment and the distinction between old and new capital. One example is Auerbach's (1989) estimates of the impact of the Tax Reform Act of 1986 on the value of corporate equipment and structures. That analysis found that TRA86 increased corporate taxes at the margin of new investment, leading to a small decline in the value of existing assets following the logic of the previous section, but also provided substantial windfalls to existing capital through the corporate tax rate reduction and investment tax credit repeal. The net impact was a substantial increase in existing asset values, estimated at from 9-14 percent for equipment and 4-14 percent for structures, with the results varying with assumptions about the speed of capital stock adjustment and expectations regarding the tax reform. Thus, changes that were estimated to have little net impact on corporate tax revenues¹² nevertheless could have significant incidence effects, the result of a combined

increased burden on new capital and reduced burden on existing capital. These were predictions

¹² The 1986 act contained a number of other corporate tax provisions that accounted for a projected overall increase in corporate tax revenues. See Auerbach and Stemrod (1997), Table 1.

based on theory, of course, although contemporaneous empirical evidence provided some support (Cutler 1988).¹³

CORPORATE FINANCIAL POLICY AND SHAREHOLDER TAXES

As discussed above, one of Harberger's assumptions was that the corporate tax rate was imposed as an increment, over and above the individual tax rate that applied in both corporate and non-corporate sectors. This would be a reasonable characterization of the situation in the United States prior to 2003 if all corporate-source income were paid out as dividends, for until 2003 dividends were taxed as ordinary income after the corporate tax had been applied. But only a share of corporate earnings are distributed as dividends, and only a share of the returns to corporate capital accrues as corporate earnings – a large portion passes out of the corporation as interest payments on corporate debt.

With corporations having the option to issue debt, the interest payments on which are deductible at the corporate level, and to retain earnings, thereby trading off current dividends for capital gains on which taxes may be lower and can be deferred, how much "double taxation" does corporate capital actually face? In the extreme, if corporations finance all their investment by borrowing, there is no corporate tax imposed on investment; indeed, corporate tax liability is reduced, because *nominal* interest payments – a portion of which simply compensates lenders for a loss in purchasing power – are tax deductible.

¹³ One can apply the same methodology to the most recent changes in capital recovery provisions, the temporary "bonus depreciation" schemes of 2002 and 2003. The provisions (described in more detail by Desai and Goolsbee 2004) provided immediate write-off rather than depreciation for 30 percent (under the 2002 legislation) or 50 percent (under the 2003 legislation) of qualifying investment purchases (equipment investment, plus special purpose structures with tax lifetimes of 20 years or less); this accelerated write-off acted like a small, temporary investment tax credit. The reduction in market value due to the new-old capital distinction should have been approximately 1-2 percent of the affected capital stock, with a portion of this being offset by gradual adjustment to the increased incentive to invest. The size of this latter effect depends not only on adjustment costs but also on expectations regarding the permanence of the provisions, but under reasonable assumptions the net overall impact predicted is a decline in value of less than 1 percent of the affected capital stock.

Corporate capital structures are not exclusively debt, of course, but the presence of the debt-equity choice means that we must look more closely at the reasons for equity finance. While some theories argue simply that debt capacity is limited, and so that some corporate capital must be subject to double taxation, other theories suggest that the choice of equity capital indicates a tax *preference* for equity, i.e., that the overall tax on equity income is lower than that on debt income, so that the burden implied by debt finance represents an upper bound for the burden on corporate capital. Because the tax imposed on debt finance – with single taxation to the recipient – is similar to that on non-corporate capital, these theories, in turn, suggest that corporate capital may be *favoured* by the tax system, rather than being discriminated against. This implies, in turn, that the presence of the corporate income tax may not discourage corporate activity, but also that increases in the corporate tax rate may simply be borne by shareholders who, as a result, derive lower benefits from the corporate tax structure.

Two such theories are those developed originally by Stiglitz (1973) and Miller (1977). Stiglitz argued that equity would be used by firms to finance only that portion of their value in excess of invested capital. For example, an entrepreneur already in possession of patents or other valuable intangible assets might be able to turn an investment of \$1 million in plant and equipment into an enterprise worth \$1.5 million. If the entrepreneur incorporated, he would wish to finance the \$1 million investment using borrowed funds, so that the returns to capital could be sheltered from the corporate tax. But issuing any additional debt, up to the corporation's full value of \$1.5 million, would require an immediate taxable distribution of funds to the owner/entrepreneur.¹⁴ Thus, Stiglitz argued, corporate equity supported intangible assets within the corporation that had been accumulated without tax at either the corporate or individual level,

¹⁴ The firm could, of course, invest additional borrowed funds in interest-bearing assets, with no net tax impact, but this action would not represent any change in the value of its equity.

and that would remain free of tax as long as the corporation could avoid paying dividends and the investor could avoid selling shares. Until then, only the additional income on these assets would be taxable annually, at the corporate level. Indeed, one can show that the decision of whether to cash in immediately or maintain ownership of the intangible assets in the form of equity depends only on whether the corporate tax rate is higher or lower than the individual tax rate, assuming that the tax treatment of the asset sale would be the same at different points in the future.¹⁵ That is, the effective tax rate on this component of equity is simply the corporate tax rate τ – there is effectively no double taxation of corporate equity that arises in this manner.

As it is empirically reasonable that the corporate tax rate will be less than or equal to the ordinary tax rate, t_p , for well-to-do shareholders, this theory suggests that corporate equity may bear no higher burden than corporate debt, and hence that the corporate income tax imposes no additional burden. Further, given the same assumptions about the relationship between τ and t_p , the entrepreneur would gain nothing from eschewing the corporate form at the outset, for selling the intangible asset held in a non-corporate enterprise would still generate a tax liability at the capital gains tax rate, t_g , and the annual returns on the asset held in non-corporate form would be taxed at rate t_p ; the decision of whether to incorporate or not depends, again, on whether τ is lower or higher than t_p . Thus, a small increase in τ that maintains the inequality $\tau < t_p$ would be borne by the entrepreneur-shareholders, at least to the extent that their original innovation activity was unaffected.

¹⁵ Cashing in immediately would yield $(1-t_g)$ for each dollar inside the firm, assuming capital gains tax treatment at rate t_g . If the assets remained in equity form, they would accumulate at the rate $r(1-\tau)$, where r is the before-tax rate of return and τ is the corporate tax rate. Cashing in at some future date T would thus yield a net amount of $(1+r(1-\tau))^T(1-t_g)$, providing an annual return of $r(1-\tau)$ per dollar of funds retained as equity. Had the funds been withdrawn, they would have earned an annual return $r(1-t_p)$, where t_p is the ordinary individual tax rate.

While interesting and influential in its impact on subsequent research, Stiglitz's theory fails to characterize most of the equity in the corporate sector. Recall that the theory predicts that debt will be used to finance capital expenditures. Hence, corporate debt should equal the corporate capital stock or, on a flow basis, borrowing should equal capital expenditures. In fact, capital expenditures typically far exceed borrowing. In 2004, for example, U.S. non-farm, non-financial corporations had \$900 billion in capital expenditures and obtained \$231 billion through credit markets (Board of Governors 2005, Table F.102). What can explain the remaining portion of equity? Here, the theory of Miller (1977) comes in. Miller focused on the heterogeneity of individual investors, arguing that, under a progressive tax system, there may be some investors in a high enough tax bracket that the extra taxation at the corporate level is more than offset by the preferential individual tax treatment of equity income.

The after-tax return to equity holders from a dollar of pre-tax corporate returns is $(1-\tau)(1-t_e)$, where t_e is the effective individual tax rate on equity income. The return to debt holders is $(1-t_p)$. Hence, even though there is double taxation of equity income, equity faces a lower tax burden if:

$$(3) \quad (1-\tau)(1-t_e) > (1-t_p); \text{ or } t_p - t_e > \tau(1-t_e).$$

That is, the taxes saved at the individual level exceed the net additional corporate taxes. According to Miller's theory, investors with a tax preference for equity would hold equity, those with a tax preference for debt would hold debt, and corporations would be indifferent between the two, issuing enough of the two securities, in the aggregate, to satisfy the demands of investors. Assuming that the equity tax rate is some fraction of the ordinary tax rate, say $t_e = \lambda t_p$, the decision to hold equity, from the second equation in (3), becomes:

$$(4) \quad t_p(1-\lambda) > \tau(1-\lambda t_p), \text{ or } t_p > \frac{\tau}{1-\lambda(1-\tau)} \equiv t_p^*.$$

Expression (4) implies that investors will sort by personal tax rate; those with a personal tax rate below some critical level, t_p^* , will hold only debt, and those with a higher tax rate will hold only equity, with those at that critical tax rate indifferent. If the corporation's before-tax rate of return equals r , then it will pay equity holders $r(1-\tau)$ and debt-holders r , reflecting the corporate-level tax differences. This sorting equilibrium is shown in Figure 4.

Even with investor heterogeneity, is it plausible that a significant share of investors will have a tax preference for equity, based on expression (3)? Currently, the U.S. top rates of tax on corporations and individuals are 35 percent, so this would be impossible. Even before recent tax cuts, the top individual rate in recent years has not been substantially higher than the corporate rate since before 1981. Thus, a very low effective equity tax rate would be required, and this seems inconsistent with the fact that a substantial share of equity earnings come to investors as (until 2003) fully taxed dividends. However, according to the "new view" of dividend taxation (Auerbach 1979, Bradford 1981, King 1977), the effective rate of individual tax on equity may be the capital gains rate, adjusted for deferral – a very low rate – even if dividends are distributed, when retained earnings are the source of equity finance, as they are for most large corporations. Further, the relevant corporate tax rate in expression (3) may be below the statutory rate if corporations face limits on their ability to deduct additional interest payments, an issue that has been found to be relevant empirically in various studies.¹⁶ Thus, through potentially low values of t_e and τ , expression (3) may be satisfied for a number of investors, and

¹⁶ See Auerbach (2002) for further discussion.

it is these investors' portion of shareholder wealth, not of the shareholder population, that determines the extent of equity preference in the Miller model.

The Miller model has interesting implications for the incidence of the corporate tax. Because investors holding equity are taxed at a lower rate than they would be holding debt, the corporate tax is a tax shelter – equity-holders would be worse off if corporate-source income were treated just like non-corporate income. Thus, an increase in the corporate tax rate will reduce the tax benefit from holding equity, but, unless the preference for equity over debt disappears, will not affect portfolio choice.

The dashed line in Figure 4 illustrates the impact on equilibrium of an increase in the corporate tax rate from τ to τ' . Investors with personal tax rate above τ_p'' will continue to hold equity, but will receive a lower return for doing so – they bear the full brunt of the corporate tax increase; investors with tax rates between τ_p' and τ_p'' will shift from equity to debt; doing so allows them to avoid a portion of the corporate tax increase; and investors with a personal tax rate below τ_p' will not be affected at all. Unlike in the Harberger model, there is nowhere for those with tax rates above τ_p'' to go, because equity is still their tax preferred asset – after-tax returns on different assets are not equal for them.¹⁷ Thus, there is no shift out of corporate equity for investors with wealth above τ_p'' and, because debt is always an option, no need for capital to shift out of the corporate sector, even for those investors with tax rates between τ_p' and τ_p'' who now choose not to hold corporate equity.¹⁸

¹⁷ This specialization highlights another requirement of the Miller model, that investors not be able to hold unlimited short positions in either debt or equity.

¹⁸ These conclusions, like those of the original Harberger model, are based on the assumption of fixed wealth. If corporate shareholders' wealth accumulation declined in the face of higher tax rates, this could drive up before-tax returns to all investors, partially offsetting the initial impact of the corporate tax.

According to the Miller model, then, an increase in the corporate tax is largely borne by corporate shareholders – yet another way in which shareholders may bear the corporate tax. But, leaving aside whether expression (3) is satisfied for an adequate portion of shareholder wealth, there is another serious challenge to the Miller model – investors clearly do not specialize. A large share of the portfolios of tax-exempt institutional investors takes the form of equity, and at least some corporate bonds are held in the portfolios of higher income individuals.

As discussed by Auerbach and King (1983), the Miller model breaks down when assets are risky and investors must balance the objectives of diversification and tax minimization. High-bracket investors may wish not to hold only equity, and low-bracket investors may wish to hold a portion of their portfolio in higher-yielding risky assets such as equity. Tax preferences will influence portfolios – those in higher brackets will still gravitate toward assets, like equity, with more favorable individual tax treatment. This modification of the model implies that the incidence conclusions based on the simple Miller model are overly strong: while high-bracket investors suffer more from an increase in the corporate tax, because of their higher concentration in equity, even tax-exempt investors will bear some of the burden as well. A second implication is that corporate bonds and non-corporate equity are no longer perfect substitutes, tax considerations aside, so that investors fleeing from corporate equity may need to look outside the corporate sector for their investments.¹⁹

Thus, the predictions of the Harberger model, that owners of corporate capital are hit initially by an increase in the corporate tax and that this leads to a shift of capital outside the corporate sector, are partially reestablished by modifying the Miller model to incorporate risk.

¹⁹ Some equity investors would also flee the corporate sector if the Miller model were extended to include an additional tax-favored asset, e.g., tax-exempt municipal debt. In that case, investors in the very highest individual tax brackets would choose to hold municipal bonds, and an increase in the corporate tax rate would make such bonds attractive to individuals near the equity-municipal bond margin. As with a shift of investors into the non-corporate sector, this would spread the incidence of the tax increase to the returns on other assets.

The Incidence of Corporate Integration Proposals

The previous discussion shows that having two levels of tax on corporate-source income doesn't necessarily imply double taxation of that income, in the sense of a cascade of corporate and individual rates. The structure of corporate and individual taxation may allow some investors to face marginal tax rates on corporate-source income that are little higher or even lower than their tax rates on ordinary income. Just as having two levels of tax doesn't equate simply to double taxation, reducing tax rates at one level doesn't translate simply into marginal tax rate reductions.

Proposals for the "integration" of corporate and individual income taxes typically do not involve full integration of the two taxes, in the sense of treating C corporations like S corporations or partnerships. As mentioned above, this would be difficult, given the complexity of allocating income to different classes of shareholders in the modern C corporation. Rather, integration proposals and integration schemes in practice elsewhere in the world generally involve reduced taxation of dividends, reflecting the assumption that dividends face a higher individual tax burden and that firms can choose to pay earnings as dividends (or can be deemed to have done so) to qualify for the tax benefit²⁰. What is the incidence of adopting such schemes, starting from the current U.S. system?

A first observation is that schemes can be made roughly equivalent regardless of whether they are imposed at the corporate or shareholder level. For example, a dividends-paid deduction for the corporation (also called a split-rate system) equates to a dividends-received credit for corporate taxes paid (also called an imputation system) as long as the latter is refundable to shareholders (such as tax-exempt investors) whose tax liability is insufficient to cover the credit.

²⁰ See Graetz and Warren (1998) for a detailed discussion of various integration mechanisms developed in two studies during the early 1990s, one by the U.S. Treasury and the other by the American Law Institute.

Each of these schemes, the standard approaches to integration in practice, amounts to a reduction in the tax rate on dividends. This leads to a second observation, that the incidence of a corporate tax reduction depends on the manner in which corporate taxes are reduced. Reducing the corporate tax rate and reducing the tax rate on corporate dividends are not the same policy, even if the tax reductions are both implemented through a reduction in corporate tax payments and have the same revenue costs. Indeed, under the new view of equity taxation discussed above, the dividend tax does not impose a marginal tax rate on new corporate capital investment, but is capitalized into the value of corporate shares. Thus, a reduction in that tax does not reduce the marginal tax rate on corporate capital, but simply increases the value of corporate shares.²¹ This highlights yet another possible way, in addition to those already explored above, in which an increase in corporate taxation, in this instance an increase in the rate of tax on dividends, would be borne by existing shareholders rather than being spread to other current and future owners of all capital.

RISK

Since the work of Domar and Musgrave (1944), economists have noted that taxes on capital income provide insurance as well as imposing burdens. Consider an arms-length asset-market investment that yields a risky rate of return at rate r , which has an expected value greater than the safe rate of return, i . We may decompose the return on the risky asset into two components, the safe rate of return and the excess return,

$$(5) \quad r = i + (r - i)$$

²¹ Under the same theory, a reduction in the corporate tax rate *would* lower the cost of corporate capital.

As has been established in the literature²⁷, a proportional tax system that provides a full loss offset (that is, the same tax rate applies whether income is positive or negative) imposes a burden on investors only to the extent that the first component on the right-hand side of (5), the risk-free return, is taxed. Put another way, for a hypothetical tax system that imposes a tax rate t on the safe return and a tax rate r^* on the excess return, leaving the investor with an after-tax return of

$$(6) \quad i(1-t) + (r-i)(1-r^*),$$

the investor is indifferent to the value of r^* . The reason is that the investor can undo taxation of excess returns simply by holding more of the risky asset and less of the safe asset.

This result, combined with the empirical observation that the real, safe rate of return is very close to zero, led Gordon (1985) to suggest that the corporate income tax imposes few economic distortions, although it collects tax revenue on average (i.e., in expected value). One could also express this argument as saying that the corporate tax has little incidence to attribute, because it imposes little burden. What of the revenues the government collects? Under Gordon's view, the revenues have positive expected value, but have little *market* value to the investors who forgo them, because of their risk. If capital markets already spread risk efficiently, moreover, these revenues will be of no greater value to the government than to taxpayers, because any pooling that could reduce aggregate risk would already have been done by the private sector. Hence, under this argument, a uniform corporate tax is of little consequence, and we need not devote much thought to concerns about its distortions and its incidence.

This theory, however, must confront an obvious empirical contradiction. Since excess returns on the risky asset must sometimes be negative – otherwise, the risky asset would

²⁷ For a good exposition of this and related results, see Kaplow (1994).

dominate the safe asset – corporate tax revenues should sometimes be negative as well, even if they are positive on average. There are basically three different explanations for this contradiction, with different implications for tax incidence.

The first explanation is that corporate earnings include more than a normal safe rate of return and an excess return to risk-taking, i.e., economic rents. If such rents are included in the corporate tax base, revenue will be positive. The incidence and distortions associated with this component of revenue depend on whether the rents respond to taxation. Pure economic rent in a competitive market will not respond, and hence a tax on it would be borne by shareholders.

The second explanation is that the tax on excess returns isn't symmetric, as characterized in expression (6). As the overall return to capital equals gross returns less actual depreciation, a tax on excess returns would include depreciation allowances that track actual depreciation. As depreciation allowances do not vary in this way, taxpayers face a higher burden than expression (6) implies (Bulow and Summers 1984). Also, the tax on excess returns should be negative when excess returns are negative, but loss offsets are limited; this, too, increase the prospective tax burden on investors. In both of these cases, the corporate tax would impose a net burden on investors even if the safe rate of return were zero, with corporate investment being discouraged and incidence analysis once again relevant.

The third possible reason for corporate revenues being positive is that private capital markets may not be fully efficient. If individual investors do not fully pool risks, then assets that are risky from the investor's perspective, and hence yield excess returns, may not be as risky from the government's perspective; only the risks common to all assets would remain once the government pooled its revenue from the assets. In this case, the revenue would have value to the government, but not to the taxpayers, and could be positive in all *aggregate* states of nature; and,

because the revenue, once pooled, could then be redistributed to taxpayers or spent by government, it ultimately would have value to the population of taxpayers. In this case, the corporate tax on excess returns would have *negative* incidence – it would impose no initial burdens but would make at least some individuals better off. However, this potential explanation for persistently positive corporate tax revenues would not seem particularly relevant, given the very large share of tax revenues attributable to extremely large companies, the vast majority of which are easily traded on major stock exchanges.

In summary, the fact that corporate revenues are risky reduces the burden of corporate taxation. Given that corporate tax revenues are always positive, though, the corporate tax cannot be seen simply as a symmetric tax on excess returns. The necessary modification of theory could mean higher burdens on shareholders, higher burdens on capital-owners more generally, or, less plausibly, negative burdens, depending on why corporate revenues are positive.

IMPERFECT COMPETITION

We have evaluated the impact of a tax on the normal return to corporate capital and on the excess return to corporate capital that is attributable to risk. But are there other components of corporate profits with which we must deal? The question of economic rents has already come up in the discussion above. Once one subtracts the normal return to capital providers and the return to risk, any profits that remain represent a rent received by the corporation's owners. But this rent could come from many sources, with different consequences for incidence.

Corporate rents could simply represent the earnings on ideas, as discussed above in relation to Stiglitz's (1973) theory. In this case, the corporation tax might effectively be a tax on entrepreneurial labor, for it would reduce the present value of the efforts that lead to the

development of intangible capital; that is, the garages of Silicon Valley might have been used to store cars if the corporate tax rate had been higher.

Corporate rents can also arise in a competitive model if there are decreasing returns to scale in production. In this case, theory tells us that a tax on rents imposes no distortions and is borne by shareholders. Finally, corporate rents can arise from imperfect competition. In the simplest case of monopoly provision, the consequences are the same – a tax on corporate rent is not distortionary, because a monopolist is already maximizing before-tax rent and cannot do better once the tax is imposed. But under more complicated types of imperfect competition, before-tax rents due to imperfect competition could respond to taxation²³.

In an oft-cited empirical study, Krzyzaniak and Musgrave (1963) examined the behavior of corporate taxes and corporate profits over time and came to the startling conclusion that *after-tax* profits rose in the short run in response to increases in the corporate tax rate: shareholders actually benefited from corporate tax increases, even in the short run! This conclusion necessarily points to imperfect competition, because theory under competitive markets predicts that a tax on corporate rents cannot be shifted at all, and (as discussed above in relation to Figure 2) a tax on corporate capital will only gradually be shifted over time. The study's methodology does not allow one to identify the nature of corporate responses, but, presumably, corporations in the world of Krzyzaniak and Musgrave raise profits by restricting output and increasing product prices, thereby passing the corporate tax on to the consuming population.

The presence of imperfect competition would also influence the corporate response to taxation of the normal return to capital. Noncompetitive rents occur in the first place because producers restrict output below the competitive level. A further tax on one of these inputs, in

²³ For one such analysis of tax incidence in this environment that takes the Harberger model as its starting point, see Davidson and Martin (1985).

this case capital, would lead to further restriction of output. Starting from a point where output is already restricted, it is possible that producers will over-shift in response to this tax as well – prices could rise by more than the increase in costs.²⁴ Thus, as corporations respond to the increase in the corporate tax rate, there could be an even greater shift of capital out of the corporate sector than the Harberger model predicts, although this is not an unambiguous prediction. One thing is sure, though – a tax on production in an industry in which output is already restricted by imperfect competition will be more distortionary than one in a competitive environment, because it exacerbates an already existing distortion.

THE STRUCTURE OF PRODUCTION

A key assumption of the Harberger model is that corporate and non-corporate enterprises produce different commodities. This was obviously a simplification, given that Harberger divided industries into corporate and non-corporate sectors based on each industry's *predominant*, not universal organizational form. As a logical matter, though, having corporate and non-corporate producers of the same commodities poses a problem for incidence analysis, for if production methods and organizational form (for tax purposes) can be chosen separately, then the corporate form will be adopted if and only if its tax treatment is preferred. Thus, the coexistence of corporate and non-corporate entities producing the same commodity requires either (1) that organizational form and production techniques are not independent, or (2) that producers have access to different technologies, some of which benefit from corporate tax treatment and others that achieve a lower tax burden outside the corporate sector.

Gravelle and Kotlikoff (1989) model the corporate-non-corporate distinction following the first of these approaches, assuming that incorporation facilitates operation on a larger scale,

²⁴ See the discussion in Auerbach and Hines (2003)

while non-corporate operation facilitates the use of entrepreneurial ability. With a scarcity of entrepreneurs, production will balance between the corporate and non-corporate sectors at the point where the non-corporate advantage provided by entrepreneurial ability is just offset by the scale economies provided by incorporation. In this model, and maintaining Harberger's other major assumptions, the corporate income tax is still bad for capital, which is driven out of the corporate sector, but it is good for entrepreneurs, whose services are in greater demand. The impact on labor is uncertain, depending on relative substitution elasticities in corporate and non-corporate production; if workers and entrepreneurs are sufficiently complementary, the increased demand for entrepreneurs will help workers as well.

Although they offer an explanation of the coexistence of corporate and non-corporate firms in the same industry, Gravelle and Kotlikoff do not test this explanation. Subsequent empirical analyses by Gordon and Mackie-Mason (1997) and Goolsbee (1998) find much smaller implied within-industry responses to changes in the relative taxation of corporate and non-corporate income, and hence much smaller implied deadweight losses from differential taxation than Gravelle and Kotlikoff report. These and other contributions to the literature also emphasize, following the second approach listed above, why differences among firms (with respect to risk, for example) might lead some to opt for corporate taxation and others to prefer taxation as non-corporate entities. In one result of note, Gordon and Mackie-Mason find that increases in the tax "price" of being in corporate form attract firms with negative taxable income while deterring firms with positive taxable income. This result also highlights the dynamic nature of the choice of organizational form. Although transition between corporate and non-corporate form is far from costless, the availability of the two forms may, over time, provide firms with a net tax benefit even if one form is usually preferred, by allowing them to switch

when tax incentives dictate. This is unlikely to be a realistic option at an annual frequency, but it might be relevant over a firm's life cycle and especially in the transition from (usually loss-making) start-up to (usually profit-making) established company (Cullen and Gordon 2002).

While this more recent literature has made progress in understanding the impact of taxes, particularly the corporate income tax, on the choice of organizational form, and has provided estimates of the deadweight loss of this impact, there has been limited analysis of the implications for corporate tax incidence.

INTERNATIONAL ISSUES

In recent decades, the U.S. economy has experienced a steady increase in the importance of international trade and capital flows. Between 1987 and 2003, the net stock of private U.S. fixed capital, valued at current cost, rose from \$10.71 trillion to \$24.82 trillion²⁵, at an annual growth rate of 5.4 percent. By comparison, U.S. privately-owned assets abroad, at current cost, rose over the same period from \$1.39 trillion to \$7.37 trillion, at an annual growth rate of 11.0 percent, and foreign-owned U.S. assets (excluding foreign official assets) rose from \$1.44 trillion to \$8.23 trillion, at an annual growth rate of 11.5 percent.²⁶

The significance of the international investment channel has immediate implications for incidence analysis, because capital fleeing the U.S. corporate income tax now has an alternative potential destination that is much bigger than the U.S. non-corporate sector and therefore much more able to absorb the capital without driving down the pre-tax rate of return. But, aside from the expanded size of the relevant capital market, considering the international capital market affects corporate tax incidence analysis in three other important ways. First, the corporate tax

²⁵ U.S. Bureau of Economic Analysis (www.bea.gov, Fixed Asset Table 2.1, March 8, 2005).

²⁶ Nguyen (2005), Table 2.

burden need not be borne fully by domestic residents but, can, potentially, be partially "exported" abroad. Second, there is an added dimension of tax rules to analyze, governing how cross-border flows are treated by different countries; one must know whether the corporate tax is essentially source-based or residence-based, for example. Finally, with other governments' tax systems involved, their responses are relevant to analyzing the effects of U.S. tax changes.

With capital mobile in a large world capital market, one's intuition might be that capital owners should be more able to avoid the burden of U.S. corporate taxation. But this intuition is misleading. As discussed by Bradford (1978) and Kotlikoff and Summers (1987), the total burden on capital need not fall with the ability of the United States to affect the worldwide rate of return, because at the same time the burden of U.S. taxation is being spread over a larger total, worldwide capital stock. What does fall as the United States becomes small relative to the world capital market is its ability to export the burden of a source-based capital income tax, even if some capital is foreign owned. How can this be so, if capital bears all of the tax? The answer, in this model, is that the tax is *also* being borne by other domestic factors (in this case, land), while comparable factors abroad gain.²⁷

The tax treatment of cross-border flows adds considerable complexity to the analysis of taxation and its effects, including incidence analysis. Unlike in the purely domestic context, there is a distinction between where income is earned and where its owner resides, and the concept of residence, itself, is applied not only to individuals but also to corporations. Countries may seek to tax corporate income on a source basis, a residence basis, or some combination of the two, and most countries follow this last approach, taxing at least some income at source at

²⁷ Gravelle and Smetters (2001) argue that these domestic U.S. factors will bear little of the corporate tax in the long run, as the result of the large size of the United States and the additional market power conveyed by imperfect substitutability of foreign and domestic capital and commodities.

the corporate level, even if the corporation is owned abroad, and taxing at least some portfolio income of domestic residents on holdings of foreign assets.

But the effects of a change in, say, the U.S. corporate tax rate cannot even be considered without first characterizing the equilibrium that might result in this very complex tax environment. As in the analysis underlying the Miller model, an equilibrium with individuals possessing different relative tax preferences for different assets leads to specialization of the highest-bracket investors in the most tax-favored assets (Gordon 1986), but the number of possible allocations of assets among investors is increased by the fact that individuals may hold foreign assets in many countries and in a variety of ways (e.g., portfolio investment versus direct investment), and corporations (and, to a lesser extent, individuals) can change the location not only of their investments but also of their tax residence. To this complexity of individual and firm choices, one must add the strategic interactions of governments in their choice of tax systems. A thorough discussion of the effects of corporate taxation in this context is well beyond this paper's scope; the reader is referred to the survey by Gordon and Hines (2002). But some important threads of the literature as it relates to incidence can be highlighted.

Residence versus Source Taxation

Taxation of corporate capital income on a residence basis would seem to leave less scope for shifting than taxation on a source basis. In the former case, the U.S. tax rate would apply wherever the capital moved, so it would be harder to avoid. But residence is not immutable, particularly for corporations. Thus, a residence-based corporate income tax might induce less shifting of capital but more shifting of residence.²⁸

²⁸ An example is the corporate "inversions" of recent years, when U.S. companies relinquished "parent" status to foreign subsidiaries to become, for tax purposes, subsidiaries of foreign corporations. See Desai and Hines (2002).

It is also important to remember that the U.S. corporate income tax, although sometimes referred to as being a residence-based tax, has many features that cause it to resemble a source-based tax. First, by allowing tax credits for foreign income taxes, the U.S. tax collects little additional tax on foreign-source income of U.S. corporations. Second, income of foreign subsidiaries is taxed only upon repatriation to the United States. Thus, little foreign-source income is subject to tax, and at low net tax rates.

Tax Rate versus Tax Base

As already discussed, changes in the corporate tax burden effected through changes in the tax base, as through depreciation provisions, have a different impact than equal-revenue changes in the corporate tax rate because the two policies have different relative effects on old and new capital. In the international context, there is an added reason why these policies' effects would differ – the ability of firms to locate corporate income independently from corporate capital through the mechanism of "transfer" pricing – the prices assigned to transactions between related parts of the firm located in different tax jurisdictions. Variations in transfer prices can be used to shift income among jurisdictions, but are responsive to the tax rates on additional income, not to investment-related provisions. Thus, transfer pricing reduces the relative efficiency of investment incentives. Simultaneous increases in the corporate tax rate and investment incentives that hold constant the marginal effective tax rate on new investment would no longer just impose a capital levy on existing corporate assets, but would be partially shifted through behavioral responses.

The corporate tax rate could have similar effects even if shifts in corporate income location were limited to actual changes in investment location, rather than to transfer pricing. If the use of capital in production in a given location is "lumpy" and does not obey the assumption

of constant returns to scale, then the investment decision also involves a discrete location decision; the decision will be not simply one of plant size in each location, but also of where to locate the plants. Without constant returns, there may be economic rents associated with the location decision, and the tax on these rents will depend only on the corporate tax rate. Thus, while the investment decision, conditional upon location, may be analyzed as in the domestic context, the location decision will depend on the combined burden on capital and rents, strengthening the impact of the corporate tax rate (Devereux and Griffith 2003). In this context, corporate shareholders can shift not only a tax on corporate capital, but one on rents as well.

MANAGERIAL ISSUES

Economists stress that only individuals and not entities can bear tax burdens. From this perspective, it is difficult to see the logic of a separate tax on corporations. With no retreat from the position that only individuals bear taxes, though, there may be something to the view of the corporation as a separate entity to be taxed, in the sense that corporate managers, as a group, may be affected by the corporate tax in ways that differ from the effects of other taxes and may in turn have an objective different than profit maximization.

This discussion will relate primarily to the corporate tax rate, rather than to investment-related tax provisions, as the issues all concern the extent to which behavior by corporate managers, holding investment fixed, affects the reported corporate tax base.

In one limited sense, the corporate income tax should have no impact on the behavior of managers. As employee compensation is tax deductible, it is still in the corporation's interest to

pay employees, including managers, their before-tax marginal products.²⁹ But there are other respects in which the existence of the corporate tax may affect managerial behavior.³⁰

First, the corporate income tax reduces the after-tax cost to shareholders of managerial underperformance. Thus, to the extent that the costs of monitoring and acquiring information about managerial performance are not deductible from the corporate tax, the effect of the tax may be to reduce efficiency in managerial performance. Even if managers receive lower compensation as a result, the incidence of the increased inefficiency is still to be considered, as with a decline in managerial input, the impact on capital and other factors would depend on relative complementarities in the structure of production.

Second, tax compliance is largely a managerial decision, and a quite substantive one given the great complexity of the corporate tax system. It is customary to distinguish between (legal) tax avoidance and (illegal) tax evasion, but the choices are better characterized as being along a continuum of legal probability. In the standard model of individual income tax evasion the individual trades off tax savings from successful evasion against the penalty if caught. The impact of an increase in the tax rate depends on a number of factors, including the agent's risk aversion and the penalty structure.³¹ In the corporate context the situation is even less clear because it is difficult to know what motivates managers to evade on behalf of shareholders.

The incidence of corporate tax evasion depends upon the "technology" of tax evasion. Following Slemrod (2004), we can think of two questions that affect the outcome. First, is evasion general or limited to a few managers? In the former case, evasion will reduce taxes for

²⁹ This does not hold exactly for stock options, which are deductible only when exercised rather than when granted, but the offsetting deferral of individual income tax should roughly offset this delay.

³⁰ There will also be ways in which the structure of corporate and shareholder taxes may affect managerial decisions, for example the decision whether to distribute earnings in response to the taxation of dividends.

³¹ See Slemrod and Yitzhaki (2002) for further discussion.

all concerned and may reduce effective tax rates, driving down the before-tax rate of return to capital, the effect would be like a corporate tax cut, though one with a lesser reduction in deadweight loss because of the resources wasted through evasion arrangements. In the latter case, the taxes saved will not be eroded through a reduction in before-tax returns, so the reduced burden will benefit the shareholders and possibly managers. The second question involves the relationship between evasion and the scale of operations. If evasion is not part of the “constant returns” technology, but rather more of an inframarginal activity, then it is more of a lump-sum transfer to shareholders, even if it is widely practiced. As in the discussion at various points above, there is an important distinction here between the treatment of old and new capital; in this case, the question is whether the “evasion tax cut” extends to new capital.

But the corporate tax evasion game is different from the individual game in a very fundamental way, for there are not just two players, but (at least) three: the government, the manager, and the shareholder. The manager decides not only what to report to the government, but also what to report to the shareholder, and these decisions are as distinct as tax accounting and financial accounting. This leads to interesting interactions that have only recently been explored. As discussed by Desai and Dharmapala (2004), one needs to consider the technology that governs the two processes of hiding resources from the government and hiding resources from shareholders. Quite plausibly, the two processes are complementary, in which case managers who are aggressive with respect to corporate tax evasion may also engage in large-scale diversion of shareholder resources. If this is true, then the act of evasion may not actually benefit shareholders (even if there are no competing evaders to reduce before-tax returns), and strengthened corporate tax enforcement need not make shareholders worse off.³²

³² See also Crocker and Slemrod (2005) on this topic.

In summary, the corporate tax may affect managerial behavior in two ways, through the incentive effects of changes in after-tax payoffs, and by giving rise to decisions regarding tax avoidance and evasion. While some of the potential incidence effects have been considered, this is an area in which the literature is still developing.

CONCLUSIONS

Our journey beyond the Harberger model through the more recent literature takes us both forward and backward: forward in considering issues not previously studied, but backward in reestablishing the relevance of the shareholder incidence approach. For a variety of reasons, shareholders may bear a certain portion of the corporate tax burden. They may be unable to shift taxes attributable to a discount on “old” capital, taxes on rents, or taxes that simply reduce the advantages of corporate ownership. In the short run, they may also be unable to shift taxes on corporate capital. Thus, the distribution of share ownership remains empirically quite relevant to corporate tax incidence analysis, though attributing ownership is itself a challenging exercise.

Another of this paper’s lessons is that one-dimensional incidence analysis – distributing the corporate tax burden over a representative cross-section of the population – can be relatively uninformative about who bears the corporate tax burden, because it misses the element timing. For example, for a tax that is shifted over time from shareholders to all owners of capital, as depicted in Figure 2, the part not shifted will fall entirely on initial shareholders, while the part that is shifted will fall on future capital owners. Collapsing the burdens on shareholders and capital owners into a single cross section completely misses this important distinction.

A related point is that it is more meaningful to analyze the incidence of corporate tax changes than of the corporate tax in its entirety, because (1) different components of the tax have different incidence (e.g., a change in the corporate tax rate versus a reduction in corporate tax

payments through a dividends-paid deduction), and (2) incidence relates to the path of the economy over time, not just in a single year; for example, it would make little sense to consider the incidence of one-year's depreciation deductions for a long-lived investment.

A further point is that corporate tax collections don't equate to corporate tax incidence, even in the aggregate. A well-known reason for this distinction is the deadweight loss of taxation, which makes burdens exceed revenue collections. But burdens may also fall short of corporate revenue collections if (1) distortions are reduced (as in the case of improved risk-sharing) or (2) other taxes (e.g. personal taxes) are avoided.

Finally, while exploring many extensions of the Harberger model, I have devoted little attention to one of that model's important omissions, the impact of corporate income taxes on capital accumulation. But the implications are clear. For taxes on capital income, in general, we would expect an increase in the effective tax rate on new saving and investment to reduce capital accumulation. The resulting decline in the capital-labor ratio would increase before-tax returns to capital and lead to a fall in wages, thus partially shifting the tax burden from capital to labor. This analysis would apply to the corporate tax as well, but *only* to the extent that the corporate income tax represents a tax on new saving and investment. The shift in the corporate tax burden from capital to labor can proceed only if it is first shifted from shareholders.

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Table 1. U.S. Corporate Equity Ownership, 2004
(end of year, billions of dollars)

<u>Asset Holder</u>	<u>Amounts</u>	<u>Detail</u>
Households	5,979	
Mutual funds	3,694	
Nonprofit organizations ^a	597	
Retirement funds	2,993	
Private pension funds (DB) ^b		720
Private pension funds (DC) ^b		971
State and local govt. retirement funds		1,202
Federal government retirement funds		99
Bank personal trusts and estates	221	
Life insurance companies	1,065	
Savings institutions	28	
State and local governments	89	
Rest of the world ^c	-467	
Market value of domestic corporations	14,198	

Source: Board of Governors of the Federal Reserve System (2005), Table L.213. Amounts net out inter-corporate holdings.

Notes:

^a Holdings of households and nonprofit organizations are grouped together for 2004; breakdown is based on assumption that proportion held by nonprofits is the same as in 2000, using Table L.100.a.

^b Detail from Tables L.119.b and L.119.c.

^c Rest of world equals holdings of U.S. issues by foreign residents less holdings of foreign issues by U.S. residents.

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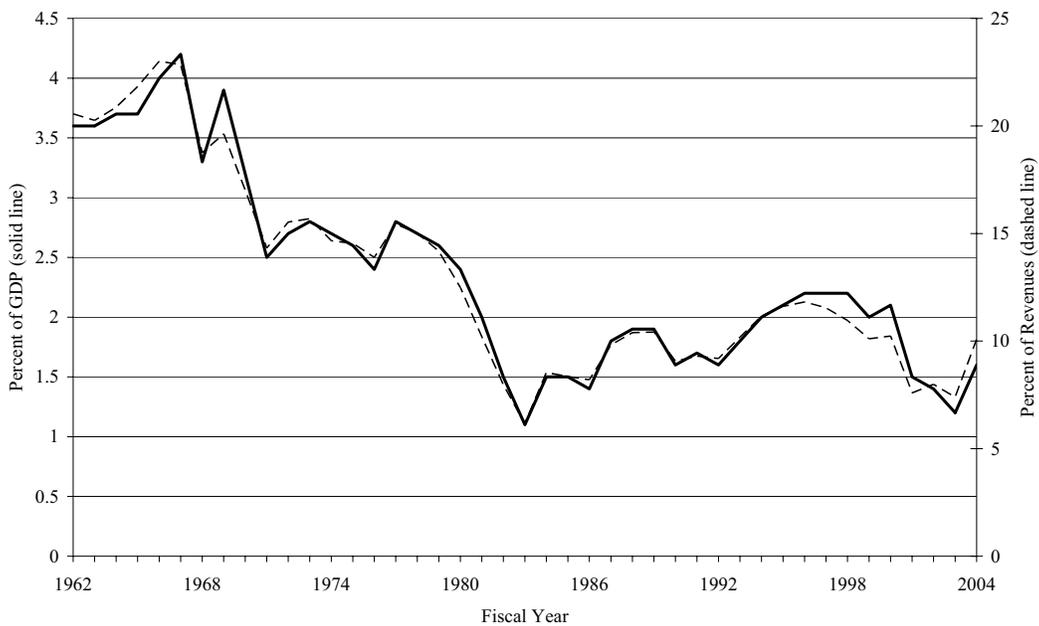
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Figure 1. U.S. Federal Corporate Income Taxes, 1962-2004



Source: Congressional Budget Office

Figure 2. Adjustment to Equilibrium

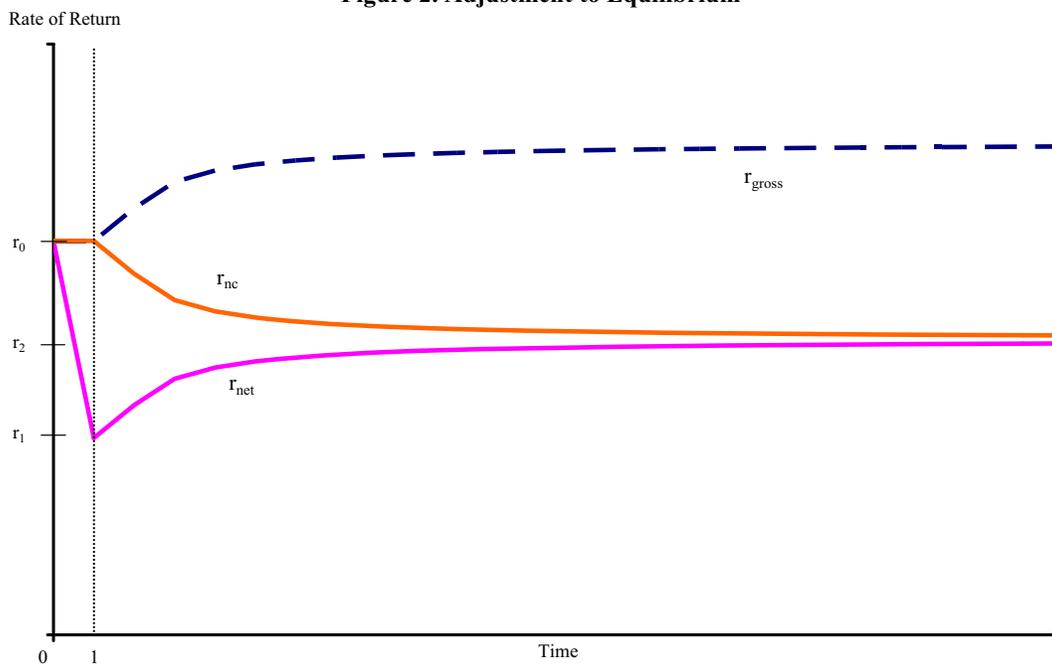


Figure 3. Depreciation Schedules

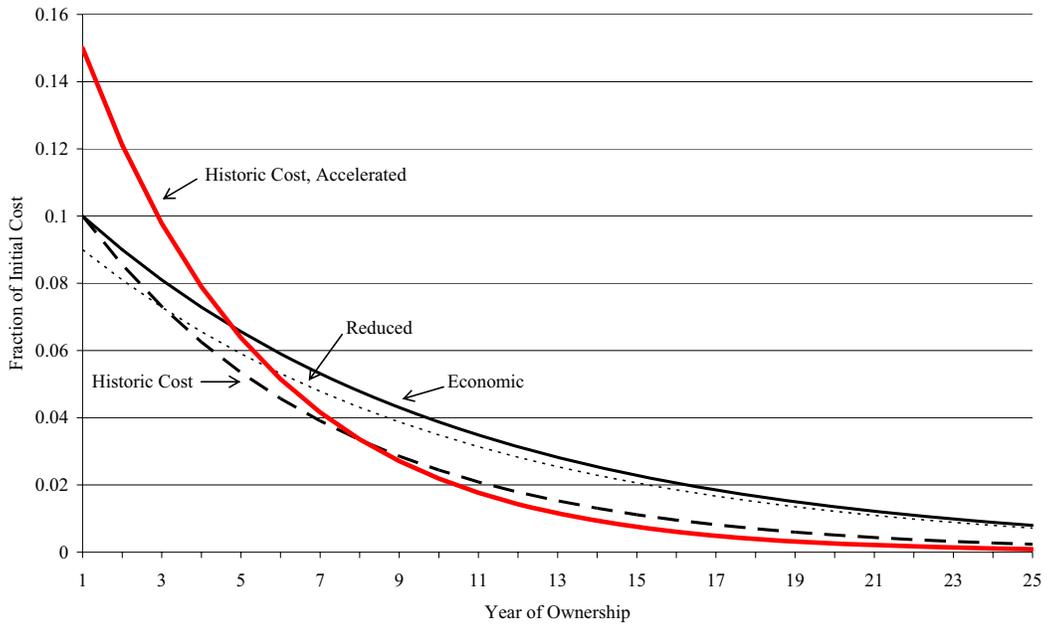
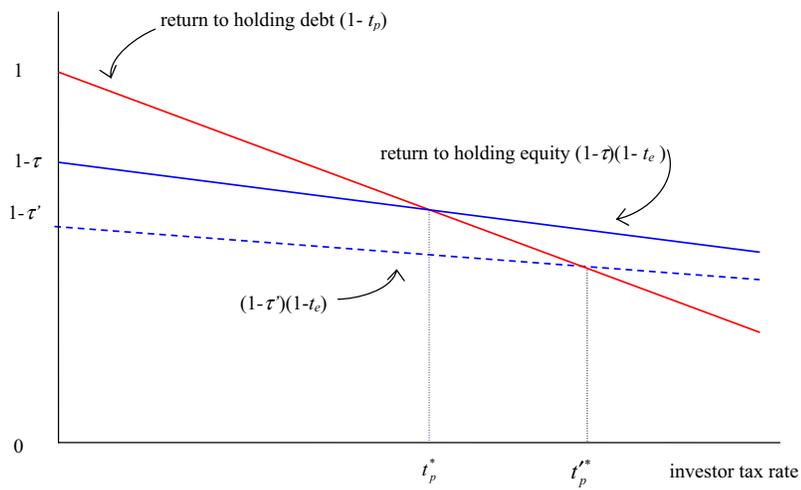


Figure 4. The Miller Equilibrium

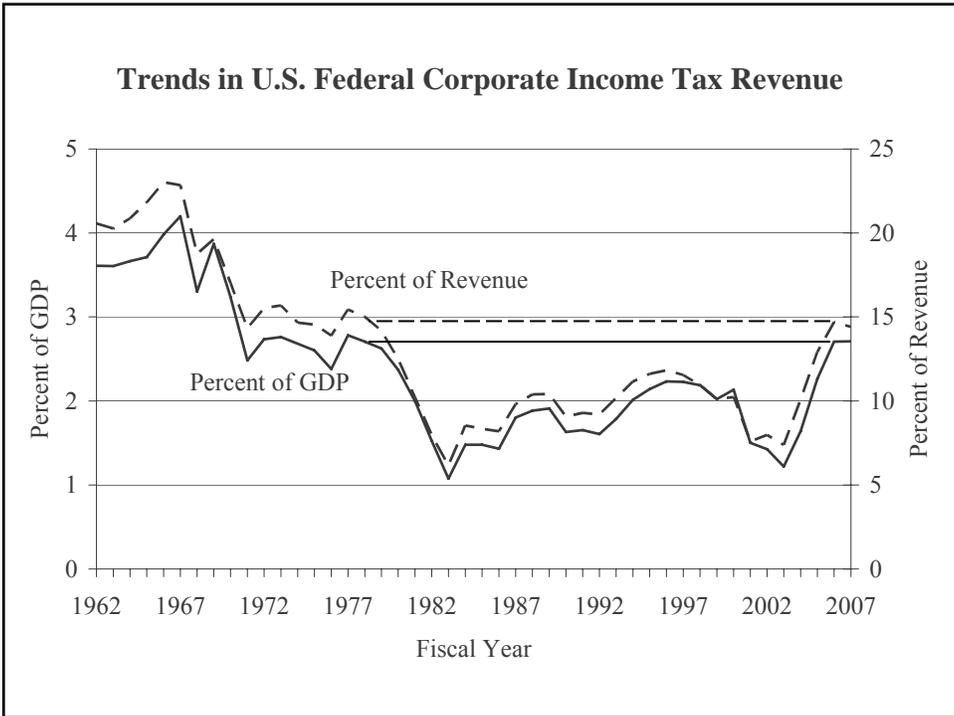
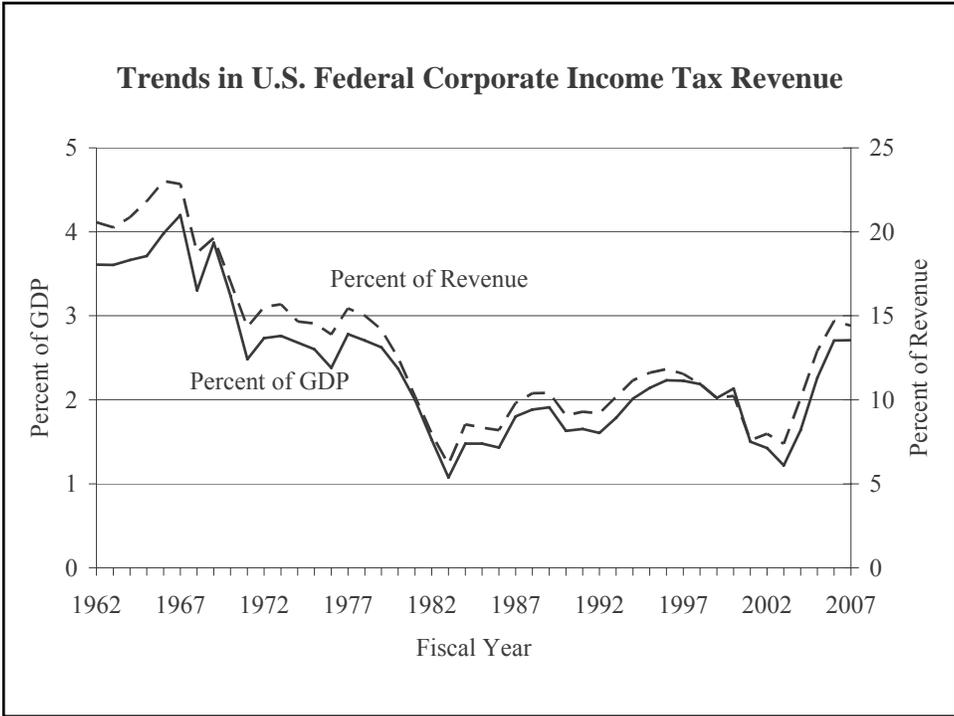


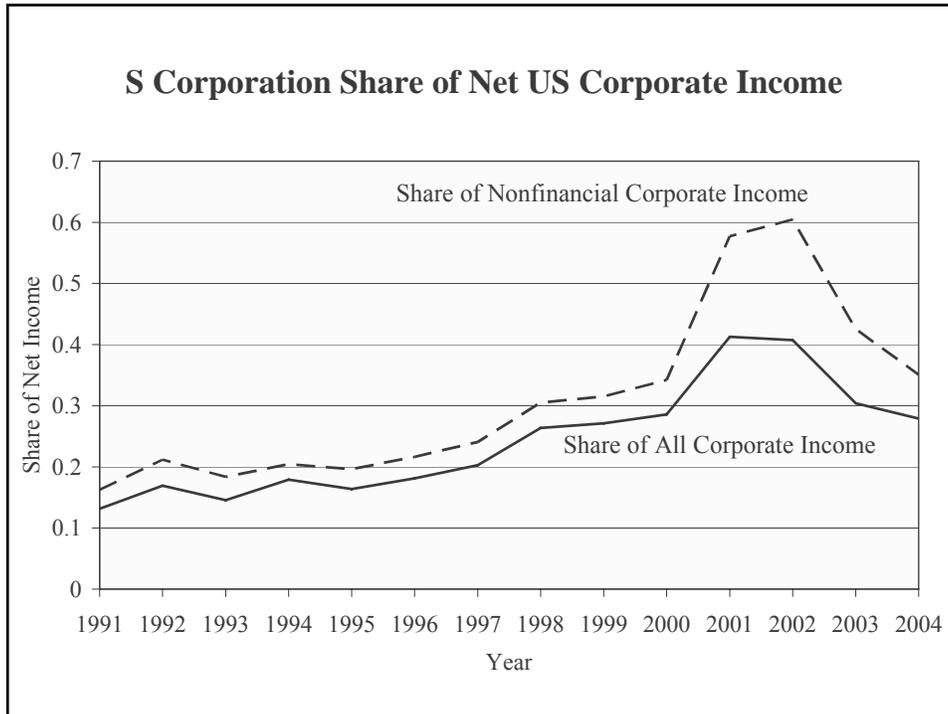
Who Bears the Corporate Tax Burden?

Alan J. Auerbach
December 18, 2007

Outline

- The US Corporate Tax
- Old (Naïve?) Theory of Incidence
- The Harberger Model
- Beyond the Harberger Model





Who Bears the Tax Burden?

- Simplest theory: a burden on corporations
- Simplest coherent theory: a burden on shareholders, since it is really their income that is being taxed
- Even this approach complicated by importance of tax-exempt shareholders; would require further allocation
 - DC plans: workers
 - DB plans: firms (liability)? workers? (bargaining); all taxpayers? (PBGC)
 - Nonprofit institutions: donors? beneficiaries?
- Maybe not as progressive as in past

The Harberger Model

- Investment will shift out of the corporate sector, leading to an equalization of after-tax returns on all investment
 - Owners of corporate capital bear only a share of the burden
 - But owners of all capital bear (roughly) the total burden
- Not as progressive as under shareholder incidence, but still progressive
- In introducing the possibility of behavioral responses, raises the issue of behavioral distortions
 - Burden > Revenue

What's Missing?

- Dynamics
- Investment Provisions
- Corporate Financial Policy
- Imperfect Competition
- Saving

What's Missing?

- Dynamics
- Investment Provisions
- Corporate Financial Policy
- Imperfect Competition
- Saving
- **International Context**

Dynamics

- Even if Harberger's is the right long-run approach, adjustment takes time
 - the corporate tax (or changes in the corporate tax) should fall on corporate capital in the short run, gradually shifting to all capital in the long run
 - But the incidence of the tax would have different timing than this suggests, because of capitalization
 - all of the differential should be reflected in current asset values and hence borne by current shareholders

Investment Provisions

- With investment incentives (example: bonus depreciation) and historic cost depreciation, old and new capital have different tax attributes; new capital is favored
- Again, this extra tax on old capital should be reflected by capitalization, with the capitalized differential borne by shareholders

Corporate Financial Policy

- With debt and the interest deduction, does capital bear any burden?
- Stiglitz (1973), Miller (1977): corporate tax is voluntary, since can always use debt
- So, shareholders may bear tax, but *net* incidence of corporate tax may be negative: burdens of other taxes would be higher if option removed
- Changes in corporate tax fall on those who benefit, i.e., shareholders

Imperfect Competition

- Krzyzaniak and Musgrave (1963): corporate tax “over-shifted” – after-tax returns increase
- Over-shifting indicates the presence of imperfect competition
- With imperfect competition, there are noncompetitive rents being taxed
- If rents fixed, another component of the tax shareholders can’t shift. True for monopoly, but not necessarily for other modes of imperfect competition

Implications Thus Far

- For several different reasons, part of the corporate tax is likely to be borne by shareholders
- Because of capitalization of future taxes, incidence analysis has a second dimension – not just what income class, but also which generation

Saving

- So far, various channels through which a portion of the corporate tax will be borne by shareholders
- With capital stock fixed, the balance will still be borne by all capital via a lower rate of return, following Harberger's logic
- If lower rates of return reduce saving, then part of the burden will be shifted to other factors of production, primarily labor
- But evidence weak on saving responsiveness

International Context

- In an open economy, another mechanism for an incipient decline in rates of return to reduce the domestic capital stock – capital flows
- But in the international context, further issues also arise
 - Tax systems at home and abroad (territorial, worldwide, or mess)
 - Responses include not just location of capital, but also location of corporate residence and profits

International Context

- Simplest situation: a world of source-based taxation
- By driving capital out, the part of the corporate tax that would otherwise fall on capital is at least partially shifted to domestic labor by capital outflows
- How much of this shift depends on how small a country and how well capital, goods and services flow

International Context

- First complication: with transfer pricing, profits can flow even if capital doesn't
- This may not be bad for labor (the capital is still in place), but it is bad for revenue
- If we include the cost of distortions, burden goes down by less than revenue, and still likely to be shifted

International Context

- Second complication: with “lumpy” investment decisions (location, not just scale), the statutory tax rate may gain in importance relative to provisions aimed at investment
 - some rents may be internationally mobile

International Context

- Both complications – transfer pricing and shifting of rents – increase share of burden on domestic factors associated with an increase in statutory corporate tax rate

International Context

- Third complication: what about world-wide taxation?
- If done “right” by US – no taxation at source, full immediate taxation of US earnings at home and abroad – then corporate tax won’t influence capital flows by discouraging investment in US vs. elsewhere; but...

International Context

- Even in this case, corporate residence choice would be distorted, so shifting possible
- We don’t tax worldwide profits as accrued
- We tax at source
- All this makes the impact of actual US system hard to analyze, but likely closer to a source-based tax than a residence-based one

Summing Up

- The corporate tax isn't borne by corporations
- Part of the corporate tax is borne by shareholders – but we should pay attention to which part and which shareholders
- The rest of the corporate tax would fall on capital, but saving and especially international capital flows shift some of this to labor and other domestic factors (e.g., land)

Summing Up

- Incidence depends on the structure of taxation
 - Simple measures like revenues or effective tax rates insufficient for assessment
- Burden $>$ tax revenue
- Openness of the economy influences the relative impact of different provisions (e.g., tax rate vs. tax base) and makes new issues (e.g., source vs. residence, expense allocation rules, etc.) relevant

How does the U.S. government distribute corporate tax burdens?

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December 18, 2007

Complex issues in distributional analysis

- Income classifier
- Tax payments v. tax burdens
- Phase-ins, sunsets
- Timing provisions
- Key issue: Short-run v. long-run incidence

Distributional analysis of corporate income tax

- Few analyses released recently
 - CBO annual effective-rate study
- Few big recent corporate tax changes
- Waning interest in distributional analysis by policymakers
 - Particularly, for corporate tax

Congressional Budget Office

- Oct. 1987, July 1988: Two alternatives, all to capital and all to labor
 - Allocating to (any) individuals viewed as new
- Feb. 1990: Half to capital, half to labor
 - Policymakers prefer single allocation
- Jan. 1994 and thereafter: All to capital
 - Based on assessment of literature

CBO measure of capital income

- Interest, dividends
- Realized capital gains (scaled by economy-wide realizations)
- NOT income from pass-thru firms
- No allocation to tax-sheltered accounts, tax-exempt organizations

Treasury

- Longstanding allocation to capital
- But, 1992 integration study included half-capital, half-labor alternative

Treasury measure of capital income

- Interest, dividends
- Realized capital gains
- Income from pass-thru firms IF exempt from payroll, self-employment tax
- Distributions from tax-sheltered accounts
- No allocation to tax-exempt organizations

Joint Committee on Taxation

- 1993 Red Book: All to *corporate* capital
 - Disclosure: Participated in writing
- Many ambitious recommendations, followed for about a year
- JCT stopped allocating corporate tax due to uncertainty

Council of Economic Advisers

- 2004 ERP chapters
 - Disclosure: Participated in writing
- Recommended long-run tables allocating part of burden to labor
 - Supplement, not replace, short-run tables

Other taxes disguised as corporate taxes

- Disguised payroll taxes, subsidies
 - Red Book, p. 49 n.65; 2004 ERP, p. 108
- Disguised excise taxes, subsidies
 - Fullerton, Gillete, Mackey (1987); Gravelle (JEL, 1992)
- In practice, rarely treated separately

Investment incentives

- Apply only to new capital
- Could be allocated to savers rather than holders of capital (Red Book, pp. 50-51)
- In practice, allocated to holders of capital
- Treatment of timing – Red Book, Treasury

Consistency with individual tax

- Dividend taxes allocated to stockholders
- To be consistent, corporate income tax should be allocated to *corporate* capital
- Burman, Gravelle, Rohaly (NTA Proceedings, 2005)

Views of profession (1996)

- Fuchs, Krueger, Poterba (JEL, Sept. 1998)
- Fraction of tax “ultimately” borne by capital
 - Presumably refers to long-run incidence
 - Mean 41 percent, median 40 percent
 - Standard deviation 29 percent
- Three-quarters said 65 percent or less

Labor and Capital Shares of the Corporate Tax Burden: International Evidence

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Labor and Capital Shares of the Corporate Tax Burden: International Evidence

ABSTRACT

This paper develops and applies a simple framework for measuring the incidence of the corporate tax. This framework offers an empirical approach that jointly analyzes the degree to which owners of capital and workers share the burdens of corporate income taxes with the restriction that the overall burden is ultimately shared between them. Data on the foreign activities of American multinational firms provide wage rates and interest rates for a panel of more than 50 countries between 1989 and 2004. Evidence from applying this framework to these data indicates that between and 45 and 75 percent of the burden of corporate taxes is borne by labor with the balance borne by capital.

JEL Classifications: H22, H25, H87.

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1. Introduction

While there is universal agreement with the proposition that someone ultimately bears the burden of corporate taxes, there is considerable uncertainty, and indeed controversy, over exactly who this might be. The obvious candidates are owners of capital, whose after-tax returns may decline as tax rates rise, and workers, whose real wages may be adversely affected by corporate tax increases. Theoretical efforts to examine this question offer conflicting conclusions and demonstrate an unsettling sensitivity to underlying assumptions. These highly stylized models also leave open the question of whether actual economies, with their messy markets and no less messy tax systems, in fact react to corporate tax changes in the ways that the models predict.

The prevailing uncertainty over the incidence of the corporate tax is particularly unfortunate given that the distributional consequences of alternative tax policies are of fundamental importance to their desirability and political attractiveness. It has proven extremely difficult to evaluate corporate tax reforms on the basis of induced effects on the distribution of real income in the absence of reliable empirical evidence. Since there is no sense in which the burden of corporate taxes can fail ultimately to be borne, governments and policy analysts have been obliged to take stabs in the intellectual dark by attributing corporate tax burdens to different taxpaying groups. In practice, these attributions have an arbitrary feel: changes in corporate tax burdens are sometimes assigned to owners of corporate shares, sometimes to capital owners generally, and sometimes they simply are not attributed to anyone, despite the incoherence of such an approach.

This paper develops and tests a simple framework to analyze the incidence of the corporate tax. The theory of tax incidence offers guidance that is employed to sharpen estimates of the distribution of corporate tax burdens. The simple fact that corporate taxes must be paid by someone carries the implication that, if the economy consists of labor and capital, then any tax burden not borne by labor must be borne by capital. As a result, one can estimate the impact of corporate taxes on wages and returns to capital jointly, imposing a restriction that the effects sum to total tax burdens. Specifically, the theory points to the use of a seemingly unrelated system of regressions of wages and borrowing rates on measures of corporate taxes that includes a cross-equation restriction on the total tax effects. This method offers a more powerful, reliable, and

consistent method of identifying the distribution of tax burdens than does estimating the returns to labor or capital separately. This framework emphasizes the lessons of recent theoretical developments, particularly Randolph (2006), that factor shares are critical for understanding the incidence of the corporate tax.

This paper applies this framework to data collected from American multinational firms operating in a large number of countries between 1989 and 2004. One of the benefits of using these data is that they reflect the experiences of relatively comparable firms that report extensive information on their operations in a consistent manner between countries and over time. This sample excludes the United States, but includes evidence for more than 50 countries. Data on wage rates and returns to capital are related to corporate tax rates and measures of factor shares in several annual cross-sections and in a pooled analysis. The constraint on the coefficients allows capital or labor to bear more than 100 percent of the burden, as some theoretical variations suggest, but restricts the sum of the burden shares to equal one.

The results consistently indicate that corporate taxes depress both real wages and returns to capital, with most of the burden of corporate taxes borne by labor. The baseline estimate for the share of the burden borne by labor is 57 percent, and estimates vary between 45 and 75 percent, depending on the sample period and specification. These results are robust to the inclusion of control variables that might otherwise explain wages and returns to capital and to the inclusion of country fixed effects in a panel setting.

The method adopted in this paper moves part of the way toward reconciling empirical estimates with the underlying theory of corporate tax incidence. Recent empirical efforts to investigate corporate tax incidence focus largely on the extent to which high tax rates depress real wages. Such an approach does not capitalize on the theoretical insight that the overall tax burden must be shared between capital and labor. A second difference with earlier empirical studies is that this paper analyzes data that are collected and reported on a comparable basis by firms operating around the world. The use of these data has the potential to allay some of the concerns that would otherwise arise from using data obtained from disparate sources.

The approach employed in the paper also has several limitations. First, the empirical specifications rely heavily on the competitive market assumption that underlies the standard

theory of tax incidence. To the degree that the theory departs from reality, the estimating equations may be misspecified. On balance, however, the benefit of the empirical power obtained by constraining coefficients in accordance with standard economic theory seems to outweigh the disadvantage of relying on the theory. Second, the use of data from multinational firms may limit the applicability of the results obtained using these data. In particular, wage rates, returns to capital, factor shares and tax rates faced by multinational firms may be idiosyncratic and unrepresentative of the overall economy. Again, these potential limitations must be weighed against the benefits of employing highly comparable data for a significant fraction of global capital flows. These limitations and other matters of interpretation are discussed below.

Section 2 of the paper reviews some of the theoretical insights and empirical estimates from the literature on the incidence of the corporate tax. Section 3 provides a simple framework that leads to a set of estimating equations and describes the data employed in the paper. Section 4 presents empirical evidence on the degree to which labor and capital share the burden of the corporate tax. Sections 5 and 6 offer interpretations of these estimates, discuss their limitations, and conclude.

2. *Corporate Taxation and the Distribution of Its Burdens.*

The simple intuition that owners of corporations bear the burden of corporate taxes appears to be surprisingly fragile. The pioneering work of Harberger (1962) identifies the source of the common perception that owners of corporations bear the burden of the corporate tax and also demonstrates its sensitivity to modeling assumptions by showing that returns to capital owners can *increase* with a corporate tax. The simple intuition relies on the insight that corporate tax obligations contribute to the cost of investment and thereby encourage substitution of other productive factors (such as labor) for capital used by corporations. Labor expenses are deductible against taxable income, so the corporate tax does not affect the marginal condition characterizing a firm's decision of whether or not to employ additional labor. This substitution of labor for capital depresses the demand for capital and thereby reduces its after-tax market return in a closed economy.

Even in a closed economy, however, induced intersectoral reallocations of resources can reverse this result. Corporate taxation increases the cost of producing corporate output, thereby raising output prices, depressing demand, and shifting output from the corporate sector of the economy to the noncorporate sector. This reallocation affects factor demands to the extent that factor input ratios differ between the corporate and noncorporate sectors of the economy. If the corporate sector of the economy has a lower capital/labor ratio than the noncorporate sector, then the introduction of a corporate tax shifts resources into the noncorporate sector and thereby raises the demand for capital. If this effect is large enough, then it has the potential to exceed in magnitude the countervailing impact of factor substitution, thereby implying that higher rates of corporate tax are associated with greater after-tax returns to capital – including capital invested in corporations. It would then follow that labor bears the burden of the corporate tax in the form of lower wages.

Open economy considerations further complicate the simple intuition that capital owners bear the full burden of the corporate tax. As noted by Diamond and Mirrlees (1971), and applied to open economies by Gordon (1986), Kotlikoff and Summers (1987a) and Gordon and Hines (2002), any source-based capital income tax falls entirely on fixed local factors – typically labor – in a setting with perfect capital mobility and product substitution. It follows from the assumption of perfect capital mobility that after-tax rates of return to capital cannot differ between countries, so higher corporate tax rates must discourage investment and thereby drive up pretax rates of return to the point that after-tax returns remain equal. Since after-tax rates of return to local capital do not change with corporate tax changes, it must be the case that local labor and any other local factor whose location is fixed, the archetypal example being land, bear the full burden of corporate taxes. Additionally, corporate taxes in large open economies may have spillover effects. With fixed world supplies of capital, higher tax rates in one country discourage local investment and drive investment to other countries, where it can reduce rates of return to capital and increase wages.

Harberger (1995, 2006) and Randolph (2006) explore the sensitivity of conclusions drawn from models of perfect capital mobility and fixed world capital supplies. They calibrate models that incorporate what they argue are realistic estimates of relative capital intensities, capital mobility, and product substitutability, finding that labor can be thought to bear a

significant fraction of the burden of the corporate tax. In the classes of simple models used in these papers, any imperfect substitutability between foreign and domestic traded goods effectively operates as a form of imperfect capital mobility. As the trade and capital accounts must balance, imperfect substitutability between traded goods implies that extensive net borrowing is expensive as it entails importing large volumes of foreign goods for which there is diminishing marginal substitution. Gravelle and Smetters (2006) use a computable general equilibrium model to allow for subtler variants of imperfect product competition, concluding that corporate capital owners may bear the lion's share of the corporate tax burden despite the availability of capital inflows and outflows.¹

The extensive theoretical results on the incidence of the corporate tax have not been matched with as extensive an empirical investigation. The relative absence of empirical efforts may reflect one of the central insights of Harberger (1962) - corporate taxation must be understood in the context of the general equilibrium of an economy. In general equilibrium, all markets affect each other and, as a result, it is typically necessary to use national information to evaluate the impact of a country's system of taxing corporate income. From an estimation standpoint this greatly reduces the extent of tax variation that can be appropriately used to identify the distribution of tax burdens, since tax differences among firms and between industries may have broader effects that would be overlooked in standard partial equilibrium estimation. The need to identify tax effects at national levels severely restricts the available sample from which to draw inferences, and as a result, makes it particularly difficult to obtain reliable empirical estimates.

Despite these challenges, several recent studies attempt to measure tax incidence in open economies.² Arulampalam et al. (2007), Felix (2007) and Hasset and Mathur (2006) all employ international databases to explore the extent to which corporate taxes influence wages, thereby indirectly assessing the incidence of the corporate tax. Arulampalam et al. (2007) employ micro data from four countries over five years and conclude that between 60 to 100 percent of the

¹ For more on the importance of product substitutability, see Davidson and Martin (1985) and Gravelle and Kotlikoff (1989, 1993).

² There were several earlier efforts to empirically examine the incidence of the corporate tax, typically through time series analysis of domestic data. These include Krzyzaniak and Musgrave (1963), Gordon (1967), Dusansky (1972), Oakland (1972) and Sebold (1979). For excellent reviews of the existing empirical and theoretical literatures, see Auerbach (2006) and Gentry (2007).

corporate tax is passed on to labor. Given the limited number of countries in their estimating sample, Arulampalam et al. (2007) are unable to estimate the impact of national tax rate differences, instead considering differences in the tax situations of individual firms. They analyze the extent to which a firm facing a higher tax burden than other firms shares the cost of its disadvantaged tax situation with workers in the form of lower wages. Felix (2007) and Hassett and Mathur (2006) instead consider the effects of national tax rates on wage determination in competitive markets, employing measures of local wage rates in a much larger sample of countries, and finding large effects of corporate taxes on wages. These empirical studies offer specifications that investigate the relative importance of economic openness, the magnitude of capital flows, the global nature of firms and the skill composition of the workforce to the incidence of the corporate tax.

As noted by Gravelle and Hungerford (2007) and Felix (2007), some of the reported wage equations indicate that labor bears an enormous cost of corporate taxation, the implied burdens in some specifications approaching twenty times the revenue raised by corporate taxes. Taken at face value, these estimates suggest that the distortions associated with the corporate tax are huge. Another possibility is that these results reflect the impact of data inconsistencies or correlated omitted variables. In order to assess the reliability of these estimates it is helpful to compare them to results obtained using a consistent data set and an estimating method that implicitly controls for some country-specific factors.

3. *Estimation Method and Data.*

This section sketches a framework that can be used to estimate corporate tax incidence. The first part of this section considers the implications of economic openness for the incidence of corporate income taxes, while the second part of the section describes the data used to estimate the impact of corporate taxation.

3.1 Accounting for tax changes.

Consider a firm that produces output with capital (K) and labor (L) inputs, using a production function denoted $Q(K, L)$, and with output price normalized to unity. The firm's capital investments are assumed not to depreciate, and are financed with a combination of debt

(B) and equity (E). Labor is paid a wage of w , and debt holders receive a return of r . Denoting by ρ the firm's after-corporate-tax rate of return to equity investments, and denoting the corporate tax rate by τ , it follows that:

$$(1) \quad \rho E \equiv [Q(K, L) - wL - rB](1 - \tau).$$

Differentiating this expression with respect to τ , and applying the envelope theorem, produces:

$$(2) \quad \frac{d\rho}{d\tau} E + \frac{dw}{d\tau} L(1 - \tau) + \frac{dr}{d\tau} B(1 - \tau) = -[Q(K, L) - wL - rB].$$

The left side of equation (2) consists of three terms, of which the first is the change in returns to equity holders, the second is the change in after-tax labor cost, and the third is the change in after-tax borrowing costs. The right side of equation (2) is simply the effect of a tax change on after-tax profits. Hence equation (2) reflects that higher tax costs must be compensated by a reduction of wages or capital returns, or equivalently, that some factor in the economy must bear the burden of corporate taxes.

It is noteworthy that output prices are normalized to one in the derivation of equation (2), which implies that output prices are assumed not to change as corporate tax rates change. In a single sector closed economy this assumption would simply represent a normalization of units, having no economic consequence, but in a multisector economy, or an open economy, the assumption that output prices are unaffected by corporate tax rates rules out effects that arise from intersectoral reallocation of resources (as in Harberger, 1962) or changing terms of trade between countries. For a small open economy in which the corporate and noncorporate sectors produce goods for a competitive world market, it follows (Gordon and Hines, 2002) that output prices cannot change in response to corporate tax changes, making the fixed price assumption a reasonable specification in this situation.

Suppose that capital investments are financed with a fraction α of debt and $(1 - \alpha)$ of equity. Then equation (1) implies:

$$(3) \quad \rho(1 - \alpha)K \equiv [Q(K, L) - wL - r\alpha K](1 - \tau),$$

and differentiating with respect to τ produces:

$$(4) \quad \frac{d\rho}{d\tau}(1-\alpha)K + \frac{dw}{d\tau}L(1-\tau) + \frac{dr}{d\tau}\alpha K(1-\tau) = -[Q(K,L) - wL - r\alpha K].$$

If investors are indifferent between receiving certainty-equivalent returns in the form of bond interest and equity returns, then $\rho = r$, and (4) implies:

$$(5) \quad \frac{d\rho}{d\tau}(1-\alpha\tau)K + \frac{dw}{d\tau}L(1-\tau) = -[Q(K,L) - wL - r\alpha K].$$

In an extreme case, in which $\alpha \cong 0$, and investments are financed almost entirely with equity, (5) implies:

$$(6) \quad \frac{dr}{d\tau}K + \frac{dw}{d\tau}L(1-\tau) = -[Q(K,L) - wL].$$

Equation (6) clarifies that the burdens of corporate tax increases are shared between labor and capital.

Under these conditions, the use of equation (1) allows equation (6) to be rewritten as:

$$(7) \quad \frac{1}{r} \frac{dr}{d\tau} rK + \frac{1}{w} \frac{dw}{d\tau} Lw(1-\tau) = -\frac{rK}{(1-\tau)}.$$

This in turn implies:

$$(8) \quad \frac{1}{r} \frac{dr}{d\tau} + \frac{1}{w} \frac{dw}{d\tau} \frac{Lw}{rK} (1-\tau) = -\frac{1}{(1-\tau)}.$$

Defining a labor share of output as $s \equiv \frac{wL}{Q}$, it follows that $\frac{Lw(1-\tau)}{rK} = \frac{Lw}{(Q-wL)} = \frac{s}{(1-s)}$. By

also applying that $\frac{dr}{d\tau} = -\frac{dr}{d(1-\tau)}$ and $\frac{dw}{d\tau} = -\frac{dw}{d(1-\tau)}$, equation (8) becomes:

$$(9) \quad \frac{dr}{d(1-\tau)} \frac{(1-\tau)}{r} + \frac{dw}{d(1-\tau)} \frac{(1-\tau)}{w} \frac{s}{(1-s)} = 1.$$

3.2. Empirical implications.

In order to move to an estimating framework, it is useful to revisit an estimating equation that is employed to assess the effect of corporate taxes on wages. The corporate tax rate is not the only economic variable that affects wages and returns to capital. Letting X denote a vector of country attributes relevant to wage determination, and defining $s^* \equiv \frac{(1-s)}{s}$, it follows that the traditional framework for estimating wages can be framed as:

$$(10) \quad \ln w = \beta X + \gamma s^* \ln(1-\tau) + \varepsilon.$$

In this setting, $\gamma = \frac{dw}{d(1-\tau)} \frac{(1-\tau)}{w} \frac{s}{(1-s)}$. Note that this corresponds to the second half of the left hand side of equation (9). Strictly speaking, equation (10) requires that s^* not be a function of τ .

One can readily imagine also estimating the parallel relationship for interest rates:

$$(11) \quad \ln \rho = \beta' X + \gamma' \ln(1-\tau) + \varepsilon',$$

for which $\gamma' = \frac{d\rho}{d(1-\tau)} \frac{(1-\tau)}{\rho}$.

The relationship expressed in equation (9) carries implications for the estimated relationships (10) and (11), since these equations are not independent, but instead must satisfy an adding-up constraint. In particular, equation (9) implies that:

$$(12) \quad \gamma + \gamma' = 1.$$

This cross-equation restriction, which does not constrain the values of γ and γ' between zero and one, can then be employed when jointly estimating equations (10) and (11). It is worth noting that coefficients derived from estimating these equations without imposing the cross-equation constraint do not have natural interpretations, as they would then capture efficiency effects of corporate taxation, and the influence of correlated omitted variables, instead of the determinants of relative burdens.

The coefficients γ and γ' from equations (10) and (11) serve to identify the relative tax burdens on the two factors of production. To see this, note that $(1-s) = \frac{Q-wL}{Q} = \frac{rK}{Q}$ and therefore:

$$(13) \quad (1-s) \frac{dr}{d \ln(1-\tau)} \frac{1}{r} = \frac{K}{Q} \frac{dr}{d \ln(1-\tau)}.$$

Similarly, $s = \frac{wL}{Q}$, so

$$(14) \quad s \frac{dw}{d \ln(1-\tau)} \frac{1}{w} = \frac{L}{Q} \frac{dw}{d \ln(1-\tau)}.$$

Equations (13) and (14) lead directly to:

$$(15) \quad \frac{\gamma}{\gamma'} = \frac{\frac{s}{(1-s)} \frac{dw}{d \ln(1-\tau)} \frac{1}{w}}{\frac{dr}{d \ln(1-\tau)} \frac{1}{r}} = \frac{L[dw/d \ln(1-\tau)]}{K[dr/d \ln(1-\tau)]}.$$

From the envelope theorem, the effect of a tax change on returns to labor is given by $L[dw/d \ln(1-\tau)]$, and the effect of a tax change on returns to capital is given by $K[dr/d \ln(1-\tau)]$. Hence the right side of (15) is simply the ratio of the burdens borne by labor and capital, respectively, to a small tax change. This ratio equals the ratio of the two estimated coefficients, γ and γ' .

It follows from equation (15) that estimating γ and γ' from equations (10) and (11), constraining the resulting estimates to sum to one, provides direct estimates of the relative shares of the corporate tax burden borne by labor and by capital. These shares are independent of the deadweight loss of corporate taxation, reflecting tax burdens rather than total tax collections. For example, if $\gamma = 0.67$, so that labor bears two thirds of the burden of corporate taxation, and the deadweight loss of the corporate tax equals 50 percent of revenue collected, then labor's total burden equals 100 percent of corporate tax revenue, with capital bearing a burden equal to an additional 50 percent of corporate tax revenue. An important way in which this estimating

method differs from its predecessors is that it identifies relative, but not total, burdens of the corporate tax.

3.3. *Data*

The empirical work presented in section 4 is based on the most comprehensive and reliable available data on the activities of U.S. multinational firms. The Bureau of Economic Analysis (BEA) Benchmark Surveys of U.S. Direct Investment Abroad in 1989, 1994, 1999, and 2004 provide a panel of data on the financial and operating characteristics of U.S. multinational affiliates.³ As discussed above, the question of incidence recommends the use of data that are aggregated at the national level. Accordingly, an aggregation of the majority-owned activities of foreign affiliates at the country-year level is employed in the analysis below.

Table 1 presents means, medians, and standard deviations of variables used in the regressions that follow. The wage rate is defined as the ratio of total employee compensation (including benefits) paid by majority owned foreign affiliates to numbers of employees. Since the BEA data are measured in U.S. dollars, these can be interpreted as real wage rates to the extent that purchasing power parity holds and thereby automatically corrects for the effects of local inflation. As profit-type returns may reflect tax-motivated reallocation of pretax income, returns to capital are captured by measuring average interest rates paid on the liabilities of foreign affiliates. The interest rate is computed as the ratio of interest payments made by majority foreign owned affiliate to the aggregate level of current liabilities and long-term debt, with both variables again measured in U.S. dollars.⁴ Tax rates are measured for each country-year combination as the ratio of aggregate foreign income tax payments to aggregate net income plus foreign income tax payments. Given that country-specific values of s also have the potential to reflect tax-motivated income reallocation, yearly aggregate values of s for the total foreign activities of U.S. multinational firms are used in their place. Specifically, s is calculated as the ratio of total employee compensation to the sum of total employment compensation, net income, foreign income taxes and depreciation in a given year.

³ The International Investment and Trade in Services Survey Act governs the collection of the data and the Act ensures that “use of an individual company’s data for tax, investigative, or regulatory purposes is prohibited.” Willful noncompliance with the Act can result in penalties of up to \$10,000 or a prison term of one year. As a result of these assurances and penalties, BEA believes that coverage is close to complete and levels of accuracy are high.

⁴ See Desai, Foley and Hines (2004) for a discussion and analysis of this interest rate variable and its alternatives.

In addition to these variables constructed from the BEA data, some regressions include control variables used to explain wages and interest rates. For wages, the Barro-Lee measure of average workforce education, measured in years, and obtained from Barro and Lee (2000), is used as an explanatory variable. For interest rates, national measures of creditor rights, drawn from Djankov, McLiesh, and Shleifer (2005), and local inflation rates, drawn from the World Development Indicators, are included as explanatory variables. Desai, Foley and Hines (2004) note that stronger legal protections for lenders and higher inflation rates are associated with lower interest rates.⁵

4. *The Distribution of Corporate Tax Burdens.*

This section reports the results of estimating the distribution of corporate tax burdens using the data from American multinational firms described in section 3.

4.1. Annual cross-sections

Table 2 presents results of seemingly unrelated systems of equations that restrict the sum of the tax coefficients in the wage and interest rate specifications to equal one. The specification explaining wages and the specification explaining interest rates are not therefore separate regressions but instead components of a single regression. The estimated 0.6943 coefficient estimated in the first regression implies that higher tax rates are associated with lower wages, since 69 percent of the total tax burden is borne by labor. The corresponding 0.3057 coefficient carries the mirror image implication that 31 percent of the total burden is borne by capital. The estimated interest rate effect does not differ significantly from zero, but does differ significantly from one, which is consistent with (indeed, implied by) the statistical significance of the estimated wage effect reported in column one.

The second system of equations adds explanatory variables to the wage and interest rate specifications. Specifically, the wage specification now includes the Barro-Lee measure of workforce education, and the interest rate specification now includes measures of creditor rights and local inflation. Since the regression requires information on all of these variables for any

⁵ Desai, Foley and Hines (2004) also report that higher corporate income tax rates are associated with lower interest rates in their affiliate-level specifications that control for various firm and affiliate attributes, a finding that is consistent with the results reported in section 4.

country included in the sample, the sample size falls from 52 observations for the regression reported in columns one and two to just 41 observations. Workforce schooling has a large and statistically significant effect on wages, the 0.2056 coefficient reported in column three implying that each additional year of education increases employment compensation by about 20%. The creditor rights and inflation variables appear to have only insignificant effects on reported interest rates.

The inclusion of additional explanatory variables and restriction of the sample size together reduces the magnitude of the estimated tax coefficient in the wage specification to 0.4839. There is a corresponding rise in the tax coefficient in the interest rate specification to 0.5161. Hence from these coefficients it appears that roughly half of the burden of corporate taxation is borne by labor in the form of reduced wages, and half by capital in the form of reduced returns.

In order to consider the dependence of these results to the use of 2004 data, Panels A, B, and C of Table 3 repeat these regressions for cross sections of data covering 1999, 1994, and 1989. The results are broadly consistent with those reported in Table 2, though the estimated burden on labor tends to be somewhat higher in these regressions than in the regressions reported in Table 2. For example, regression (4) in Panel B of Table 3 reports estimated coefficients from a regression explaining 1994 wages and interest rates as functions of local tax rates, worker education, creditor rights and inflation. The estimated 0.7456 coefficient implies that three quarters of the burden of corporate taxation is borne by labor, with the remaining 25 percent borne by capital. This estimated labor share is significantly different from zero, but not statistically different from one, implying that these results do not rule out the possibility that labor bears 100 percent of the burden of corporate taxation, whereas they are inconsistent with labor bearing none of the burden.

4.2. *Panel evidence*

Table 4 presents estimated coefficients from regressions using data from all four benchmark survey years, 1989, 1994, 1999, and 2004. The estimated 0.7118 coefficient obtained from the first seemingly unrelated regression implies that 71 percent of the burden of corporate taxation is borne by labor, with the remaining 29 percent borne by capital. The

relatively small standard error suggests that it is possible to reject that the labor share of the tax burden is either zero or 100 percent.

The second pair of specifications repeats this analysis but adds education, creditor rights, and inflation as controls. The need to incorporate this information reduces the sample size. The estimated labor share falls in these regressions, the 0.6152 coefficient in column three implying that 62 percent of the burden of corporate taxes is borne by labor, again with a small enough standard error that it is possible to reject that the labor share is either zero or 100 percent.

The third seemingly unrelated system of equations omits the control variables but introduces country fixed effects, thereby estimating tax effects from changes in corporate tax rates between benchmark survey years. This approach implicitly controls for country attributes that do not change over the 1989-2004 period. The 0.5665 coefficient in column five implies that labor bears 57 percent of the burden of corporate taxes. Together with the small associated standard error, this coefficient implies that it is possible to reject that labor's share of the total tax burden is outside the range of 40-74 percent.

Finally, the fourth pair of specifications presented in Table 4 adds country fixed effects to the second pair of specifications. The results of this regression suggest that labor bears a somewhat smaller share of the total corporate tax burden than does the third regression. The 0.4469 coefficient in column seven implies that labor bears 45 percent of the total tax burden, the remaining 55 percent falling on capital.

The regressions reported in Table 4 include specifications that interact local tax rates with measured values of s^* , a function of aggregate shares of labor compensation in total returns. Since the sample mean value of s is 0.4823, it does little injustice to the data simply to fix the value of s^* at unity, thereby effectively removing this interaction from the tax term on the right side of the wage specifications. Table 5 reports results from estimating the same regressions as those reported in Table 4, but imposing that $s^* = 1$.

The estimated coefficients reported in Table 5 are similar to those reported in Table 4, the primary difference being that the estimated labor share of the total tax burden is somewhat higher in the specifications in Table 5. For example, the 0.7521 coefficient estimated from the

first regression implies that labor bears three quarters of the total burden of corporate taxes, which compares to the 0.7118 coefficient reported for the analogous regression in Table 4. The differences between the results in these two tables are the greatest for the third and fourth regressions, reported in columns 5-8, that include country fixed effects. Thus, the 0.7326 coefficient estimated from the third regression presented in Table 5 implies that labor bears 73 percent of the corporate tax burden, whereas the corresponding 0.5665 coefficient in Table 4 implies that labor bears only 57 percent of the burden. Similarly, the 0.5889 coefficient estimated from the fourth regression presented in column 8 of Table 5 suggests a notably larger labor share of total burdens than does the corresponding 0.4469 coefficient in Table 4. It is clear, therefore, that time-varying labor shares of total output are not responsible for the significant labor shares of total tax burdens implied by the results reported in Table 4. It is also the case that, at least in these specifications, treating labor shares in an arbitrary manner by imposing a value that removes the labor share variable from the estimation has the effect of increasing the estimated fraction of the tax burden borne by labor.

5. *Interpretation*

This section considers two issues that arise in interpreting the empirical results. The first of these issues is the consistency of the empirical estimates with the theoretical literature that emphasizes perfect international capital mobility. The second issue is the extent to which it is appropriate to draw broad economic conclusions from an analysis based on data drawn from American multinational firms.

5.1. *Local effects and spillover effects*

Do the regression estimates presented above capture the entire distributional consequences of corporate tax changes? These cross sectional and panel regressions provide estimates of the average effect of tax differences on after-tax returns to local factors. As emphasized in the Randolph (2006) application of the Kotlikoff and Summers (1987a) framework, a corporate tax change in one country typically affects wages and rates of return to capital in all other countries. As such, the statistical evidence presented in section four does not identify all of the distributional effects of a country's corporate tax rate. The evidence instead isolates any effect of international differences in corporate tax rates on differences in factor

returns, not incorporating any distributional impact that average corporate tax rate levels may have.

If the assumption of perfect capital mobility embodied in the Randolph (2006) and Kotlikoff and Summers (1987a) approach were correct, then regressions such as those presented in section four would show that borrowing rates are unrelated to corporate income tax rates. Nonetheless, Randolph's model implies that roughly 30 percent of the burden of U.S. corporate income taxes is borne by U.S. capital. This burden arises because, with a fixed worldwide capital stock, worldwide capital bears 100 percent of the burden of U.S. corporate taxation and the U.S. comprises 30 percent of the worldwide capital stock. Consequently, these models imply that the worldwide rate of return to capital varies year by year according to how heavily the whole world taxes corporate income. Regressions, however, do not pick up this effect as they are based on comparing rates of return between countries in the same year.

How should one interpret the findings in section four in light of the effects of average world tax rates identified in the work of Kotlikoff and Summers (1987a), and applied in the Randolph (2006) model? From the standpoint of a small open economy, the cross sectional results likely identify the full burden of the corporate tax, given that spillover effects from a small open economy to the rest of the world, and thereby back to the small country, are apt to be tiny. For a large open economy such as the United States, corporate tax changes have the potential to have sizable spillover effects on world interest rates and wages that are not captured in the empirical estimates provided in this paper.

It is difficult to combine the effects of average world tax rates with cross-sectional estimates to project the distributional impact of corporate tax changes in large countries. Simply adding empirical estimates of within-country effects of corporate tax changes and the numerical simulations from Randolph's model for spillover effects would be incorrect. Indeed, the evidence that interest rates vary with corporate income tax rates, for example, is inconsistent with assumptions underlying the Randolph model, instead being consistent with a framework in which there is imperfect international capital mobility, at least in the short run. Furthermore, the strong and untested assumption of Randolph's model that the total world capital supply is unaffected by after-tax returns is responsible for at least some of the model's stark conclusions.

While some of the implications of average world corporate tax rates highlighted by Randolph's calculations certainly should be incorporated in a complete assessment of the effects of a U.S. corporate tax reform, in the absence of empirical evidence it is difficult to know exactly to what extent it is necessary to modify conclusions that can be drawn from cross-sectional evidence.

5.2. *Multinational firms and national economies*

If the activities of American multinational firms operating abroad were perfectly representative of their host economies, then estimating the relationship between taxes, wages and returns to capital in the manner employed in section four would constitute a straightforward application of the framework sketched in section three. In reality, available evidence on the activities of multinational firms suggests that multinational firms differ in important dimensions from local firms. For example, there is a consensus that wages paid by multinational firms exceed those paid by local firms.⁶ Such differences, while well-established, need not influence the interpretation of the empirical results if multinational firms pay wages that exceed prevailing local wages by percentages that are not influenced by corporate tax rates. Similarly, while foreign investors may confront borrowing costs that differ from those facing local firms, the use of interest rates paid by multinational firms as indicators of local capital returns produces valid inferences as long as the ratio of these two borrowing costs is not itself influenced by corporate tax rates.

These considerations and others suggest that it would be worthwhile to estimate the extent to which corporate taxes affect wages and capital returns in a simultaneous system using data that cover more than the foreign operations of American multinational firms. One formidable challenge facing such an estimation is the compilation of consistent data for a large enough number of countries to provide statistical reliability for the results. While there is good reasons to expect that conclusions drawn from the environment facing American firms are likely to apply to entire economies, this is a proposition that might well benefit from further empirical exploration.

⁶ The wage premium paid by the foreign affiliates of multinational firms reflects the greater than average skills of the labor force they employ, rather than a tendency to assign some home country workers to foreign locations. U.S. citizens represented less than 0.3 percent of the employees of foreign affiliates of American multinational firms in 1999, far too small a fraction to influence average wages significantly.

6. *Conclusion*

Who bears the burden of corporate taxes in modern open economies? Economic theory points to a range of possibilities. While the available theory does not identify specific answers, it does suggest a worthwhile empirical framework that can be used to estimate the distribution of corporate tax burdens. Applying this framework to data on American multinational firms that operate around the world produces estimates that imply that the burden of corporate taxation is borne by labor to a significant degree. These estimates evaluate the extent to which differences in corporate tax rates are associated with differences in after-tax returns to capital and labor, likely capturing the full burden of corporate taxes in small economies and most if not close to all of the distributional effects of corporate taxes in large economies.

It is possible to bring both more evidence and sharper theory to bear on the question of the distributional impact of corporate taxation. The use of aggregate national data collected on a consistent basis for a large number of countries has the potential to enlighten our understanding of the workings of corporate taxation on parts of economies that are less influenced by foreign direct investment. Tax incidence theory might usefully distinguish the effects of tax rates and tax bases, the treatment of individual industries and sectors, and other realistic features of corporate taxation that could be incorporated in future empirical work. For all that remains to be done, however, it is a mistake to overlook the evidence before us, in which it appears that the burden of corporate taxation is not, as some have thought, entirely borne by owners of corporations or owners of capital, but instead shared between labor and capital.

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Table 1
Descriptive Statistics

	<u>Mean</u>	<u>Median</u>	<u>Standard Deviation</u>
LN (Wage)	3.0984	3.2091	0.7365
LN (Interest Rate)	-3.6777	-3.6379	0.7374
<i>s</i>	0.4823	0.4931	0.0584
LN (1-Tax Rate)	-0.3744	-0.2971	0.3793
$((1-s)/s) * \text{LN (1-Tax Rate)}$	-0.3989	-0.3118	0.3893
Workforce Schooling	7.6838	7.8930	2.2323
Creditor Rights	2.0695	2.0000	1.1362
LN (Inflation)	-2.9234	-2.8895	1.3894

Notes: LN (Wage) is the natural log of employment compensation per employee as measured in the BEA data. LN (Interest Rate) is the natural log of the ratio of interest payment to current liabilities and long term debt, computed using BEA data. Tax Rates are imputed from the BEA data by taking the ratio of foreign income taxes paid to the sum of foreign income taxes paid and net income. *S* is the ratio of employment compensation to the sum of employment compensation, net income, foreign income taxes, and depreciation and it is calculated at the annual level using aggregate worldwide BEA data. Workforce Schooling is the average schooling years in the population over 25 years old provided in Barro and Lee (2000). Creditor Rights is an index of the strength of creditor rights developed in Djankov, McLiesh, and Shleifer (2005); higher levels of the measure indicate stronger legal protections. LN (Inflation) is the natural log of the rate of inflation as measured using GDP deflator data drawn from the World Development Indicators.

Table 2

2004 Cross-Sectional Constrained Seemingly Unrelated Regressions

<i>Dependent Variable:</i>	LN (Wage)	LN (Interest Rate)	LN (Wage)	LN (Interest Rate)
	(1)		(2)	
Constant	3.6416 (0.1271)	-3.8137 (0.1053)	1.8783 (0.3108)	-3.7709 (0.3406)
$((1-s)/s) * \text{LN (1-Tax Rate)}$	0.6943 (0.2047)		0.4839 (0.1847)	
LN (1-Tax Rate)		0.3057 (0.2047)		0.5161 (0.1847)
Workforce Schooling			0.2056 (0.0363)	
Creditor Rights				0.0442 (0.0725)
LN (Inflation)				-0.0154 (0.0914)
No. of Obs.	52		41	
Log Likelihood	-103		-61	

Notes: This table presents the results of constrained, seemingly unrelated regressions using 2004 data. LN (Wage) is the natural log of employment compensation per employee as measured in the BEA data. LN (Interest Rate) is the natural log of the ratio of interest payment to current liabilities and long term debt, computed using BEA data. Tax Rates are imputed from the BEA data by taxing the ratio of foreign income taxes paid to the sum of foreign income taxes paid and net income. s is the ratio of employment compensation to the sum of employment compensation, net income, foreign income taxes, and depreciation and it is calculated at the annual level using aggregate worldwide BEA data. Workforce Schooling is the average schooling years in the population over 25 years old provided in Barro and Lee (2000). Creditor Rights is an index of the strength of creditor rights developed in Djankov, McLiesh, and Shleifer (2005); higher levels of the measure indicate stronger legal protections. LN (Inflation) is the natural log of the rate of inflation as measured, using GDP deflator data drawn from the World Development Indicators.

Table 3
Alternative Annual Cross-Sectional Results

<i>Dependent Variable:</i>	<i>Panel A: 1999</i>			<i>Panel B: 1994</i>			<i>Panel C: 1989</i>			
	LN (Wage)	LN (Interest Rate)	LN (Interest Rate)	LN (Wage)	LN (Interest Rate)	LN (Interest Rate)	LN (Wage)	LN (Interest Rate)	LN (Interest Rate)	
	(1)	(2)	(3)	(4)	(5)	(6)				
Constant	3.3461 (0.1488)	2.2437 (0.3814)	3.3214 (0.1185)	1.8132 (0.3406)	-3.5696 (0.1061)	-2.9711 (0.1815)	3.0581 (0.1287)	-3.0228 (0.1323)	1.8119 (0.3286)	-2.1200 (0.2613)
$((1-s)/s) * \text{LN}(1-\text{Tax Rate})$	0.4547 (0.3426)	0.7241 (0.3222)	0.7263 (0.1802)	0.7456 (0.2190)			0.5695 (0.1328)		0.5538 (0.1229)	
LN(1-Tax Rate)	0.5453 (0.3426)		0.2759 (0.3222)	0.2737 (0.1802)	0.2544 (0.2190)		0.4306 (0.1328)		0.4462 (0.1229)	
Workforce Schooling		0.1429 (0.0434)		0.1860 (0.0409)					0.1717 (0.0421)	
Creditor Rights			0.0623 (0.0826)		-0.0327 (0.0536)					-0.0525 (0.0960)
LN(Inflation)			0.1036 (0.0630)		0.1570 (0.0454)					0.3125 (0.0707)
No. of Obs.	50	31	50	39	52	42				
Log Likelihood	-107	-44	-97	-54	-125	-81				

Notes: This table presents the results of constrained seemingly unrelated regressions using data from 1999, 1994, and 1989 in Panels A, B, and C, respectively. LN (Wage) is the natural log of employment compensation per employee as measured in the BEA data. LN (Interest Rate) is the natural log of the ratio of interest payment to current liabilities and long term debt, computed using BEA data. Tax Rates are imputed from the BEA data by taxing the ratio of foreign income taxes paid to the sum of foreign income taxes paid and net income. s is the ratio of employment compensation to the sum of employment compensation, net income, foreign income taxes, and depreciation, calculated at the annual level using aggregate worldwide BEA data. Workforce Schooling is the average schooling years in the population over 25 years old provided in Barro and Lee (2000). Creditor Rights is an index of the strength of creditor rights developed in Djankov, McLiesh, and Shleifer (2005); higher levels of the measure indicate stronger legal protections. LN (Inflation) is the natural log of the rate of inflation as measured using GDP deflator data drawn from the World Development Indicators.

Table 4

Panel Analysis: 1989, 1994, 1999, and 2004

<i>Dependent Variable:</i>	LN	LN	LN	LN	LN	LN	LN	LN
	(Wage)	(Interest Rate)						
	(1)		(2)		(3)		(4)	
Constant	3.3823 (0.0661)	-3.5698 (0.0648)	1.8567 (0.1762)	-2.8089 (0.1341)	2.3000 (0.3282)	-3.0667 (0.5003)	1.3252 (0.3080)	-2.8009 (0.2974)
$((1-s)/s) * \text{LN (1-Tax Rate)}$	0.7118 (0.1002)		0.6152 (0.0909)		0.5665 (0.0843)		0.4469 (0.0734)	
LN (1-Tax Rate)		0.2882 (0.1002)		0.3848 (0.0909)		0.4335 (0.0843)		0.5531 (0.0734)
Workforce Schooling			0.1878 (0.0212)				0.3182 (0.0499)	
Creditor Rights				0.0274 (0.0416)				0.1407 (0.1438)
LN (Inflation)				0.2206 (0.0338)				0.2340 (0.0369)
Country Fixed Effects?		N		N		Y		Y
No. of Obs.		204		153		204		153
Log Likelihood		-463		-272		-178		-85

Notes: This table presents the results of constrained seemingly unrelated regressions using pooled data from 2004, 1999, 1994, and 1989. LN (Wage) is the natural log of employment compensation per employee as measured in the BEA data. LN (Interest Rate) is the natural log of the ratio of interest payment to current liabilities and long term debt, computed using BEA data. Tax Rates are imputed from the BEA data by taxing the ratio of foreign income taxes paid to the sum of foreign income taxes paid and net income. s is the ratio of employment compensation to the sum of employment compensation, net income, foreign income taxes, and depreciation, calculated at the annual level using aggregate worldwide BEA data. Workforce Schooling is the average schooling years in the population over 25 years old provided in Barro and Lee (2000). Creditor Rights is an index of the strength of creditor rights developed in Djankov, McLiesh, and Shleifer (2005); higher levels of the measure indicate stronger legal protections. LN (Inflation) is the natural log of the rate of inflation as measured using GDP deflator data drawn from the World Development Indicators.

Table 5

Panel Analysis with Fixed Values for the Labor Share

<i>Dependent Variable:</i>	LN	LN	LN	LN	LN	LN	LN	LN
	(Wage)	(Interest Rate)						
	(1)		(2)		(3)		(4)	
Constant	3.3800 (0.0644)	-3.5849 (0.0647)	1.9249 (0.1760)	-2.8496 (0.1320)	2.3131 (0.3088)	-3.6142 (0.4615)	1.5434 (0.3006)	-2.8682 (0.2879)
$((1-s)/s) * \text{LN (1-Tax Rate)}$	0.7521 (0.1006)		0.6989 (0.0924)		0.7326 (0.0825)		0.5889 (0.0748)	
LN (1-Tax Rate)		0.2479 (0.1006)		0.3011 (0.0924)		0.2674 (0.0825)		0.4111 (0.0748)
Workforce Schooling			0.1805 (0.0212)				0.2660 (0.0494)	
Creditor Rights				0.0277 (0.0407)				0.1220 (0.1392)
LN (Inflation)				0.2179 (0.0332)				0.2330 (0.0358)
Country Fixed Effects?		N		N		Y		Y
No. of Obs.		204		153		204		153
Log Likelihood		-461		-268		-167		-76

Notes: This table presents the results of constrained seemingly unrelated regressions using pooled data from 2004, 1999, 1994, and 1989. In these regressions, the value of the labor share, s , is fixed at 0.5. LN (Wage) is the natural log of employment compensation per employee as measured in the BEA data. LN (Interest Rate) is the natural log of the ratio of interest payment to current liabilities and long term debt, computed using BEA data. Tax Rates are imputed from the BEA data by taxing the ratio of foreign income taxes paid to the sum of foreign income taxes paid and net income. Workforce Schooling is the average schooling years in the population over 25 years old provided in Barro and Lee (2000). Creditor Rights is an index of the strength of creditor rights developed in Djankov, McLiesh, and Shleifer (2005); higher levels of the measure indicate stronger legal protections. LN (Inflation) is the natural log of the rate of inflation as measured using GDP deflator data drawn from the World Development Indicators.

Preliminary and Incomplete:

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Taxes and Wages

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Abstract

Using panel data for 72 countries and 22 years, we explore the link between taxes and manufacturing wages. We find, controlling for macroeconomic variables that have been found in the literature to influence wages, statistically significant evidence that wage rates are not responsive to median or average income tax rates. We find that wages are significantly responsive to corporate taxation, and that the responsiveness of wages to corporate taxation is larger in smaller countries. We also find that tax and wage characteristics of neighboring countries, whether geographic or economic, have a significant effect on domestic wages. These results are consistent with the frequently employed assumptions in the public finance literature that capital is highly mobile, but labor is not. Under these conditions labor will bear the burden of labor taxes, and bear or share the burden of capital taxes.

I. Introduction

Taxes distort incentives for economic agents. Corporate taxes raise the cost of capital for the business owner, thus reducing the demand for capital. However, the incidence of the corporate tax need not fall solely on capital. Lower investment in capital may lead to lower capital per worker, lower worker productivity, and lower real wages.¹ Similarly, personal income taxes distort the work-leisure decision for workers. High personal taxes may discourage participation in the labor market, thus reducing the supply of labor. However, if labor supply is sufficiently elastic, workers may pass on a share of the tax to capital in the form of higher wages. Hence both corporate taxes and personal income taxes may affect wages, through their impact on labor.

There is ample evidence linking national corporate tax rates to investment levels. Cummins, Hassett and Hubbard (1999) have documented the negative correlation between effective *marginal* corporate tax rates and investment across a large panel of countries. If investment and capital formation are a function of corporate tax rates, then worker productivity and wages may be as well. To date, this link has not been the subject of detailed econometric analysis. This paper fills that gap in the literature, and explores the relationship between corporate tax rates and wage rates.

Capital taxation does not occur in a vacuum. Accordingly, it is important to explore not only the impact of levels of tax variables, but also the impact of *relative* tax variables for competing countries.

¹ See Auerbach (2005) for a more recent analysis of who bears the burden of the corporate tax.

The effect of personal income taxes on work activity has been extensively studied in the literature. Davis and Henrekson (2004), among others, find that higher tax rates reduce work time in the market sector. However, there are no studies linking personal income tax rates and wage rates. Taken in this context, our paper fits into the larger public finance literature relating the tax on a commodity to its price. Poterba (1996) and Besley and Rosen (1994) examine the impact of sales and local taxes on prices of commodities, in order to analyze how much of the price increase due to the tax is actually shifted to consumers. If retail prices rise by exactly the amount of the tax, there is evidence of full tax shifting. Along the same lines, we aim to study the effect of an increase in labor income taxes on the price of labor, and whether there is any evidence to suggest that tax increases are shifted to capital through higher wages, thus transferring some of the burden from labor to capital.

Accordingly, the paper addresses two main questions: Do tax rates, corporate and personal income, systematically affect wage rates? Are wages in the domestic economy affected by taxes and wages in competing economies? These questions are addressed using a sample of developing and developed economies. Our empirical results indicate that domestic corporate taxes are negatively and significantly related to wage rates across countries. We also find that higher average wages in a country's neighbors leads to higher domestic wages. Further, high corporate taxes in competing countries also lead to higher domestic wages. Taken together, our results suggest that capital moves from high tax to low tax countries, and affects wages.

Our results for personal income taxes are surprising. We find that tax rates do not significantly impact wage rates. This is consistent with a model wherein no part of the

increase in labor taxes is passed onto wages. In such a model, labor bears the entire burden of the tax.

Section II provides a brief theoretical background and literature survey. Section III discusses the data and presents summary statistics. Section IV discusses preliminary regression results. Section V concludes.

II. The Linkage Between Capital Taxation and Wages

Since the theoretical linkage between labor taxes and the supply of labor (and hence wage rates) is fairly straightforward, we will focus the discussion in this section on capital taxes and wages. There are many *ex ante* reasons to expect that the linkages between capital taxation and the welfare of workers could be significant. Relying, for example, on the Solow model with a Cobb-Douglas production function with labor-augmenting technology:

$$Y = F(K, L) = K^\alpha (AL)^{1-\alpha}$$

The wage equation is:

$$w = \frac{\partial Y}{\partial L} = (1-\alpha)A^{1-\alpha} \left(\frac{K}{L}\right)^\alpha = (1-\alpha)A^{1-\alpha} k^\alpha$$

where k is the capital stock per worker and A is the level of technology. The more capital per worker (the greater the value of k), the greater the wage is. Therefore, a lower corporate tax may lead to a larger capital stock, which may benefit those people at the lower end of the income distribution, who only earn labor income.

The effect might be immediate if there were no capital adjustment costs, but these are likely to be important in practice. It is not plausible, however, that enough capital could flow into a country in a single year to dramatically alter the marginal product of labor, although the effect could be quite large in a very small and undeveloped country. Accordingly, we will look for these effects over longer time horizons, giving the capital stock time to adjust to the lower tax rates.

These linkages can, in theory, be quite significant, and can lead to counterintuitive results. Mankiw (2001), for example, develops a simple model wherein a union that can dictatorially set taxes on capital and labor chooses optimally to set the capital tax to zero, even though its objective is simply the maximization of wages. In Mankiw's (2001) model, there are two distinct types of agents: workers and capitalists, and two types of taxes: capital taxes and labor taxes. Since workers outnumber capitalists, and the hypothesized economy is a democracy, workers effectively get to dictate the tax on capital and labor to maximize their own welfare. Mankiw shows that even in this context workers would optimally choose to set the capital tax to zero. The intuition is that workers would be better off with a higher capital stock, since that would increase worker productivity and feed through to wages. The theoretical case for zero capital taxes is explored in great detail in two recent reviews (Auerbach and Hines, 2001; Judd 2001).

Of course, the link would not be interesting if capital flows were unresponsive to tax variables, but the opposite appears to be the case. Indeed, as mentioned earlier, there are numerous studies linking corporate tax rates to investment levels, both at a domestic and at an international level. The empirical literature discussed in Hassett and Hubbard

(2002), has generally found that effective marginal tax rates significantly impact capital formation.

In addition, relative treatment across countries changes significantly over time. After large reductions in statutory corporate tax rates by Ireland, UK and USA in the mid 1980's, other OECD countries also cut their rates perhaps out of a concern that they would lose investments.² The international tax literature, recently summarized by Gordon and Hines (2002) and Devereux and Griffiths (2002) finds that mobile capital may often flow to low tax jurisdictions. Cross-sectional studies such as Grubert and Mutti (1991) and Hines and Rice (1994) estimate the effect of national tax rates on the distribution of aggregate American-owned property, plant and equipment in 1982. They report a negative elasticity with respect to local tax rates. If there is a drop in investment in relatively high-tax countries, this would reduce the amount of capital available to workers and thus reduce real wages in that country. Hence if tax competition is prevalent, then investment may not only be influenced by the level of rates but also by relative rates.

To move to an empirical model of wages, one needs to model the linkage between specific corporate tax variables and capital formation. The literature suggests that marginal tax rates may not be the only relevant variable. Corporate income taxes may also distort the incentives for *international* investment and create opportunities for international tax planning. If firms locate plants in low-tax jurisdictions, and plant location is the decision at the margin, then average tax rates may play an important role in determining international capital flows, and wages. Devereux and Griffiths (1998) concludes that the effective *average* tax rate play an important role in the choice of

² "Corporate Income Tax Rates: International Comparisons", November 2005, CBO

investment location within Europe. However, they do not find a significant role for effective marginal tax rates.

Tables 2 and 3 report the top statutory corporate tax rates, and average hourly wage rates, for a subset of the countries in our sample. There is considerable variation in corporate tax rates across countries. For example, in 1981, Australia had a top corporate tax rate of 45 percent, while Bolivia's highest rate was 30 percent. Also, there has been considerable variation in corporate tax rates over time; corporate tax rates have tended to decline over the last twenty years. For instance, among the OECD economies, Australia experienced a decline in corporate tax rates from 46 percent in 1985 to 30 percent in 2001. Over the same period, among non-OECD economies, Chile experienced a drop from 46 percent to 16 percent. These movements are also apparent in effective average and effective marginal tax rates (Figure 1).³

At the same time, average hourly wage rates, which are affected by many things in addition to tax rates, have generally increased over time for most countries (Figure 2). In Australia, the average dollar wage per hour went up by 17.5 percent over this period, while in Chile, the corresponding increase was 18.75 percent. Figure 2 also shows a downward trend in average personal income tax rates. The decline has been steeper for the OECD economies, but the OECD economies, on average, experienced higher rates of personal taxation than non-OECD economies.

To date, studies seeking to explain the cross-country variation in wage growth have not focused on the role of capital taxation. Rodrik (1999) finds that there is a robust

³ An effective marginal tax rate is the percentage of the income from a marginal investment that must be paid as corporate income taxes. These rates are affected by rules for depreciation of productive assets and other features of the tax code.

and statistically significant association between the extent of democracy and the level of manufacturing wages in a country. This holds even after controlling for labor productivity and per capita incomes. Freeman and Ostendorp (2000) explain cross-country differences in terms of the level of gross domestic product per capita and unionization and wage setting institutions. Rama (2003) concludes that in the short run, wages fall with openness to trade and rise with foreign direct investment, but after a few years the effect of trade on wages is reversed. At a micro level, the widening wage distribution in the United States has been explained in terms of de-unionization and the erosion of the real value of the minimum wage (DiNardo, Fortin and Lemieux, 1996). Card, Kramarz and Lemieux (1996) similarly emphasize labor market rigidities as important factors. Katz (1999) points to the increasing use of computers and computer based technologies as affecting the relative demand for skilled workers, and wage inequality. Other papers, such as Davis and Hennekson (2004) study the effect of high personal income tax rates on hours worked in the market sector and other labor market outcomes. Some papers also study the effect of foreign direct investment on wage determination in a spatial setting. Feenstra and Hanson (1995) find that increased foreign direct investment in Mexico, just across the US border, caused an increase in the relative wages of skilled workers, in *both* countries along the border. They, however, did not explicitly model or estimate this relationship using regression analysis or spatial econometrics techniques.

III. Data and Empirical Model

The data cover the period 1981-2003 and include 72 countries.

Our basic approach is to follow Rodrik (1999), but to include tax variables as well.⁴ That is, we estimate a fixed effects model with the (five year average) Log wage rate per hour (in manufacturing) as the dependent variable, and beginning of period values of other variables such as Log Corporate Tax Rates, Log Value Added (per worker in manufacturing) and Log consumer price index as the independent variables. We also include fixed year effects. Following Devereux et al. (1998) we present results with different measures of the corporate tax rates, such as the top national corporate tax rate, the effective marginal and the effective average corporate tax rate. In addition, we present results with the spatial variables included in the analysis, such as weighted average tax rates and weighted average wage rates. These capture the effect of spatial tax competition and spatial wage effects across countries.

The dependent variable in the empirical analysis is the average dollar wage earned in manufacturing per hour. The main source of data on wages is the Labor Statistics database available from the International Labor Organization (<http://laborsta.ilo.org/>). This source provides information on wages for a broad sample of countries, for the period 1981-2003. These figures are provided in local currency terms and we have converted them to US dollars using exchange rates provided by the Penn World Tables. The dependent data are therefore in nominal terms, although a price deflator is also included in the regression. That is, we take a specification for the real wage, and rearrange it so that the deflator is an explanatory variable. This specification follows Rodrik.⁵ We tried specifications with the real wage as the dependent variable i.e the nominal wage deflated by the CPI. Results were similar.

⁴We discuss later why we do not include democracy as an explanatory variable, which Rodrik (1999) does.

International comparability of the data is made possible through use of various controls for differences in coverage and definitions. In most countries, the statistics on wages refer to “wages and salaries” which include direct wages and salaries, bonuses and gratuities, etc whereas in some countries they refer to “earnings”, which include, more broadly, all compensation such as employers’ contribution to social security, pension and insurance schemes. We then converted these total wage payments to hourly wage payments by dividing by the total number of hours worked, data for which was again obtained from the ILO. We check for the robustness of empirical results when controls for differences in coverage are included. The data are discussed in detail in the appendix. Average wages have been rising over the period 1981-2003 for all countries, though there is wide variation in countries both cross-sectionally and over time.

The other key variables in this paper are the tax rate variables. For these we draw on a new source, the AEI International Tax Database. From the raw tax rates, we calculate three measures of corporate tax rates: top national tax rate, effective average and effective marginal tax rates. Their derivation follows Devereux and Griffiths (1999). We control for difference in income taxation as well. To do this, we use average and median personal income tax rates from the AEI International Tax Database.⁶ The tax database has information on the number of tax brackets and the corresponding tax rate for each country. We constructed average and median tax rates using these.

Other variables include the value added per worker (in manufacturing, constant 1990 dollars) and trade as a fraction of GDP (available from the ILO KILM database) to measure openness. To control for the effect of prices, we include the log of the consumer price index. This variable captures cost-of-living differences not captured by exchange

⁶ Access to the AEI International Tax Database can be provided by writing to the authors.

rate conversions. We also experiment with additional variables such as the level of schooling, computerization and urbanization, highlighted by other papers in the literature.

To allow for the effect of labor market institutions, we use two variables. One of these measures the percentage of workers in a country covered by collective bargaining agreements, as a percent of total salaried or dependent workers. The second is a broader measure which is a count of the cumulative number of ILO conventions ratified by the country. The ILO conventions include ratification of conventions on child labor, forced or compulsory labor, discrimination, the right to organize and the right to bargain collectively. Thus the greater the number of ratified conventions, the greater the protection of workers rights. Information on these variables is available from the Fraser Institute’s Economic Freedom of the World dataset and the World Bank Labor Market Database (WBLMD), (Rama, 1996), respectively.

Following Rodrik (1999), ideally we would like to include both the level of gross domestic product (GDP) per capita (available from Penn World Tables) and manufacturing Value Added (MVA) per worker (constant dollars) in the same regression. In case all changes in productivity are not captured by MVA, some should show in the estimated coefficient on aggregate GDP. However, our measure of MVA is noisy. We obtained MVA data from three sources: Key Indicators of the Labor Market (ILO), WBLMD (Rama, 1996) and UNIDO. The problem we faced was one of missing data for our sample of countries and years. The ILO database has more information on total Value Added across all sectors, rather than Value Added only in Manufacturing. The World Bank database provided information for selected countries only until 1993, while the

UNIDO database again had lots of missing values for the countries in our sample.⁷ Thus our best option was to use the ILO total Value Added data as a proxy for MVA. For the countries that do report MVA, we have included that data. The correlation between this variable and the GDP variable is high, above 0.70. Hence while we get similar results with the two variables, we report results using the Value Added variable to measure productivity.⁸

Finally, we include in the regression analysis weighted averages of tax rates and wage rates in competing countries, following the standard spatial regression literature as summarized by Anselin (1999). The spatial weights matrix takes the form, $W_t = [W'_{1t}, \dots, W'_{Nt}]'$. At any time t , the i th row of this matrix is given by W'_{it} , which specifies "neighborhood sets" for each observation i . The ij -th element of W_t , namely, $w_{ij,t}$ is positive if j is a "neighbor" of i , and is zero otherwise. In our model, we consider many forms of the weighting matrix. One is based on regional economic weights. In this, the countries are assigned to be "neighbors" if they are in the same region as country i . For example, Zambia would have as its neighbors, Zimbabwe, Malawi and Mauritius since they are all in the East African region, but would not include Bolivia, Australia etc since they are in other regions. Countries within the same region would then be weighted by their GDP. A second form of the weighting matrix is based on Income weights i.e. countries within the same income group, such as high income, low income, or upper

⁷Rodrik (1999) uses two samples. The BLS sample covers the period 1975-1994, while the WBLMD/UNIDO sample covers the period 1960-1994. Therefore he does not face a similar problem. The number of observations in the UNIDO data for our sample is 754, in WBLMD, 725 and in ILO 1305. Even though the sample size drops by a lot when we consider the UNIDO data (after taking five year averages and including other variables in the regression), it is comforting to note that we are able to reproduce our main results discussed later.

⁸The coefficient on corporate taxes is negative and significant, even when we include *both* GDP and MVA in the analysis. Also, if we use only the countries with manufacturing value added data in the ILO sample, and use 3-year averages (to increase sample size), we are still able to reproduce our results.

middle income etc are classified as neighbors. These countries are then weighted by their GDP. The third kind of weighting we used was to assign distance weights to countries within the same income group.

These weighting matrices were used to create weighted averages of corporate tax rates and wage rates in "neighbor" countries. In somewhat more detail, the ij th element of the weighting matrix at time t , is,

$$w_{ij,t} = \frac{GDP_{jt}}{\sum_k GDP_{kt}} \quad \text{where } k \text{ is the number of "neighbor" countries for country } i.$$

The weighting matrix based on distance is defined in a similar manner. By convention, a cross sectional unit is not a neighbor to itself, so that the diagonal elements of W_t are all zero i.e. $w_{ii,t} = 0$.

B. Summary Statistics

Summary statistics for the core variables are presented in Table 1. The average wage for the OECD economies for this period was nearly \$9 per hour, whereas for Non-OECD economies it was \$2.50. Surprisingly, however, the mean top corporate tax rate was similar-around 35 percent-for both sets of countries. Average personal income taxes were larger for the OECD economies (.31) than for the non-OECD economies (.23). Average wages nearly doubled for both OECD and Non-OECD economies over this period, and corporate tax rates declined by slightly less than half. As shown in Figures 1 and 2, on average for all countries, corporate and personal income taxes have been declining over the sample period 1981-2003. This is true for the top national corporate tax rate, as well as the effective marginal and average tax rates. At the same time, average hourly wage rates have been rising over time. The average corporate tax rate for all

countries went down from 42 percent in 1981 to around 29 percent in 2000.⁹ For the same period, average wage rates increased from 3.5 dollars per hour to 6 dollars per hour. The correlation between these two variables was larger for the OECD countries (.355) than for the non-OECD countries. This is also reflected in the large negative coefficient on tax rates in a regression of tax rates on average wages for OECD countries (Figure 3).

IV. Regression Results

For purposes of the empirical analysis, we have grouped the data into nonoverlapping five year periods covering five sub-periods over 1981-2002.¹⁰ The average wage is a five year average of each of the sub-periods. Note that the average wage is in nominal dollar terms. This is Rodrik's (1999) specification, but with tax variable added.¹¹ For the right hand side variables, we use the beginning of period values.

Table 4 presents the first set of regression results. All the regressions, unless otherwise stated, are estimated using fixed effects. All specifications also control for period (time) dummies. The main variables of interest in this paper are the corporate tax rate and the personal income tax rate. Regressions in Table 4 use the top national corporate tax rate as the explanatory variable. Results with other measures of corporate taxes, such as effective average and marginal corporate tax rates are presented in Table 5.

The corporate tax rate variable is negative and highly significant. ($p=.005$) in the wage equation. This result is fairly stable across different specifications, and declines in

⁹ The countries with the highest corporate tax rates were Belgium, Italy and Turkey, with rates close to 40 percent.

¹⁰ The sub-periods are 1981-1985, 1986-1990, 1991-1995, 1996-2000, 2001-2002.

¹¹ Rodrik (1999) has a specification with log nominal wages as the dependent variable. He, however, acknowledges the possibility of spurious effects arising from wage and price inflation. Therefore, in one of his specifications using WMBLD/UNIDO data, he divides the nominal wage per hour by the Manufacturing Value Added (MVA) per hour, and that becomes the dependent variable.

significance only marginally when the number of observations is reduced in columns (4)-(5). The point estimates suggest that a one percent increase in corporate tax rates is associated with nearly a 0.8 percent decrease in wage rates according to the regression in Column (1), and on average about 0.95 percent decrease across different specifications. In Figure 3 we present scatter plots of corporate tax rates and wage rates for OECD and Non-OECD countries. In general, countries with high tax rates tend to have lower wages rates. A regression of average wages on corporate tax rates in different sub-samples of OECD and non-OECD economies yields a larger slope coefficient in the case of OECD countries, suggesting that on average over this period, capital-wage links have been stronger for the OECD countries.

In our model, corporate tax rates are assumed to affect wages through their impact on capital-labor ratios (investment) and worker productivity. To test for this, we obtained information on capital-labor ratios (from the Penn World Tables), and estimated a 2SLS regression of average wages on capital labor ratios using taxes as instruments. The first stage regression of capital labor ratios on corporate tax rates yielded a negative and significant coefficient on corporate tax rates ($p=0.048$). In the second stage regression, the coefficient on capital labor ratio is positive and significant at nearly 95 percent level of significance ($t\text{-statistic}=1.93$), with a coefficient close to 2. This confirms our intuition that higher corporate taxes may feed through to lower wages, through lower capital investment per worker.

Perhaps, surprisingly, we find that average personal income tax rates are insignificant in all specifications. Labor taxes do not systematically affect wages. This result holds even when we drop other variables, including the corporate tax variables,

from the regression (Column (3)). This suggests that labor bears the entire burden of labor taxes. There is no shifting of the tax to capital in the form of higher wages. This result is in line with Davis and Henrekson (2004). They conclude that the manufacturing sector is relatively insensitive to personal tax rates, because manufacturing production is highly capital intensive, larger firms and establishments predominate, and the workforce is highly specialized. They find in cross-country data a statistically insignificant effect of labor tax rates on manufacturing's share of total employment. Thus it is likely that manufacturing wages too are unresponsive to personal tax rates. We re-ran the regressions using *median* personal income tax rates as an alternative measure of the typical income tax paid by the typical manufacturing employee, but the results did not change. Median personal taxes were insignificant in all specifications.¹²

The regressions in columns (1)-(5) also reveal that MVA per worker is a significant determinant of wage levels. Not surprisingly, higher labor productivity is associated with higher wages. When Log wages are regressed on Log Value Added per worker alone, the coefficient is significant and positive with a coefficient of 2.3 and a t-statistic of 17.74. If instead of MVA per worker we substitute Log (GDP per capita) in the regression in Column (1), the results are similar. Therefore, we do not present them separately, and our analysis will be entirely in terms of MVA per worker.¹³

We tested for robustness of the coefficient on tax rates, by including additional variables. These include the level of schooling (measured by enrollment at different

¹² Davis and Henrekson (2004) study the effect of labor taxes on substitution away from market activities towards non-market activities within a country. They find that this kind of substitution is much lower in the manufacturing sector.

¹³ As mentioned before, we are able to reproduce these results in the smaller UNIDO sample using a RE GLS model and a simple OLS regression with region dummies, both of which impose fewer restrictions on the degrees of freedom.

levels of schooling, such as primary, secondary and tertiary (ILO)), labor market regulations (as measured by the number of ILO conventions ratified by the country or the percent of workers covered by collective bargaining agreements), extent of computerization (measured as the estimated number of personal computers in use as a fraction of the population, available from ILO) and openness (measured by share of total trade in GDP). None of these enters significantly, since we control for labor productivity directly.¹⁴ The estimated coefficient on corporate tax rates remains fairly similar across different specifications, and is significant at either the 95 or 99 percent level of significance. Note that the use of the fixed effects methodology eliminates country-specific idiosyncrasies regarding the type of coverage provided on wages and salaries.

In other regressions (not shown here), we defined the dependent variable as the real wage, rather than the nominal wage. Results were similar. The coefficient on corporate tax rates was in the same range as in other specifications. Personal taxes, median and average, were not significant.

We controlled for the effect of consumer prices. In general, higher prices may cause workers to bargain for higher wages. This variable remains positive and significant in all specifications.

We also experimented with other variables such as the share of government enterprises in all enterprises, number of employees in service industry or agriculture. However, none of these variables were significant while the sign on the corporate tax coefficient continued to be negative and significant.

¹⁴ An OLS regression of average wages on corporate taxes, schooling and (trade/GDP) (controlling for region effects and time dummies) alone yields significant and positive coefficients on schooling and (trade/GDP), while still yielding a negative and significant coefficient on corporate taxes. A regression of average wages on computerization or number of ILO conventions alone yields a positive and statistically significant impact of these variables.

In Table 5, we tested to see if the above results carried over to other measures of the corporate tax rate, such as the Effective Marginal Tax Rate and the Effective Average Tax Rate. The coefficient on the effective marginal tax rate variable is negative and significant only at 90 percent level of significance in Column (1), while on the effective average tax rate variable is significant at 95 percent. In Columns (3) and (4) we have presented these results for the case when our sample includes only non-OECD economies. In this case, we do find that effective average taxes matter more than effective marginal tax rates. This supports weakly the results of Devereux and Griffiths (1998) and Hassett and Hubbard (2002) of the impact of tax rates on investment for effective average and marginal tax rates, respectively. Results for the other variables are similar to those in Table 4.

Table 6 incorporates measures of average tax rates and average wage rates in “neighbor” countries in the regression analysis. The domestic economy corporate tax rate variables continue to be significant in these specifications. Since personal taxes are found to be insignificant in all specifications, we do not include them in the specifications shown in Table 6. Interestingly, we find significant results for the spatial variables. Column (1) defines a weighted average of top corporate tax rates and wage rates in “neighbor” countries. “Neighbor” countries here are defined as all those countries that are in the same region, as described before. The weights that we use for these countries are GDP weights. Thus every country is weighted by its economic strength in the region. In this specification, the weighted average wage in the region turns out to be positive and significant. There could be at least two reasons for this result. An increase in wages in neighboring countries may increase capital outflow from these regions to relatively lower

wage neighbor countries, which in turn may increase the demand for labor, and hence the wage rate. Secondly, high wages in neighboring countries may cause workers to move to the high wage country. This would cause a decrease in supply of workers in the relatively low wage country, which could cause an increase in wages in the low wage country as well. For the weighted average tax rate, the coefficient is positive, but not significant.

In Column (2), we change the spatial neighbors by defining as neighbors those countries that are in the same *income* group (rather than in the same region). Countries within the same income group are then weighted by their respective GDP. This specification would be justified if workers are more likely to move between countries with the same per capita income than from very high to very low or vice-versa. In this specification, the weighted wage variable is again positive and significant. In this case, the weighted (top corporate) tax variable is positive, but not significant.¹⁵

Column (3) presents results with a different weighting scheme. While neighbors continue to be defined in terms of income groups, the countries within the group are now weighted using (inverse) distance weights. Thus the farther the country, the lower the weight it receives within the group. In this specification both the own region wage and the own region (top corporate) tax rates are positive and significant.

Finally, in Column (4), we re-ran the regression using as a measure of the domestic and international tax rates, the effective marginal tax rates, instead of the top corporate tax rates. In this specification, the income weighted tax rates are positive and

¹⁵ While we use beginning of period values to ensure exogeneity of right-hand side regressors, we also use 2SLS estimation to test for this. It's possible that beginning of period average neighbor wages may be correlated with the left-hand side dependent variable. We therefore instrument for this variable in the standard way suggested in the spatial econometrics literature (Anselin, 1999). If our regression model has Y as the dependent variable and X, WX and WY as the right-hand side regressors, we instrument for WY using X, WX and W²X, where W is the weighting matrix. Results did not change in the 2SLS specification.

significant at 90 percent level of significance. In Column (5), we use the GDP-weighted average of the effective average tax rates in neighbor countries to capture spatial tax competition. These results suggest that tax competition exists among “neighbor” countries, whether we consider the top corporate tax rate, effective marginal tax rates, or effective average tax rates. Competition could result from being geographic neighbors i.e countries within the same region, or from “economic” neighbors i.e countries in the same income group.

Table 7 presents results with the democracy variable included in Rodrik (1999), and other forms of taxes such as VAT and payroll taxes. Following Rodrik, we construct our measure of democracy using Freedom House’s classification of countries based on political rights and civil liberties.¹⁶ Column (1) shows that in a regression including the democracy variable, along with our tax rate variable, the coefficient on the democracy variable is insignificant, while the estimated coefficient on tax rates and MVA per worker continue to be significant as before. Unlike Rodrik (1999), we do not include democracy as an explanatory variable in our baseline specification since a variable like democracy is difficult to measure, and is highly likely to be correlated with other unobservables in cross-country regressions. Persson and Tabellini (2005) suggest that democracies are correlated with other features of the economic system, such as liberalization and trade openness, form of government and type of electoral rule. A VAR analysis of democracy and corporate tax rates suggests that democracy may granger-cause corporate tax rates. In the political science literature, Hays (2003), finds that international capital tax competition has the greatest negative impact in majoritarian democracies with closed

¹⁶ Freedom House rates countries on a scale of 1 to 7 with higher ratings signifying less freedom. We combine the two ratings into a single index that varies from 0 to 1 (with higher values indicating greater democracy) by using the transformation [(14-civillib-polrights)/12].

economies. The paper uses a different measure of democracy, and distinguishes between majoritarian and consensus democracies.

In Columns (2) and (3), we test to see if other forms of taxes, such as value-added or sales tax (VAT) and (employer and employee) payroll taxes affect average wages, and find an insignificant effect. In Column (4), we address the question whether social security contributions by employers may be driving our results on personal taxes. Thus we exclude those countries where the wage measure includes contributions to social security by employers. As we can see from the table, this does not change our results. Moreover, any differences in the definition of wages across countries would be captured by the fixed effects.

Table 8 presents results for the case when the large economies (selected on the basis of GDP) are excluded from the sample. The intuition for this is that relatively small economies are much more likely to experience a sudden spurt in productivity and wages as a result of increased capital investment as compared to the richer economies have capital stocks that are large relative to the world supply of investment. Hence we should expect to see a larger impact of capital taxes on wages in these small economies, in terms of a larger size estimate of the coefficient on tax rates. Therefore Column (1) first presents results with the entire sample which serves as a basis of comparison. Column (2) presents results with the top 10 richest economies excluded from the sample. As we predicted, the coefficient on corporate tax rates increases to 1.07 from its value of 0.84 in Column (1).

Column (3) focuses specifically on the small or poor economies. We re-ran the regression including only the lowest GDP economies in the sample. In this case, the

coefficient on corporate tax rates increases significantly to 1.54. It nearly doubles in magnitude compared to Column (1). These results suggest that at least in the short-run (in the five year period used in the sample) smaller economies are significantly more likely to respond to corporate tax rates and see visible changes in productivity and wage rates. Larger economies experience the gain over a longer time period.

Finally, a Hausman test revealed no significant differences in fixed vs. random effects estimates. In Table 9 we present results using random effects GLS estimation and OLS estimation, allowing for region dummies in the latter specification. Column (1) presents the random effects estimates. The coefficient on top corporate tax rate is negative and highly significant with a t-statistic of 3.55. The coefficient on Value added per worker in manufacturing is positive and significant at 95 percent level of significance. The coefficient on Log (CPI) is positive and significant, while that on personal taxes is again insignificant. Column (2) finds similar results with OLS. Some of the region dummies are significant. Column (3) presents results using 3 year averages of the wage rate as the dependent variable. Results are similar to those mentioned for the specification in Columns (1).

To summarize, our results indicate that while personal income tax rates do not affect wages, corporate taxes are significantly related to wage rates across countries. Our coefficient estimates are large, ranging from 0.83 to almost 1—thus a 1 percent increase in corporate tax rates leads to an almost equivalent decrease in wage rates (in percentage terms). If we set all variables to their average values, an increase in corporate tax rates from a mean value of .35 to a 1-standard deviation increase of .10, would cause wage rates to decline by more than 25 percent (depending on the regression specification).

Thus a low wage-high tax economy, like Mexico (average wage over the period=\$1.67 and average tax rate=.37), could raise wage levels if it could lower its corporate tax rate to that of Canada's (.22). A 40 percent drop in corporate tax rates could raise wages by nearly 35 percent, up to \$2.25.

These results also hold for effective marginal and average tax rates. The coefficient estimate is (on average) close to 0.5, though the level of significance is lower. This suggests that wages are as likely to be influenced by the top statutory corporate tax rate, as by the effective marginal and average tax rates. Hence corporate tax cuts in the form of large allowances for depreciation of equipment and structures which reduce effective marginal rates could effectively influence wage levels as well.

We find evidence of international tax and wage competition in the data. Country wage rates are affected not only by domestic tax rates, but also tax rates in competing economies. The coefficient estimates for the spatial wage and tax variables range from 0.39 to 0.56 for average neighbor wages and 0.51 to 0.55 for the average neighbor tax variable, suggesting significant quantitative impacts. A 1 percent increase in wages (taxes) in competing countries could raise domestic wages by 0.4 percent (0.5 percent). Comparing different weighting schemes, the effects are largest when "neighbors" are defined as countries within the same *income* group, rather than within the same region. This suggests that tax competition is most intense among, say, high income countries such as Canada, France and Italy, rather than between geographic neighbors. This makes sense intuitively since there do not appear to be large transport costs associated with moving capital across large distances, so capital can easily flow to the most remunerative locations.

V. Conclusion

The results in this paper suggest that corporate tax rates affect wage levels across countries. Higher corporate taxes lead to lower wages. A 1 percent *increase* in corporate tax rates is associated with nearly a 1 percent *drop* in wage rates. The intuition for this comes from a simple analysis of the Solow model that reveals that higher capital labor ratios lead to higher wages, by enhancing worker productivity.

We find no effect of personal income tax rates on wage rates. This could be because we are focusing on manufacturing wages, and this sector is highly capital intensive and as suggested by other authors (Davis et al.2004) unresponsive to tax rates. Thus a possible area of exploration in future research is to see if this result generalizes to other sectors.

We find evidence for international tax competition. In particular, there appears to be a link between high tax “neighbors” and high domestic wages. Presumably, as capital flows out of high tax “neighbor” countries to low tax countries, this increases worker productivity and hence wages, in the low tax country. Thus countries try to compete for capital with other countries by lowering their relative tax rates. We also find strong evidence to suggest that high wages in neighboring countries lead to high wages in the domestic economy. Again, a possible reason for this is capital flight. As capital moves to relatively low wage destinations, it increases worker productivity in these regions which in turn, causes wages to rise. The results for international tax competition are strongest in the case of countries within the same income group.

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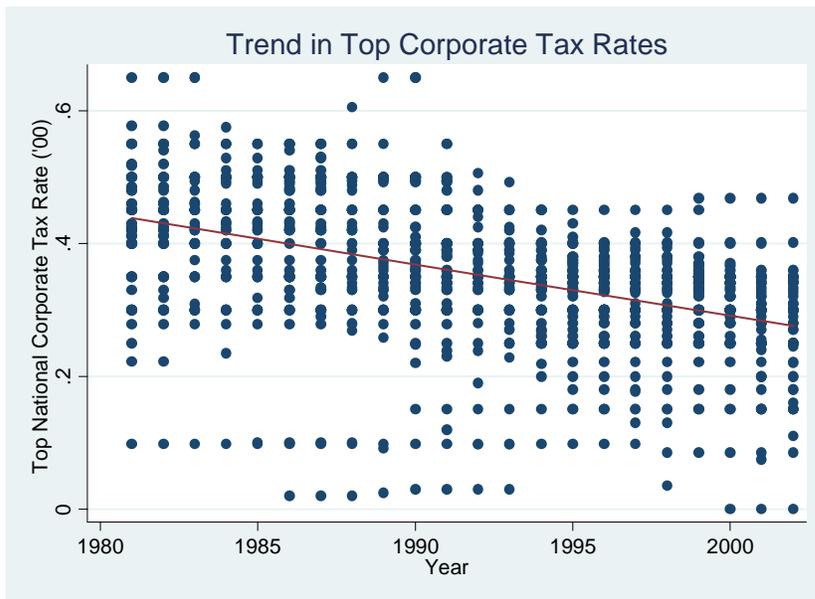
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Table 1

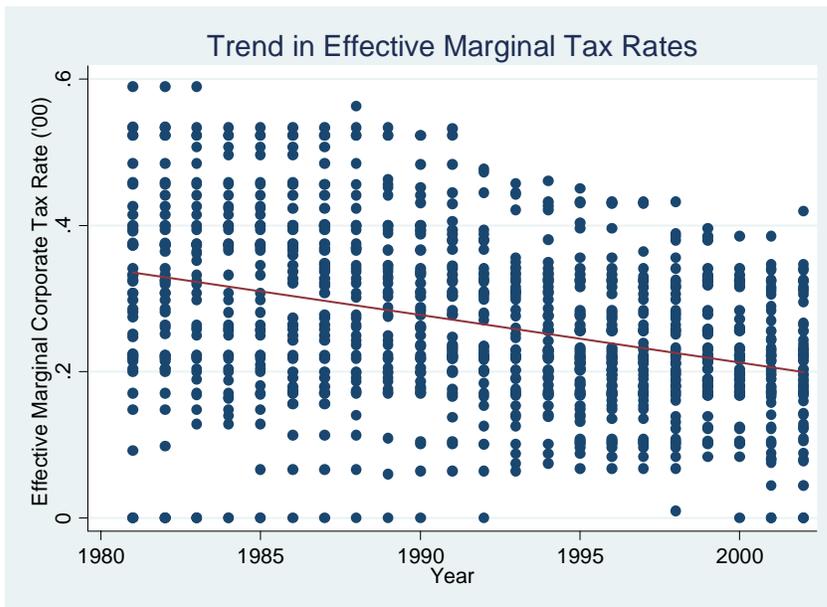
Descriptive Statistics for Core Variables used in Regression

Variable	N	Mean	Std. Dev
Average Wage Per Hour	1309	4.92	7.30
OECD		8.61	6.85
Non-OECD		2.50	4.45
Log (Average Wage)	1309	.638	1.68
Top Corporate Tax Rate	1233	.35	.10
OECD	487	.35	.89
Non-OECD	746	.34	.10
Log Top Corporate Tax Rate	1230	-1.10	.39
Log Effective Average Tax Rate	1071	-1.24	.34
Log Effective Marginal tax Rate	1048	-1.40	.46
Average Personal Income Tax Rate	1047	26.32	9.90
OECD		31.17	8.68
Non-OECD		23.22	9.37
Median Personal Income Tax	1145	27.15	10.38
Log (Value Added Per Worker in Manufacturing)	1291	9.31	1.52
Log GDP per capita	1449	8.14	1.33
Log (Trade/GDP)	1412	4.15	.52
Schooling	1190	3.84	.60
Log price level	1606	4.89	.20

Figure 1: Trends in Corporate Tax Rates

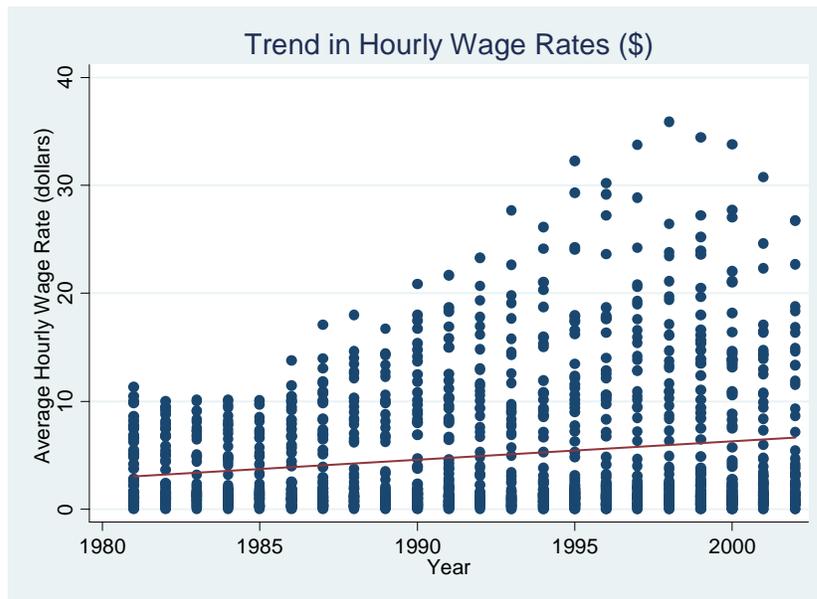


A. Top National Corporate Tax Rate

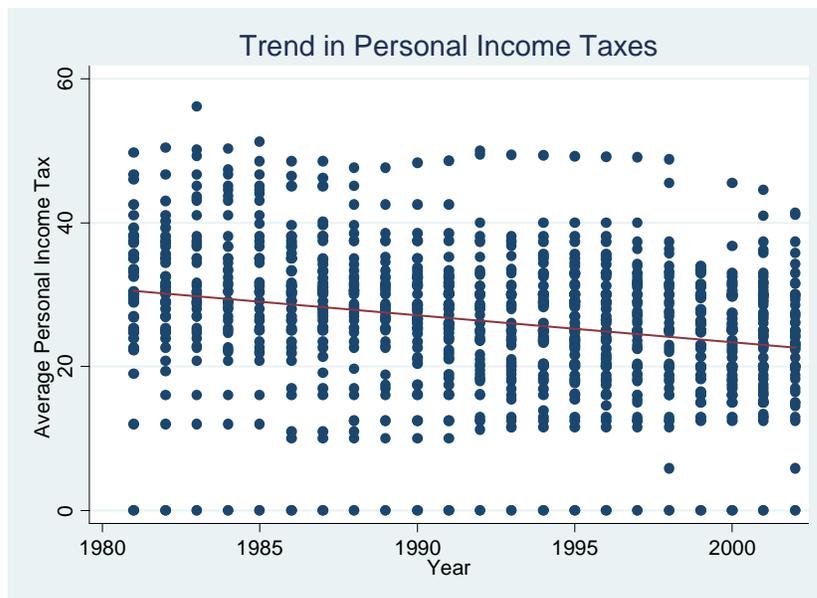


B. Effective Marginal Tax Rate

Figure 2: Wages and Income Taxes

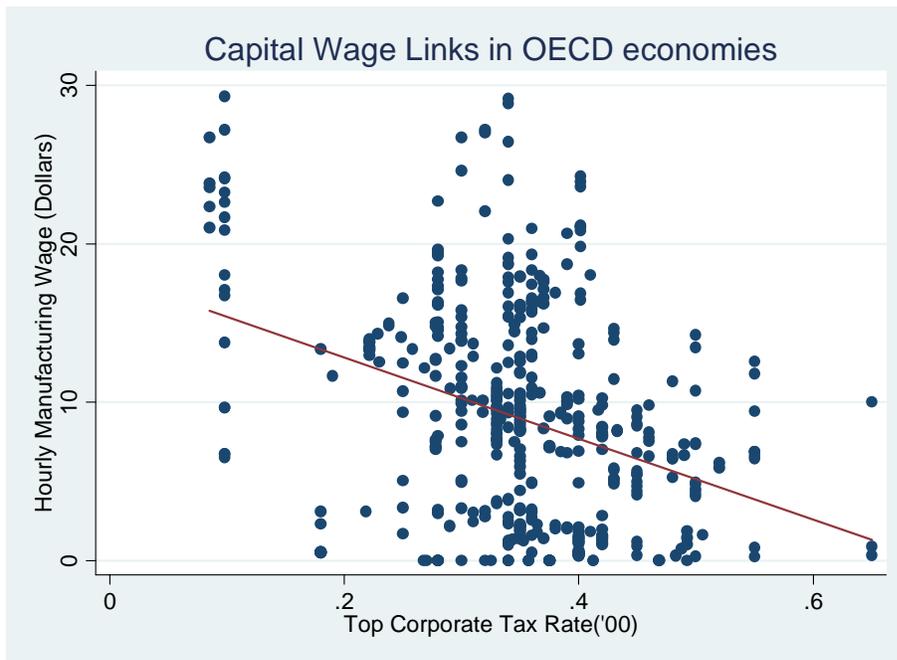


A. Trend in Average Hourly Wage Rates

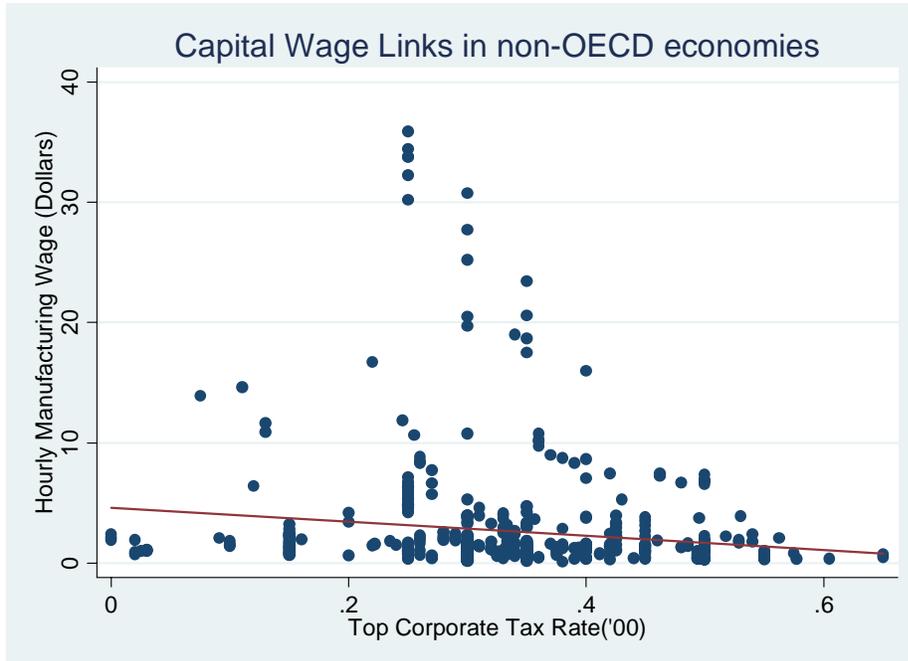


B. Trend in Average Personal Income Tax Rates

Figure 3: Capital Wage Links in OECD and Non-OECD Economies



OECD: Slope coefficient=-25.76



Non-OECD: Slope coefficient =-5.88

Table 2: Variation In Top Corporate Tax Rates ('00)

	Australia	Austria	Bolivia	Chile	Colombia
1981	0.46	0.55	0.3	0.48	0.4
1982	0.46	0.55	0.3	0.48	0.4
1983	0.46	0.55	0.3	0.46	0.4
1984	0.46	0.55	0.3	0.23	0.4
1985	0.46	0.55	0.3	0.1	0.4
1986	0.49	0.55	0.02	0.1	0.4
1987	0.49	0.55	0.02	0.1	0.3
1988	0.39	0.55	0.02	0.1	0.3
1989	0.39	0.3	0.025	0.09	0.3
1990	0.39	0.3	0.03	0.15	0.3
1991	0.39	0.3	0.03	0.15	0.3
1992	0.39	0.3	0.03	0.15	0.3
1993	0.33	0.3	0.03	0.15	0.37
1994	0.33	0.34	0.25	0.15	0.37
1995	0.36	0.34	0.25	0.15	0.35
1996	0.36	0.34	0.25	0.15	0.35
1997	0.36	0.34	0.25	0.15	0.35
1998	0.36	0.34	0.25	0.15	0.35
1999	0.36	0.34	0.25	0.15	0.35
2000	0.34	0.34	0.25	0.15	0.35
2001	0.3	0.34	0.25	0.15	0.35
2002	0.3	0.34	0.25	0.16	0.35

Table 3: Variation in Wage Rates (US \$ per hour)

	Australia	Austria	Bolivia	Chile	Colombia
1981	9.8	6.87	1.2	1.64	1.15
1982	8.12	6.86	1.09	1.43	1.29
1983	7.51	6.85	1.5	1.90	1.34
1984	7.77	6.46	0.82	1.85	1.31
1985	6.59	6.63	1	1.43	1.11
1986	6.65	9.42	1.91	1.49	1.02
1987	7.36	11.80	0.73	1.62	0.82
1988	8.96	12.56	0.93	1.82	1.03
1989	9.84	12.28	0.98	2.05	1.11
1990	10.06	15.36	1.00	2.34	1.07
1991	10.33	15.81	1.10	2.78	0.84
1992	10.04	17.80	1.06	3.23	1.29
1993	9.53	17.65	1.08	1.60	0.93
1994	10.75	18.72	1.11	1.79	1.31
1995	11.55	17.87	1.11	2.15	1.32
1996	12.83	17.57	0.84	2.32	1.44
1997	16.58	15.41	0.94	2.48	1.55
1998	10.91	16.05	1.02	2.41	1.71
1999	15.66	15.36	1.07	2.24	1.45
2000	10.52	13.60	1.09	2.20	1.59
2001	9.40	12.49	1.22	1.99	1.80
2002	11.55	18.75	1.30	1.97	1.46

Table 4: Regression Results

Dependent Variable:	(1)	(2)	(3)	(4)	(5)
Log(Average Hourly Wage) (5 year average)					
Log(TopCorpTax)	-0.836 (2.85)***	-0.841 (2.80)***		-1.047 (2.03)**	-1.193 (2.04)**
Log(ValueAdded)	0.444 (1.79)*	0.438 (1.71)*	0.644 (2.56)**	0.621 (2.37)**	0.246 (0.55)
Log(CPI)	0.566 (2.68)***	0.611 (2.53)**	0.465 (1.73)*	0.456 (1.65)*	1.004 (1.88)*
Log(PersonalTax)	-0.134 (0.51)	-0.117 (0.44)	-0.259 (0.96)	0.666 (1.37)	-0.724 (1.44)
Log(Trade/GDP)		0.067 (0.26)	0.027 (0.09)	-0.005 (0.02)	
Log(LaborMktReg)				0.121 (0.20)	
Log(Computerization)					0.032 (0.19)
Constant	-6.21 (2.35)**	-6.67 (2.32)**	-6.45 (2.13)**	-5.69 (1.63)*	-4.63 (0.98)
Observations	218	214	215	180	128
Overall R-squared	0.26	0.26	0.21	0.29	0.26

Absolute value of t statistics in parentheses

***significant at 1%; **significant at 5%; *significant at 10%

1. All specifications include country fixed effects and period dummies.
 2. The dependent variable is the 5 year average of the wage rate over sub-periods: 1981-1985, 1986-1990, 1991-1995, 1996-2000, 2001-2002. The independent variables are the beginning of period values of these variables.

Table 5: Other Tax Measures

	(1)	(2)	(3)	(4)
Dependent variable: Log(Average hourly wage) (5 year average)				
Log (Eff.Mrg.Tax)	-0.372 (1.66) *		-0.344 (1.48)	
Log (Eff.Avg.Tax)		-0.660 (2.00) **		-0.589 (1.83) *
Log (ValueAdded)	0.478 (1.84) *	0.422 (1.61)	0.568 (2.10) **	-0.528 (1.99) **
Log (PersonalTax)	-0.197 (0.73)	-0.189 (0.72)	-0.274 (0.87)	-0.263 (0.87)
Log (CPI)	0.710 (2.91) ***	0.742 (3.08) ***	0.452 (1.81) *	0.474 (1.98) *
Constant	-6.495 (2.26) **	-6.439 (2.27) **	-5.88 (2.09) **	-5.94 (2.18) **
Observations	195	199	94	97
Sample	All	All	Non-OECD	Non-OECD
R-squared	0.24	0.22	0.16	0.18

Absolute value of t statistics in parentheses

***significant at 1%; ** significant at 5%;*significant at 10%

- All specifications include country fixed effects and period dummies.
- The dependent variable is the 5 year average of the wage rate over sub-periods: 1981-1985, 1986-1990, 1991-1995, 1996-2000,2001-2002. The independent variables are the beginning of period values of these variables.

Table 6: Regressions with Spatial Variables

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:Log(Average Hourly Wage) (5 year average)					
Log(TopCorpTax)	-0.900 (3.03) ***	-0.900 (2.98) ***	-0.979 (3.18) ***		
Log (Eff.Marg.Tax)				-0.312 (1.39)	
Log (Eff.Avg.Tax)					-0.706 (2.16) **
Log (ValueAdded)	0.252 (0.96)	0.403 (1.44)	0.471 (1.77) *	0.358 (1.19)	0.173 (0.63)
Log (CPI)	0.506 (2.43) **	0.419 (1.93) *	0.449 (2.15) **	0.596 (1.49)	0.556 (2.15) **
Wgt.OwnRegWage	0.395 (2.25) *				0.408 (2.26) **
Wgt.OwnRegTax	0.097 (0.39)				0.517 (2.93) *
Incwt.OwnRegWage		0.468 (1.64) *		0.557 (1.87) *	
Incwt.OwnRegTax		0.504 (1.50)			
Incwt.OwnRegEffMargTax				0.548 (1.71) *	
Distincwt.OwnRegWage			0.347 (1.69) *		
Distincwt.OwnRegTax			0.531 (1.87) *		
Constant	-4.851 (1.93) *	-5.563 (2.07) **	-6.328 (2.46) **	-4.51 (1.49)	-3.75 (1.38)
Observations	220	222	222	197	201
R-squared	0.27	0.25	0.26	0.22	0.20

Absolute value of t statistics in parentheses

***significant at 1%; ** significant at 5%;*significant at 10%

- All specifications include country fixed effects and period dummies.
- The dependent variable is the 5 year average of the wage rate over sub-periods: 1981-1985, 1986-1990, 1991-1995, 1996-2000,2001-2002. The independent variables are the beginning of period values of these variables.
- Columns (1) and (5) use GDP-weighted own region countries as neighbors. Column (2) and (4) use GDP-weighted own Income group countries as neighbors. Column (3) uses Distance weighted own Income group countries as neighbors.

Table 7: Results with Other Explanatory Variables: Democracy, Payroll and VAT Taxes

Dependent Variable:	(1)	(2)	(3)	(4)
	Log(Average Hourly Wage) (5 year average)			
Log(TopCorpTax)	-0.794 (2.65)***	-0.592 (1.79)*	-0.625 (1.88)*	-0.949 (3.11)***
Log(ValueAdded)	-0.417 (1.70)*	0.642 (1.90)*	0.780 (2.67)***	0.685 (3.19)***
Log(CPI)	0.514 (2.45)**	0.549 (2.38)**	0.863 (2.63)***	0.464 (2.62)**
Log(PersonalTax)		-0.329 (1.02)		-0.192 (0.91)
Democracy	0.355 (0.90)			
Log(Payrolltax)		-0.223 (1.25)		
Log(VAT)			-0.510 (1.31)	
Constant	-1.498 (0.53)***	-6.73 (1.86)*	-9.52 (2.74)***	-7.86 (3.53)***
Observations	220	254	158	175
Sample	All	All	All	Exclude SS
R-squared	0.28	0.25	0.21	0.23

Absolute value of t statistics in parentheses
 *** significant at 1%; ** significant at 5%; ****significant at 10%

1. All specifications include country fixed effects and period dummies.
 2. The dependent variable is the 5 year average of the wage rate over sub-periods: 1981-1985, 1986-1990, 1991-1995, 1996-2000,2001-2002. The independent variables are the beginning of period values of these variables.

Table 8: Small Economy Results

Dependent Variable:	(1)	(2)	(3)
	Log(Average Hourly Wage) (5 year average)		
Log(TopCorpTax)	-0.842 (2.88)***	-1.070 (3.16)***	-1.543 (1.88)*
Log(PersonalTax)	-0.156 (0.61)	-0.045 (0.15)	-0.413 (0.58)
Log(ValueAdded)	0.453 (1.83)*	0.206 (0.62)	0.248 (1.20)
Log(CPI)	0.589 (2.85)***	0.556 (2.33)**	0.538 (1.53)
Constant	-6.300 (2.39)***	-4.553 (1.23)**	-4.466 (2.13)**
Sample	All	All-Top 10	Smallest 12
Observations	218	178	44

Absolute value of t statistics in parentheses
 *** significant at 1%; ** significant at 5%;**significant at 10%

1. All specifications include country fixed effects and period dummies.
 2. The dependent variable is the 5 year average of the wage rate over sub-periods: 1981-1985, 1986-1990, 1991-1995, 1996-2000,2001-2002. The independent variables are the beginning of period values of these variables.

Table 9: Other Specifications: Random Effects, OLS

Dependent Variable: Log(Average Hourly Wage)	(1)	(2)	(3)
	RE GLS (5-yr average)	OLS (5-yr average)	RE GLS (3-year average)
Log(TopCorpTax)	-0.919 (3.55) ***	-0.844 (2.55) ***	-0.517 (2.72) ***
Log(ValueAdded)	0.245 (2.47) **	0.183 (1.49)	0.319 (3.31) **
Log(PersonalTax)	-0.174 (0.76)	0.082 (0.28)	0.198 (1.06)
Log(CPI)	0.825 (4.82) ***	1.014 (4.33) ***	0.725 (4.43) ***
EastAfr	1.241 (1.88)	1.241 (1.88)	
SouthAfr	1.545 (2.88) **	1.545 (2.88) **	
Caribbean	2.416 (3.31) ***	2.416 (3.31) ***	
Cent.America	0.995 (2.09) *	0.995 (2.09) *	
South.Am	0.361 (0.84)	0.361 (0.84)	
Southasia	-0.374 (0.64)	-0.374 (0.64)	
Westasia	-0.728 (1.50)	-0.728 (1.50)	
Easteuro	0.163 (0.38)	0.163 (0.38)	
Northeuro	1.585 (4.20) ***	1.585 (4.20) ***	
Southeuro	1.052 (2.57) *	1.052 (2.57) *	
Westeuro	1.647 (4.22) ***	1.647 (4.22) ***	
Southeastasia	0.422 (1.00)	0.422 (1.00)	
Constant	-5.272 (1.55) **	-5.481 (3.22) **	-6.389 (5.61) **
Period Dummies	Yes	Yes	Yes
Observations	218	218	309
R-squared	0.29	0.50	0.27

Absolute value of z statistics in parentheses
 *** significant at 1%; ** significant at 5%; * significant at 10%

Data Appendix

The statistics on wages are obtained from the ILO's Key Indicators of the Labor Market (KILM). The ILO reports *average earnings* per worker or, in some cases, *average wage rates*. Some of the series cover wage earners (i.e. manual or production workers) only, while others refer to salaried employees (i.e. non-manual workers), or all employees (i.e. wage earners and salaried employees). The series cover workers of both sexes, irrespective of age.

Earnings: The concept of earnings relates to remuneration in cash and in kind paid to employees, as a rule at regular intervals, for time worked or work done together with remuneration for time not worked, such as for annual vacation, other paid leave or holidays. Earnings exclude employers' contributions in respect of their employees paid to social security and pension schemes and also the benefits received by employees under these schemes. Earnings also exclude severance and termination pay.

Statistics of earnings should relate to employees' gross remuneration, i.e. the total before any deductions are made by the employer in respect of taxes, contributions of employees to social security and pension schemes, life insurance premiums, union dues and other obligations of employees.

Earnings include: direct wages and salaries, remuneration for time not worked (excluding severance and termination pay), bonuses and gratuities and housing and family allowances paid by the employer directly to this employee. (a) Direct wages and salaries for time worked, or work done, cover: (i) straight time pay of time-rated workers; (ii) incentive pay of time-rated workers; (iii) earnings of piece workers (excluding overtime premiums); (iv) premium pay for overtime, shift, night and holiday work; (v) commissions paid to sales and other personnel. Included are: premiums for seniority and special skills, geographical zone differentials, responsibility premiums, dirt, danger and discomfort allowances, payments under guaranteed wage systems, cost-of-living allowances and other regular allowances. (b) Remuneration for time not worked comprises direct payments to employees in respect of public holidays, annual vacations and other time off with pay granted by the employer. (c) Bonuses and gratuities cover

seasonal and end-of-year bonuses, additional payments in respect of vacation period (supplementary to normal pay) and profit-sharing bonuses. (ii) Statistics of earnings should distinguish cash earnings from payments in kind.

Wage rates: These include basic wages, cost-of-living allowances and other guaranteed and regularly paid allowances, but exclude overtime payments, bonuses and gratuities, family allowances and other social security payments made by employers. *Ex gratia* payments in kind, supplementary to normal wage rates, are also excluded.

Thus broadly country coverage differs due to the following reasons: (1) whether the reported statistic is wages or earnings (2) whether it covers employees, wage earners or salaried employees (3) whether it includes social security contributions by employer.

When we studied the descriptions more closely, we found that certain countries like

Chile, Turkey, Colombia, Ecuador, Kenya, Kyrgyzstan, Mexico, Malaysia, Panama and Ukraine included social security contributions by employers in the earnings data. Another difference arises because the industrial classification changed during this period. Since the beginning of the 1990s an increasing number of countries have made a switchover in their data reporting systems for industrial statistics from Revision 2 to Revision 3 of the International Standard Classification of All Economic Activities (ISIC).

Including dummies to allow for all these differences in coverage in a panel regression (without country fixed effects) yielded a highly significant negative sign on corporate tax rates, and no change in results for the other variables.

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International Burdens of the Corporate Income Tax

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Abstract¹

This study applies a simple two-country, five-sector, general equilibrium model based on Harberger (1995, 2006) to examine the long-run incidence of a corporate income tax in an open economy. In equilibrium, capital is assumed to be perfectly mobile internationally in the sense that the country in which a real investment is located does not matter to the marginal investor. In addition, each country is assumed to produce at least some tradable corporate goods for which the country cannot affect world output prices. Like the original Harberger (1962) model, the worldwide stock of capital and the supply of labor in each country are fixed. Under those assumptions, the model provides closed form solutions and easily understood predictions about its comparative static equilibria. As with any simplified model, the analysis is silent about some potentially important issues – such as the effect of the corporate tax on savings, growth and other dynamics – that may also have important effects on corporate tax incidence.

The analysis shows how the domestic owners of capital can escape most of the corporate income tax burden when capital is reallocated abroad in response to the tax. But, as in Bradford (1978), capital owners worldwide cannot escape the tax. Reallocation of capital abroad drives down the personal return to investment so that capital owners worldwide bear approximately the full burden of the domestic corporate income tax. Foreign workers benefit because an increased foreign stock of capital raises their productivity and their wages. Domestic workers lose because their productivity falls and they cannot emigrate to take advantage of higher foreign wages. Under basic assumptions of the numerical application, the outcome is also similar to the implications of the simpler model of Bradford in that the full worldwide burden falls on domestic owners of productive inputs. That outcome changes, however, under alternative assumptions.

Burdens are measured in a numerical example by substituting factor shares and output shares that are reasonable for the U.S. economy. Given those values, domestic labor bears slightly more than 70 percent of the burden of the corporate income tax. The domestic owners of capital bear slightly more than 30 percent of the burden. Domestic landowners receive a small benefit. At the same time, the foreign owners of capital bear slightly more than 70 percent of the burden, but their burden is exactly offset by the benefits received by foreign workers and landowners. To the extent that capital is less mobile internationally, domestic labor's burden would be lower and domestic capital's burden would be higher. Burdens can also be affected by the domestic country's ability to influence the world prices of some traded corporate outputs. But the signs and magnitudes of those effects on burden depend upon the relative capital intensities of production in the corporate sectors that produce internationally tradable goods.

¹ The author would like to thank Alan Auerbach, Bob Dennis, Jane Gravelle, Harry Grubert, Larry Ozanne, Bob Williams, and Tom Woodward for their comments and suggestions.

I. Introduction

In a closed economy, the corporate income tax causes production to be inefficient because the tax is not imposed equally on the income from all capital used in the corporate and noncorporate sectors. That difference causes the capital intensity of production to be too low in the corporate sectors and too high in the noncorporate sectors. The corporate tax is inefficient because the marginal pre-tax return from corporate investment exceeds the marginal pre-tax return from noncorporate investment in equilibrium.²

It is not as clear who bears the long-run burden of the corporate tax in a closed economy.³ But in one of the best-known analyses in public finance, Harberger (1962) found that the U.S. corporate tax is likely to be borne entirely by all owners of capital. How that might occur can be understood, roughly, in terms of the effects that the tax has on output and input substitution decisions made by consumers and producers.⁴ In the Harberger model of a closed economy, the total supplies of labor and capital are fixed but perfectly mobile between sectors. In response to the tax, consumers substitute away from the more heavily taxed corporate goods so that production shifts to the noncorporate sector. Corporate producers substitute away from the taxed input – corporate capital – which pushes up the capital intensity of production in the noncorporate sector, thus reducing the after-tax return to capital.

Under assumptions considered reasonable for the U.S. economy, Harberger (1962) found that the output and input substitution decisions combine in such a way that personal capital

² There are also other sources of inefficiency under the corporate tax (see Gravelle, 1994; Congressional Budget Office, 2005b; and Judd, 2006).

³ In the short run, changes in the corporate income tax are most likely borne by existing corporate shareholders (see Auerbach, 2005).

⁴ Rosen (2002), pp. 294-299, and Fullerton and Metcalfe (2002), pp. 1812-1815, provide detailed discussions of the Harberger model.

income is reduced exactly by the full burden of the corporate tax, and wages remain constant. Personal capital income is reduced to the same degree regardless of whether the capital owners invest in the corporate sector or the noncorporate sector.

The effects of the corporate income tax in an open economy are obviously more complicated. The tax is likely to be even less efficient because it can distort both the domestic and the international allocations of capital. Domestic workers are more likely to bear a burden because workers cannot move readily between countries. Domestic wages will fall when capital is reallocated abroad and domestic workers cannot move to take advantage of a higher foreign wage rate. At the same time, foreign labor receives a benefit from the increase in foreign capital. The open economy is difficult to analyze because labor and capital owners can be domestic or foreign, and each sector of each economy can produce goods and services that are traded or not traded internationally. A domestic corporate tax can affect the domestic and foreign prices of inputs and outputs, the domestic and foreign national incomes, and the domestic and foreign distributions of income. The world economy simply has more dimensions.

Melvin (1982) examines a world economy in which there is international trade but no international investment. He finds that the domestic burden of the corporate income tax falls primarily on the factor that is used most intensively in the corporate sector. In the United States, that factor is labor. His model divides the world into two countries that each produce the same two internationally traded goods. The supplies of labor and capital are fixed and immobile internationally. He assumes initially that the domestic economy is small so that domestic economic decisions cannot affect the world prices of traded goods.

Under those assumptions, a domestic tax imposed on capital income in the corporate sector causes the domestic economy to shift production toward the noncorporate sector. If the corporate sector is more labor-intensive than the noncorporate sector, both the corporate and the noncorporate domestic sectors become less capital-intensive in equilibrium as a result of producer responses to the tax. At a lower capital intensity, the return to domestic capital actually increases and domestic labor can bear more than 100 percent of the corporate income tax. Even if the domestic economy is large enough to affect the world prices of the traded goods, Melvin finds that the corporate tax burden still falls primarily on the factor that is used most intensively in the corporate sector.

Melvin's analysis shows that the corporate tax burden can be shifted to domestic labor even when there is no international investment, and even when the domestic economy is large enough to influence the prices of internationally traded goods. However, those results are not fully robust to the addition of internationally mobile capital, the production of goods that are not traded internationally, and the possibility of imperfect demand substitution between domestic- and foreign-produced internationally tradable goods. Unfortunately, trying to account for all of those issues can make the analysis very difficult.

Gravelle and Smetters (2006) construct a computable general equilibrium model in which the world is divided into two countries with four productive sectors in each country. The domestic economy is divided into corporate and noncorporate sectors, like the original Harberger (1962) model, but each sector is further subdivided into a subsector that produces internationally tradeable goods and a sub-sector that produces goods that are not traded between countries. Like Mutti and Grubert (1985), Gravelle and Smetters allow for the possibility that capital is not

perfectly mobile internationally, and for the possibility that foreign and domestic tradable goods are imperfect substitutes in consumption.⁵

Gravelle and Smetters find that the corporate tax burden imposed on domestic labor is small when the demand substitutability between domestic and foreign tradable goods is low. Although their model is different from Melvin's model, their trade result is similar to that earlier finding: The burden imposed on domestic labor can be reduced when the domestic country can influence the world prices of internationally traded goods. In Melvin, that international market power is large when the domestic economy is large compared with the rest of the world. In Gravelle and Smetters, the international market power is large when there is a low degree of substitutability between the domestic and foreign tradable corporate goods. Even a small country can have the latter type of market power. In both models, the corporate tax can affect both domestic and foreign national welfare in ways that operate, in part, like an ad valorem tariff on exports, as illustrated in Whalley (1980).

When international capital mobility is perfect and the substitutability between domestic and foreign corporate tradable goods is very high, Gravelle and Smetters find that domestic labor's burden equals about 73 percent of corporate tax revenue.⁶ Although the foreign capital owners' burden equals 67 percent of the domestic revenue, that burden is fully offset by a benefit that foreign workers receive because they become more productive. Thus, none of the net burden is exported to foreigners. However, domestic labor's share of the burden can be much smaller and a net burden can be exported when the tradable goods are less substitutable. For example, when the aggregate trade substitution elasticity equals 1, a value that Gravelle and

⁵ The Gravelle and Smetters model is very similar to the model constructed by Mutti and Grubert, although Mutti and Grubert do not measure labor's incidence of the corporate income tax.

⁶ Gravelle and Smetters (2006), Table 2.

Smetters cite as reasonable based on previous empirical studies, domestic labor's burden equals only 21 percent of the corporate tax revenue. That reduction of 52 percent in domestic labor's burden is almost all exported to foreign residents, whose net burden then equals 49 percent of the domestic corporate tax revenue. If trade substitution and capital mobility are both low, domestic labor will bear almost none of the corporate income tax burden.

In addition to demonstrating the potential importance of international market power, Gravelle and Smetters show that the long-run incidence of the corporate income tax is highly uncertain. Although empirical evidence about the short-run degrees of international trade substitution and capital mobility suggest that domestic labor bears almost none of the burden of the corporate tax according to their analysis, it is not clear what should be assumed about those parameters for the long run.

Harberger (1995) measures the open-economy incidence of the corporate income tax by analyzing a simple general equilibrium model of domestic and foreign economies that each have five sectors. In contrast to Gravelle and Smetters, the corporate sector that produces internationally tradeable goods is further subdivided into two subsectors. One of those subsectors produces goods that are perfect substitutes for the goods produced by the corresponding foreign sector. The second corporate subsector produces goods that are imperfect substitutes for goods produced by the corresponding foreign sector. Otherwise, that earlier model in Harberger (1995) and later analyzed in Harberger (2006) has the same basic structure as the model in Gravelle and Smetters.

When goods are produced in both corporate tradable goods subsectors of the Harberger (1995) model, the domestic and foreign wages are determined fully by the effects that the tax has

on production costs within the first subsector. In the domestic economy, the corporate tax drives a wedge into the cost of production in the corporate sectors. Because the domestic economy cannot affect the world price of output in the first sector, the domestic wage must decrease in order to offset the increased corporate cost of capital.

Although the Harberger (1995) model splits the corporate tradable sectors in that way, the level of substitutability between the domestic and foreign outputs of the second corporate tradable sector can still affect the incidence of the tax, as in Gravelle and Smetters. But, as shown in this study, that trade effect depends upon the relative capital intensities of production in the corporate tradable sectors. When the capital intensities are equal, the incidence of the tax does not depend at all upon the degree of international output substitutability in the second corporate tradable sector.

This study examines a version of Harberger's (1995, 2006) open-economy general equilibrium model. After developing the model and analyzing the economic effects of the corporate income tax, a numerical application is presented that uses output and input share assumptions reasonable for the United States. The application starts with an assumption that capital is perfectly mobile internationally. It also assumes initially that the degree of international output substitutability does not matter because the corporate tradable sectors have equal output capital intensities. Those assumptions are relaxed later in the application.

This study examines corporate tax incidence both alone and in comparison to several replacement taxes: a general tax on the income from capital in all domestic sectors, a domestic wage tax, a tax on the worldwide capital income of the domestic owners of capital, and a uniform domestic tax on personal income or consumption. The model is also used to examine

the international burdens of the corporate income tax under alternative assumptions: about whether the country is a net international borrower or net international lender, about the relative capital intensities of production in the corporate tradable sectors, about the size of the domestic economy relative to the rest of the world, and about the degree of international capital mobility. A later section also examines how the tax burdens are affected when many countries impose corporate income taxes and may engage in international tax competition. An appendix further examines Harberger (1995), Harberger (2006), and Gravelle and Smetters.

II. The Model

The world consists of two countries. In an initial equilibrium, both economies are identical except for size. For each economy, production is divided into five sectors that each produce goods or services using labor, capital, and (for agriculture) land. All production technologies are characterized by constant returns to scale; production functions are twice-differentiable and concave; competition is perfect at the level of the producer.

The first three sectors are corporate. Sector one produces internationally tradeable outputs for which the foreign and domestic products are perfect demand substitutes. The output from that sector is the numeraire. Sector two produces internationally tradeable outputs for which the foreign and domestic products are not perfect demand substitutes. Sector three produces non-internationally tradable outputs for which consumption must occur in the same country as production; examples include utilities and transportation services.

Sectors four and five are noncorporate sectors. Sector four produces internationally tradeable agricultural products. Sector five produces outputs that are not internationally tradeable, such as residential housing and retail services.

Labor is homogeneous and perfectly mobile within each country, but cannot move between countries. Thus, the wage rate is the same for every sector within a country, but can differ between countries. Individuals do not vary their amount of labor supplied to the market.

The worldwide supply of capital is fixed but perfectly mobile between countries in that the geographic location of investment does not matter to a marginal investor. The marginal return to investment is the same everywhere in equilibrium, excluding producer-level taxes on capital income. Capital owners can own capital in either country, but cannot themselves relocate abroad. Each owns a fixed share of the world capital stock.⁷

Consumers have identical homothetic preferences and must consume where they live. They can choose from among the five types of outputs produced in their own country (or imported from the other country in the case of outputs from sectors one and four) and imports of the unique output from sector two of the other country. Initial consumer expenditures on the six types of goods and services are proportional to the initial shares of worldwide production.

The domestic government collects taxes and makes lump-sum distributions. In order to isolate the effects of the corporate income tax, the government's other policies are assumed to affect neither economic efficiency nor the distribution of income. With any available tax revenues, the domestic government purchases the six available varieties of consumer goods according to the same expenditure shares as domestic consumers. The government redistributes

⁷ The analysis thus abstracts from the effects that the corporate tax may have on tax incidence through its effect on individual savings, the capital stock, and, ultimately, labor productivity and the return to capital (see Fullerton and Metcalf, 2002, pp. 1832-1844).

that bundle of commodities to domestic residents in proportion to their incomes. The foreign government does not respond to any tax policies chosen by the domestic government.⁸

III. The Corporate Income Tax

Starting in a world equilibrium with no corporate taxes, the domestic government introduces a small tax on capital income from domestic production within the corporate sectors. The tax is imposed at a tax-exclusive rate of τ_c percent. That is the percentage by which the tax initially increases the corporate cost of capital above its initial equilibrium value r , so that the corporate cost of capital equals $r \cdot (1 + \tau_c)$. The equilibrium value of r can change as a result of the economic responses to the tax. In a new equilibrium, starting from a tax rate of zero, the corporate cost of capital increases by $\hat{r} + (1 + \hat{r})\tau_c$ percent, where a circumflex over a variable indicates the percentage by which that variable changes to its new equilibrium value. The equilibrium cost of capital outside the domestic corporate sector changes by \hat{r} percent.

Competition in sector one determines how changes in the cost of capital affect the foreign and domestic wage rates in equilibrium. Because the production technology is characterized by constant returns to scale and because competition is perfect at the producer level, any changes in the prices of output in each sector must be related proportionally to changes in the cost of inputs.⁹ For sector one, that relationship is given by:

⁸ A later section of this paper, in an examination of tax competition, discusses how the results apply when other countries also have corporate income taxes and may change their taxes simultaneously.
⁹ Fullerton and Metcalf (2002) show how such comparative static, log-linear equilibrium relationships can be derived for a two-sector closed economy under the assumptions of this model. The expression used here for the percentage change in the cost of capital in the taxed sector differs slightly from their corresponding term, $\hat{r} + \tau$, because the term in (1a) allows for a discrete finite change in the tax rate. The term used in (1a) converges to the term used by Fullerton and Metcalf as the tax rate approaches zero.

$$(a) \quad \hat{p}_1^d = 0 = \theta_{L1} \hat{w}^d + \theta_{K1} \cdot [\hat{r} + (1 + \hat{r})\tau_c]$$

(1)

$$(b) \quad \hat{p}_1^f = 0 = \theta_{L1} \hat{w}^f + \theta_{K1} \hat{r}$$

where p_j^f is the output price, θ_{Lj} and θ_{Kj} are the labor and capital shares of value added in sector one, and w^j is the wage rate in country j (which can indicate d , domestic, or f , foreign). The price of sector one output remains constant because sector one produces the numeraire, and the foreign and domestic outputs from that sector are identical. Thus, any change in the cost of capital for sector one in country j must be fully offset by a wage rate change in that country. Recognizing that the output price does not change, re-arrangement of (1a) and (1b) yields the following equations for the equilibrium changes in domestic and foreign wage rates:

$$(a) \quad \hat{w}^d = -\frac{\theta_{K1}}{\theta_{L1}} \cdot [\hat{r} + (1 + \hat{r})\tau_c]$$

(2)

$$(b) \quad \hat{w}^f = -\frac{\theta_{K1}}{\theta_{L1}} \hat{r}$$

According to (2a), any increase in the domestic corporate cost of capital for sector one will cause the domestic wage rate to fall. According to (2b), any decreases in the foreign cost of capital for sector one will cause the foreign wage rate to rise. The sizes of those wage rate changes will depend upon the capital intensity of sector one production and the amount of change in the corporate cost of capital. When the capital intensity of sector one production is lower, the wage rate does not have to change by as much for the resulting change in wage costs to fully offset the change in the cost of capital.

The fact that the tax causes the relative prices of the capital and labor inputs to change implies that producers will substitute between their demands for capital and labor. That input substitution causes the equilibrium demands for capital and labor to change according to

$$(a) \quad \hat{K}_C^d - \hat{L}_C^d = \sigma_C^d \cdot [\hat{w}^d - \hat{r} - (1 + \hat{r})\tau_c]$$

$$(3) \quad (b) \quad \hat{K}_N^d - \hat{L}_N^d = \sigma_N^d \cdot (\hat{w}^d - \hat{r})$$

$$(c) \quad \hat{K}^f - \hat{L}^f = \sigma^f \cdot (\hat{w}^f - \hat{r})$$

where K_i^j and L_i^j are the capital and labor stocks and σ_i^j is the partial elasticity of substitution between capital and labor in sector i of country j .¹⁰

Together, the relationships in (2) and (3) determine the equilibrium change in r . Recall that the aggregate supply of labor is fixed in each country and that the supply of capital is fixed worldwide. Based on those conditions, assuming that the input substitution elasticities are identical in all sectors and countries, (2) and (3) imply that the change in the equilibrium r is given by (4).¹¹

$$(4) \quad \hat{r} = -\tau_c \cdot \frac{K^d - \theta_{L1} K_N^d}{K + (K^d - \theta_{L1} K_N^d) \tau_c}$$

Equation (4) implies that the change in r is determined by the relative size of the domestic economy and the size of the domestic corporate sector. When the domestic corporate sector is small compared with the rest of the world economy, the equilibrium value of r will

¹⁰ For capital and labor demands, the subscripts C and N represent aggregate amounts for all corporate sectors and noncorporate sectors, respectively. The absence of a subscript represents an aggregate over all sectors. The absence of a superscript represents an aggregate over both countries.

¹¹ Equation (4) can also be expressed in terms of the input shares alone. It would be easy to derive a variation of equation (4) that allows the corporate and noncorporate sectors to have different input substitution elasticities.

decrease by only a small percentage. In the limit, r will not change when the domestic economy or corporate sector is very small, so the cost of capital in the domestic corporate sector,

$r \cdot (1 + \tau_c)$, will increase by approximately τ_c percent. Conversely, when the domestic

corporate sector is very large compared with the world economy, r will decrease by a large percentage, and the cost of capital in the domestic corporate sector will increase by substantially less than τ_c percent.¹²

As a basic economic interpretation of (4), when the relative cost of capital increases in the domestic corporate sectors and decreases in the domestic noncorporate sectors and abroad, domestic corporate producers demand relatively less capital. The noncorporate domestic producers and all foreign producers demand relatively more capital. As a result, the capital intensities of production increase in those latter sectors and the marginal productivity of capital decreases in those sectors. Such changes cause the marginal return to investment, r , to fall in those other sectors.¹³ The marginal return falls by more when the domestic economy and the domestic corporate sector are larger relative to the rest of the world. That happens because any given percentage reduction in the domestic corporate capital stock corresponds in that case to a larger increase in capital/labor ratios of the domestic noncorporate and foreign sectors.

The capital intensity of production in sector one enters (4) because any reallocation of capital out of the domestic corporate sector is offset, somewhat, by the fact that the domestic wage rate falls whereas the foreign wage rate rises. As a result, the domestic noncorporate producers do not increase their demand for capital by as much, proportionally, as do the foreign

¹² When the domestic corporate sector makes up the entire domestic economy and the tax rate is very small, equation (4) is the same as a relationship derived by Bradford (1978) and Koflikoff and Summers (1986). That variant is discussed in a later section of this study.

¹³ In derivation of (4), the equilibrium conditions are met through changes in the capital allocations alone. The model implies that the labor demands do not change in response to the tax.

producers. The domestic noncorporate producers will even decrease their demand for capital if the domestic economy is very small relative to the rest of the world or if production in sector one is very capital intensive. The importance of such a reaction by the domestic noncorporate producers is represented in (4) by the interaction between the domestic noncorporate capital stock and the term that represents labor's share of value added in sector one.

Changes in the land rents are determined in sector four, the agricultural sector. Following Harberger (1995), it is assumed here that the domestic country does not produce enough to affect the world price of output in that sector.¹⁴ Because sector four uses labor, capital, and land in production, any changes in the net costs of capital and labor are offset by changes in the land rents. The changes in domestic and foreign equilibrium land rents are derived from the relation between input costs and output prices in sector four, as represented by:

$$(5) \quad \hat{p}_4^j = 0 = \theta_{L4} \hat{w}^j + \theta_{K4} \hat{r} + \theta_{\ell 4} \hat{\ell}^j \quad j = d, f$$

where ℓ^j is the land rent in country j and $\theta_{\ell 4}$ is land's share of value added in sector four. Because the price of sector four output does not change, the change in the domestic and foreign land rents is derived from (5) as:

$$(6) \quad \hat{\ell}^j = - \left(\frac{\theta_{L4}}{\theta_{\ell 4}} \cdot \hat{w}^j + \frac{\theta_{K4}}{\theta_{\ell 4}} \cdot \hat{r} \right) \quad j = d, f$$

¹⁴ The additional fixed factor, land, is included in the model as an input in sector four to avoid a corner solution. Otherwise, when responses to the corporate tax drive down both the wage and the cost of capital for that sector, all domestic producers would want to produce only that output.

The domestic land rent increases in response to the corporate income tax because the tax causes a decrease in both the cost of labor and the cost of capital used by the noncorporate producers. In contrast, the foreign land rents can rise or fall depending on how the capital intensity of production in sector four compares with the capital intensity of production in sector one. Because the size of the increase in foreign labor costs and decrease in foreign capital costs are consistent with a constant price of sector one output, foreign land rents will increase or decrease depending on whether sector four production is less or more capital-intensive than sector one production.

Output prices change in sectors two and three, the other corporate sectors, according to:

$$(7) \quad \begin{aligned} (a) \quad \hat{p}_i^d &= \theta_{Li} \hat{w}^d + \theta_{Ki} \cdot [\hat{r} + (1 + \hat{r}) \tau_c] \\ (b) \quad \hat{p}_i^f &= \theta_{Li} \hat{w}^f + \theta_{Ki} \hat{r} \end{aligned} \quad i = 2, 3$$

For both domestic and foreign producers in sectors two and three, the input prices change by the same percentages as the input prices faced by producers in sector one. Because the domestic wage rate falls and the domestic corporate cost of capital rises, the domestic prices of output in sectors two and three will increase or decrease depending upon whether production in those sectors is more or less capital-intensive than production in sector one. In the foreign country, the prices of outputs from sectors two and three have the reverse relationship to the capital intensity of production in sector one because the foreign wage rate goes up and the foreign cost of capital goes down by the same amounts in all sectors. The foreign output prices in sectors two and three will therefore increase if production in those sectors is less capital-intensive than production in sector one. Those foreign prices will decrease if production in those sectors is more capital-intensive than production in sector one.

For both countries, the price changes for the outputs of sector five are given by:

$$(8) \quad \hat{p}_5^j = \theta_{L5} \hat{w}^j + \theta_{K5} \hat{r}^j \quad j = d, f$$

The price of the domestic output of sector five will decrease because the domestic noncorporate costs of both labor and capital inputs fall. The foreign price of the output of sector five behaves in the same way as the foreign output prices for sectors two and three: Whether the foreign price of sector five output will decrease or increase depends on whether production in sector five is more or less capital intensive than production in sector one.

IV. Tax Burdens

Because individuals consume all of their incomes and because the individual supplies of labor and capital are fixed, the total burden of the corporate income tax can be measured in terms of the changes it causes to personal incomes, adjusted for any welfare effects of changes in the relative prices of consumer goods. For the residents of each country, personal income can be decomposed as in (9), where the initial value of domestic output is arbitrarily set equal to 1:

$$(9) \quad Y^j = w^j L^j + r \delta^j K + \ell^j = Y_L^j + Y_K^j + Y_\ell^j \quad j = d, f$$

where $Y_L^j = \theta_L \cdot \frac{K^j}{K^d}$, $Y_K^j = \theta_K \cdot \delta^j \cdot \frac{K}{K^d}$, and $Y_\ell^j = \theta_\ell \cdot \frac{K^j}{K^d}$ are the amounts of income paid to the resident owners of income from labor, capital, and land, respectively, in country j .

The term δ^j is the share of the worldwide capital stock owned by residents of country j , and θ_L , θ_K , and θ_ℓ are the initial aggregate output shares for labor, capital, and land, respectively. The

total burden of the tax is expressed in terms of changes in personal wage income, capital income, labor income, and the prices of consumer goods as:

$$(10) \quad B^j = -d \left(\frac{Y^j}{P^j} \right) = -Y_L^j \hat{w}^j - Y_K^j \hat{r}^j - Y_\ell^j \hat{\ell}^j + \hat{P}^j Y^j \quad j = d, f$$

where P^j , initially equal to 1, is an index of the cost of living in country j .

The interaction between personal income and the change in the price index in the last term of (10) accounts for a consumer burden that results from changes in the relative prices of consumer goods. Tax burden is defined here as an equivalent variation, so the price index measures the equivalent variation in consumer expenditure when consumer prices change. The index accounts for changes in the relative prices of consumer goods and any consumer substitution that occurs in response to those price changes. That true cost-of-living index can be approximated by the change in a fixed-share Laspeyres price index:

$$(11) \quad \hat{P}^j \approx \sum_{i=1}^5 s_i \hat{p}_i^j + s_6 \hat{p}_2^{-j} \quad j = d, f$$

where s_i is the initial expenditure share for consumer good i , the j superscript represents the country of residence, and the $-j$ superscript represents the other country.¹⁵

Equation (10) shows how the total burden can be decomposed according to the sources and uses of income. That decomposition is consistent with the way that tax incidence is measured in Harberger (1962) and Harberger (1995). If consumers have identical homothetic preferences and if they face the same changes in consumer prices, the effect of the tax on the

¹⁵ The numerical applications in this study use the Laspeyres index, which can cause the estimated excess burdens of the tax to be overstated. That bias disappears when the tax rate is very small, in which case the excess burden of the tax also approaches zero.

distribution of income is independent of the consumer's burden. For example, the change in real domestic labor income, expressed as a fraction of real domestic income, is independent of the consumer's burden.¹⁶

Alternatively, the consumer's burden can be divided between the owners of each factor according to (12), which combines the effects of the tax on the sources and uses of income.

$$(12) \quad B^j = -Y_L^j \cdot (\hat{w}^j - \hat{P}^j) - Y_K^j \cdot (\hat{r} - \hat{P}^j) - Y_f^j \cdot (\hat{l} - \hat{P}^j) \quad j = d, f$$

Those combined measures of burden have a clear intuitive economic interpretation that does not depend on the choice of a numeraire. Defined in that way, burden can be thought of as the change in consumption by the owners of each input. For the owners of each factor, it measures the size of a lump-sum tax toward which those owners would be indifferent.

Consistent with Harberger (2006) and Gravelle and Smetters (2006), the combined measures of burden in (12) are used throughout the rest of this study. In addition to having a clear welfare interpretation, the combined measures are needed in order to make international comparisons between the burdens imposed on domestic and foreign residents. That combination is necessary because foreign and domestic residents can face different changes in consumer prices when some outputs are not traded internationally.

Excess burden is the excess of the total burden over the real value of corporate tax revenue:

$$(13) \quad R_C = [\tau_c \cdot (1 + \hat{r}) \cdot (1 + \hat{K}_C^d) \cdot \sum_{k=1}^3 q_k \theta_{k1}] / (1 + \hat{P}^d)$$

¹⁶ The term "real" is used here merely to represent the adjustment for changes in relative prices.

where q_i is the initial value added by production in sector i and the summed term equals the initial domestic corporate capital stock, all expressed as a share of the total value of domestic output. The real value of corporate revenue equals the real value of government purchases of domestic consumer goods that can be financed by the tax and redistributed to domestic residents.¹⁷

V. A General Replacement Tax on the Domestic Use of Capital

This section examines the effects of a general replacement tax on the income from capital in all domestic sectors. The general tax rate is chosen so that it will finance the same real government expenditures on consumer goods as the corporate tax it replaces.¹⁸

A comparison between those taxes provides a way to isolate the effects that the corporate income tax has on the domestic and international allocations of capital. In a closed economy, the corporate income tax affects efficiency and incidence only through its effects on the allocation of inputs between the corporate and noncorporate sectors. In an open economy, the domestic corporate income tax affects efficiency and incidence through its effect on the allocation of capital both between the domestic corporate and noncorporate sectors and between the domestic and foreign economies. In contrast, the general tax affects only the international allocation of capital. Thus, a comparison between the effects of the corporate tax and the general tax provides a way to separate the effects the corporate tax has because it is imposed only on

¹⁷ Revenue is thus measured in units of a bundle of domestic consumer goods rather than in terms of the numeraire good produced in sector one. Thus, revenue and burden are measured in the same units. Excess burden is then simply any excess of total burden over the value of the lump-sum government distributions financed by the tax.

¹⁸ Both taxes are referred to as taxes "at source" because they are imposed on capital income based on where the capital is used.

some domestic sectors from the effects it has because it is not imposed on the use of capital abroad.¹⁹

Under the general tax, the domestic wage rate falls by less than it does under the corporate income tax because the required replacement value of the general tax rate, τ_g , can be lower than the corresponding corporate tax rate; the general tax is imposed on a broader base. As under the corporate income tax, the wage rate is determined in sector one: The domestic wage rate is determined in the same way as in Equation (2a), but the percentage change in the sector one cost of capital under the corporate tax is replaced by its percentage change under the general tax, $\hat{r}_g + (1 + \hat{r}_g)\tau_g$.

The percentage change in the equilibrium (tax-exclusive) return to capital, which is now the cost of capital only to foreign producers, is given by:²⁰

$$(14) \quad \hat{r}_g = -\tau_g \cdot \frac{K^d}{K + K^d} \tau_g$$

Equation (14) is similar to (4), but the corporate tax rate is replaced by the general tax rate, and the term for the noncorporate capital stock does not enter the equation because all domestic sectors are subject to the general tax. When the general tax rate is extremely small, the second term in the denominator of (14) disappears so that worldwide capital income is reduced exactly by an amount equal to the revenue collected by the tax. As in Bradford (1978), capital

¹⁹ The general tax also represents a corporate integration policy that imposes a single tax rate on the income from all domestic capital investment regardless of the sector in which that capital is invested.
²⁰ Equation (14) is derived under the assumption that the domestic and foreign aggregate partial input substitution elasticities equal each other. For the general tax, the aggregate changes in capital are given by modified versions of (3), where (3b) is ignored and the aggregate domestic capital stock and change in the domestic cost of capital under the general tax are substituted into (3a). Equation (14) is derived by also noting that aggregate country labor supplies do not change and that the world capital supply is fixed.

owners worldwide bear exactly 100 percent of a very small tax on the income from capital used by domestic producers. However, as shown in the numerical application below, the worldwide burden is not divided exactly in proportion to the domestic and foreign ownership shares of world capital, because the tax can have different effects on the prices of domestic and foreign consumer goods, and capital owners must consume where they live.

The effect that the general tax on capital income at source has on output prices follows the same economic reasoning as the analysis of the corporate income tax, except that the price equations include the percentage change in the tax-inclusive cost of capital for all domestic sectors rather than just in the corporate sectors.

The real value of tax revenue under the general tax is given by

$$(15) \quad R_g = [\tau_g \cdot (1 + \hat{r}_g) \cdot (1 + \hat{K}_g^d) \cdot \theta_k] / (1 + \hat{P}_g^d)$$

where $\hat{K}_g^d = \sigma \cdot [w^d - \hat{r}_g - (1 + \hat{r}_g)\tau_g]$, and θ_k is the initial domestic capital stock, expressed as a share of the value of output. The tax rate for the general tax is chosen to equate real revenues and, thus, the lump-sum redistributions under the general tax and the corporate tax.

VI. Personal Taxes on Domestic Residents

Personal taxes on domestic residents also provide useful policy alternatives against which to evaluate the international effects of the corporate income tax and general tax. Such personal taxes are nondistortious under the assumptions of the model used in this study, because the personal supplies of labor and capital are fixed and domestic residents cannot move abroad to escape taxation. As a result, a personal tax on labor income is borne entirely by labor; a personal

tax on the worldwide income of the domestic owners of capital is borne entirely by those owners; and a uniform tax on the personal income or consumption of domestic residents is borne by those residents in proportion to their initial shares of domestic personal income.

VII. A Numerical Application

The model can be applied based on very few assumptions about the economy. Share assumptions (Table 1) apply for the United States and are taken from Gravelle and Smetters (2006).²¹ The capital intensities of sectors one and two are initially equated for simplicity. When those capital intensities are equal, the incidence results are the same as if the first two sectors are combined into one sector for which the foreign and domestic outputs are perfect substitutes. In other words, the fact that sector two produces foreign and domestic outputs that are not perfect substitutes does not affect the incidence results when the first two sectors have the same capital intensities. A later part of the application examines how incidence changes when those capital intensities are different. The domestic economy accounts for 30 percent of world output. In addition, domestic residents are assumed to own 30 percent of world output, so the country is neither a net international lender nor a net international borrower. That assumption is also relaxed later in this study. Consistent with Mutti and Grubert (1985), the partial elasticity of input demand substitution between capital and labor is initially set equal to 0.6.²²

It is not obvious how to choose the right value for the (tax-exclusive) corporate tax rate because the actual U.S. income tax system is considerably more complex than in the model. After accounting for personal and business income taxes, depreciation rules, business finance,

²¹ The appendix compares the results under alternative share assumptions consistent with Harberger (1995).
²² That value is based on estimates in Hamermesh and Grant (1979). The results of the application in the current study are not very sensitive to a change in that value to 1.0.

and other factors, the Congressional Budget Office (2005b) finds that the U.S. corporate tax causes the cost of capital in the U.S. corporate sectors to be 6.25 percent higher than the cost of capital in the noncorporate sectors. That is the tax rate used in this application. Alternatively, as a benchmark, the model's predictions are calculated when the tax rate is infinitesimally small, which has the advantage that those predictions depend on neither the actual U.S. tax rate nor the input substitution elasticity, but can still be used to characterize the incidence effects of a small change in the corporate income tax.

Economic Responses to the Corporate Income Tax

The model predicts a variety of economic responses to the introduction of the corporate tax in a new long-run equilibrium (Table 2). In response to an increase in the domestic corporate cost of capital, the capital stocks fall in the domestic corporate sectors and rise in the domestic noncorporate sectors and in the foreign country. The domestic corporate capital stock falls by almost 4 percent. The aggregate domestic capital stock falls by 2 percent, which implies that the arc elasticity of the domestic capital stock with respect to the 6.25 percent corporate tax is 0.32. For each one percent by which the tax initially increases the corporate cost of capital, the domestic capital stock falls by 0.32 percent.²³

Those investment responses drive down the cost of capital by 1.2 percent for the untaxed producers in the domestic noncorporate sectors and the foreign sectors. As a result, the cost of capital for domestic corporate producers increases by only 5.0 percent in response to the 6.25 percent corporate tax.

²³ Even though capital is perfectly mobile, only a finite percentage of the domestic capital stock is reallocated abroad in response to the tax, because a reduction in the capital stock increases the marginal product of capital in the domestic corporate sectors.

The reallocation of capital also affects wages. Because there is less domestic capital, and labor cannot emigrate, the domestic wage rate falls by 1.1 percent, driven by competition in sector one (Equations 1 and 2). The domestic wage rate has to fall by that amount in order to offset the increased corporate cost of capital. Similarly, the foreign wage increases by 0.25 percent because the larger foreign capital stock improves the productivity of foreign labor. The foreign wage rate increases by just enough for the resulting increase in labor costs to fully offset the decrease in capital costs for sector one of the foreign economy.

Both domestic and foreign land rents increase. The domestic land rent rises because the costs of labor and capital both decline for sector four (agriculture), so that land becomes more productive. Foreign land rent rises because sector four is more capital-intensive than sector one, so the decline of the foreign cost of capital more than fully offsets the increased cost of labor to sector four of the foreign economy.

Overall, consumer prices fall slightly in both countries. Output prices do not change in the first two sectors (mostly manufacturing), because sector one produces the numeraire and sector two has the same capital intensity as sector one. Thus, any wage change that exactly offsets the increased cost of capital in sector one will also exactly offset the increased cost of capital in sector two. Sector three, the other corporate sector (utilities and transportation), is more capital-intensive than sector one. As a result, the price of the domestic sector three output increases because the rise in the corporate cost of capital more than fully offsets the decrease in labor costs. Similarly, the price of sector three output in the foreign economy falls slightly because the decreased foreign cost of capital over-compensates for the increased foreign labor cost. The price of output in sector four (agriculture) does not change, by assumption. For

domestic output of sector five (housing and retail services), the domestic price declines because both capital and labor become cheaper for that sector. The foreign price of sector five output also declines because sector five is more capital-intensive than sector one, so the effect of a decrease in the foreign cost of capital dominates the increase in the foreign wage rate.

Real private incomes, before government transfers, change for both domestic and foreign residents. Those changes are the tax burdens. For domestic residents, labor and capital incomes each fall by about 1 percent. A small overall decrease in the domestic prices of consumer goods only slightly offsets the fall in domestic wages and the decrease in the domestic capital owners' return to their share of the world capital stock. In contrast, real income paid to domestic landowners increases because land rents increase and consumer prices fall. When combined, the aggregate real domestic private income falls by 0.978 percent before government transfers. Because the real value of revenue from the tax (the real value of government purchases of consumer goods financed by the tax) equals only 0.944 percent of the initial domestic income, the domestic real national income is reduced by about .035 percent (not shown in Table 2). That national loss equals about 3.7 percent of the revenue from the tax ($100 \times 0.035 / 0.944$).²⁴

Foreign labor benefits from both an increase in the foreign wage rate and an overall decrease in foreign consumer prices. Foreign capital owners lose from a reduced return to their capital. That loss is offset somewhat by a reduced foreign cost of consumer goods. Foreign land

²⁴ That is the worldwide deadweight loss, or excess burden from the tax. The deadweight loss is relatively small because the tax is small and there are no other pre-existing distortions. Because this study is about the distribution of the burden, it would be sufficient to assume that the tax rate is infinitesimal, as is done in a later section, below. However, using a small finite tax rate allows the numerical application to illustrate the potential size and nature of some of the important economic effects of the tax. The value obtained for excess burden in the example should therefore not be taken seriously as an estimate of the overall excess burden of the corporate income tax.

owners benefit slightly from an increase in foreign land rents and a decrease in the cost of foreign consumer goods.

Overall, the gains of foreign workers and landowners are exactly offset by the losses of foreign capital owners so that none of the net burden of the tax is exported under the basic assumptions. In effect, the domestic corporate tax shifts the foreign distribution of income toward labor and landowners and away from foreign capital owners. Under alternative assumptions, as examined later in this application, the tax can also shift either a net burden or a net benefit to foreign residents.

Burdens of the Corporate Income Tax

Under the basic assumptions, domestic labor and capital owners bear the corporate tax roughly in proportion to their initial shares of income. Expressed as shares of real tax revenue (Table 3), the burdens imposed on domestic workers and capital owners are just above their initial shares of domestic income. Domestic labor bears 73.7 percent of the corporate tax burden and receives about 70 percent of income in the no-tax equilibrium. Domestic capital owners bear 32.5 percent of the corporate tax burden and receive about 29 percent of income in the no-tax equilibrium. Domestic landowners benefit by 2.5 percent of the revenue.

The domestic corporate income tax shifts the foreign distribution of income away from capital owners toward labor and, slightly, toward landowners. Foreign labor's benefit is about equal to domestic labor's loss, but that benefit to foreign labor is almost exactly offset by the loss to foreign capital owners.

When measured on an aggregate worldwide basis, labor bears very little (2.4 percent of the revenue) of the burden from the corporate income tax. In contrast, capital owners worldwide bear slightly more than 100 percent of the burden (104.7 percent of the revenue), almost in proportion to the domestic and foreign ownership shares of capital.²⁵

Those worldwide implications are similar to the central predictions of the closed-economy analysis of Harberger (1962), in which all capital owners bear the full burden of the U.S. corporate tax and labor escapes the burden. The essential difference from the closed economy is that both labor and capital can be reallocated freely between sectors in the closed economy, but only capital can be reallocated between countries in the open economy.

Worldwide, capital owners still do not escape the tax in the open economy, but domestic labor bears a burden because domestic workers cannot emigrate to take advantage of an increased foreign wage rate. Domestic capital owners can escape part of the burden because, unlike workers, they do not have to live where their capital is used. If labor could move freely internationally, the domestic and foreign wages would be equal. In that case, analysis of the open-economy incidence would be just like analysis of the closed-economy incidence. For such an open economy, all foreign sectors would simply be part of the noncorporate sectors. Otherwise, the closed-economy analysis could be applied directly.

²⁵ Not shown in Table 3, worldwide capital income is reduced by 119.3 percent of the tax revenue. However, a decline in domestic and foreign consumer prices offsets part of that capital income reduction so that the burden for capital owners worldwide equals 104.7 percent of the tax revenue.

Economic Responses to the General Replacement Tax

The economic changes under the general tax are different from the changes under the corporate tax (Table 2) because the general tax rate is lower than the corporate tax rate and the general tax is imposed on all domestic sectors rather than just the corporate sectors.

Compared to the corporate tax, the foreign cost of capital does not decline by as much under the general tax because less of the world capital stock is reallocated abroad in response to the general tax. The domestic cost of capital increases in all sectors, but by less than half as much as in the domestic corporate sectors under the corporate tax. As a result, the domestic wage rate does not have to decrease by as much as under the corporate income tax, because less capital has to be reallocated away from sector one in order for the resulting decrease in labor costs to fully offset the increase in capital costs. The foreign wage rate increases by slightly less than it does under the corporate tax, also because less capital is reallocated abroad. The domestic land rent declines under the general tax because the prices of labor and capital change by the same amounts in every domestic sector. The domestic land rent falls because sector four is more capital-intensive than sector one. The foreign land rent increases by slightly less than it does under the corporate tax.

Domestic consumer prices actually increase under the general tax. The price of sector three output (utilities and transportation) increases by less than it does under the corporate tax. But, in contrast to the corporate tax, the price of sector five output (housing and retail services) increases because that sector's cost of capital increases under the general tax, and sector five production is more capital-intensive than production in sector one. In contrast, foreign consumer prices decline by slightly less overall than under the corporate tax.

Those economic differences from the corporate tax imply that, if the general tax were to replace the corporate tax, capital would be reallocated to the domestic corporate sectors and away from the foreign country and the domestic noncorporate sectors. The aggregate domestic capital stock would increase, causing domestic wages to also increase. The foreign capital stock would decrease, causing the foreign wage rate to fall and the foreign cost of capital to increase. Domestic and foreign land rents would fall, especially the domestic rents. Domestic consumer prices would increase and foreign consumer prices would increase very slightly.

Replacement of the corporate tax by the general tax would also cause real private incomes to change. Domestic labor would gain because the domestic wage increase would be more than large enough to offset the increase in domestic consumer prices. Foreign labor would lose because foreign wages would fall while foreign consumer prices would rise. Because domestic consumer prices would increase, domestic capital owners would be worse off than under the corporate tax, even though their capital would be used more efficiently worldwide than under the corporate tax. But foreign capital owners would be better off because the foreign consumer prices would not increase by enough to offset their benefit from the more efficient use of capital. Landowners, especially domestic landowners, would lose from the replacement tax. As under the corporate tax, aggregate real foreign income would not change under the replacement tax. Domestic national income would increase slightly because the general tax at source would achieve a more efficient domestic allocation of capital than the corporate tax.

Burdens of the General Replacement Tax

If the corporate tax were replaced by the general tax, the excess burden would be reduced (Table 3). Under the general tax, the excess burden would decline by almost half from 3.7 percent to just 2.0 percent of revenue because capital would be allocated more efficiently. Domestic capital would then provide the same marginal return in all sectors. Some capital would also be reallocated from abroad, so that the difference between the domestic and foreign pre-tax returns would be smaller than it is under the corporate tax. All of the benefit of that increase in efficiency would go to domestic residents, as an increase in real domestic national income equal to 1.7 percent of the tax revenue. There would be no change in the real foreign national income.

Replacement by the general tax would also change the distribution of tax burdens (Table 3). It would transfer roughly 13 percent of the burden away from domestic labor and toward domestic capital owners and landowners. It would also transfer about 10 percent of the burden away from foreign capital owners toward foreign labor and landowners.

Differential Burdens of Other Taxes

The personal taxes also provide useful comparisons (Table 3). Under the assumptions of the model used in this study, none of those taxes distort behavior because each is imposed on domestic residents who can not move abroad to escape the tax, nor can they change their labor supplies or savings behavior. Replacement of the corporate income tax by any of those taxes would therefore eliminate the excess burden and exactly reverse the distributional effects that the corporate tax has on foreign residents. Foreign labor and landowners would be worse off by an amount that is transferred, exactly, to foreign capital owners.

Domestic labor would bear all of the burden of the wage tax, so their burden would increase by about 26 percent of the revenue under the replacement tax. The burden shares of domestic and foreign capital owners would decrease and the burden shares of foreign labor would increase by amounts equal to their burden shares of the corporate tax. On a worldwide basis, a domestic wage replacement tax would shift roughly the entire burden from capital owners to domestic labor.

Domestic owners of capital would bear the full burden of a domestic tax on their worldwide capital income. If that tax was used to replace the corporate tax, their share of the tax burden would increase by 67.5 percent of the revenue. The burden shares for domestic labor and land owners would change by amounts that exactly offset their shares of the corporate income tax burden.

That worldwide tax on domestic capital owners achieves Capital Export Neutrality (CEN) because it is imposed on the residents' capital income regardless of where that capital is used in production. The U.S. and most foreign corporate income taxes violate CEN because they are effectively imposed on the domestic use of capital, regardless of where that capital is owned.²⁶

Although replacement by the tax on worldwide capital income of domestic residents would improve worldwide efficiency in the allocation of capital, the worldwide efficiency gain equal to 3.7 percent of the revenue would be realized fully as an increase in the aggregate domestic national welfare. Compared to that small efficiency gain, the domestic and foreign income redistribution effects of switching to the tax that achieves CEN would be very large. On a

²⁶ That is not how the U.S. corporate tax is described legally, but how it works in practice as a result of the combined effects of all international tax rules and corporate behavior (see Grubert, 2004).

worldwide basis, however, both labor and capital owners would be only slightly better off. Landowners would be slightly worse off.

If the corporate tax were replaced by a uniform tax on the income or consumption of domestic residents, domestic labor and capital owners would both gain slightly and landowners would lose.²⁷ Those changes would be small because the domestic burden shares of the corporate income tax are approximately equal to the domestic residents' shares of income or consumption, and hence to the shares of burden under a personal income or consumption tax. On a worldwide basis, such a replacement tax would cause a substantial transfer of income from labor to capital owners, almost entirely due to its effects on foreign residents.

Infinitesimal Corporate Tax Rate

The tax incidence is not affected much by assumptions about the level of the corporate tax rate and the size of the input substitution elasticity. That lack of sensitivity can be seen by analyzing the effects of an infinitesimal tax rate (Table 4), which would approximate the effects of a very small increase in the corporate tax rate. The burden shares shown in Table 4 are almost the same as the burden shares shown in Table 3. The main difference is that the excess burden disappears when the tax rate is very small. In that sense, Table 4 shows the pure incidence effects of the corporate income tax.

²⁷ The differential incidence of that replacement tax also measures the balanced-budget incidence of eliminating the corporate tax if the government were to offset the loss of corporate tax revenue by reducing its spending – its distributionally neutral lump-sum transfers.

Aggregate International Spillover Effects

Under the assumptions used so far, the domestic corporate income tax distorts the allocation of capital and changes the domestic and foreign intranational distributions of income. But the tax does not affect the aggregate international distribution of incomes. Not even the excess burden is exported in the aggregate, even though the tax causes capital to be allocated inefficiently on a worldwide basis. The tax burden is not exported or imported in the aggregate because the initial domestic and foreign per capita wealth endowments are assumed to be equal, and because the corporate tax has no tariff-like effects when the first two sectors have the same capital intensities.

The corporate income tax can, however, affect the aggregate international distribution of income under alternative assumptions, but the international transfer can go in either direction. The aggregate tax burden can be exported or imported, and the effect on the foreign distribution of income can be more or less intensified.

The simplest international transfer can arise when the domestic country is a net international lender or net international borrower. One of those situations would arise when the two countries had different initial per capita wealth endowments. First, suppose that the domestic country is a net international lender. While the domestic capital stock equals 30 percent of the world capital stock (the base case), suppose that domestic residents own 35 percent of world capital. Now, the corporate tax has the same effects on production and prices as in the base case, but domestic capital owners bear a larger share of the burden (Table 5). Compared to the base case, the domestic capital owners' share of the burden increases and the foreign capital owners' share falls, each by slightly more than 5 percent. Those changes are slightly greater than

5 percent because, although consumer prices fall in each country, domestic consumer prices fall by less than foreign consumer prices (Table 2). That difference between domestic and foreign consumer price changes, compared to the base case, also causes the excess burden of the tax to increase slightly from 3.7 percent to 4.0 percent of tax revenue. The aggregate domestic real national income falls by an amount equal to 9.1 percent of the tax revenue. Compared to the base case, the aggregate domestic excess burden increases from 3.7 percent to 9.1 percent of tax revenue. Foreign real national income increases by 5.2 percent of the revenue, so foreign residents receive a net benefit from the tax.

Thus, aggregate foreign welfare is improved by the domestic corporate tax when the domestic country is a net international lender. Aggregate domestic welfare falls. That international transfer occurs because foreign labor and landowners benefit from the same increased stock of foreign capital as when the two countries are equally wealthy, but the domestic capital owners now bear a greater share of the burden because they own a larger share of the world capital stock. The foreign capital owners bear a smaller share of the burden.

The aggregate international burden is shifted in the opposite direction if the domestic country is a net international borrower. Suppose that the domestic residents own only 25 percent of the world capital stock. In that case (Table 5), some of the domestic tax burden is exported and the worldwide excess burden is slightly lower than in the base case, because foreign consumer prices are lower than domestic consumer prices in the new equilibrium.

In summary, an aggregate benefit is exported if the domestic country is a net international lender. An aggregate burden is exported if the domestic country is a net international borrower.

The domestic corporate income tax can also affect the international distribution of income if the capital intensities are not equal for production within sectors one and two.²⁸ Those international spillover effects can also go either way depending on whether sector two is more or less capital-intensive than sector one. However, the effects of altering the relative capital intensities are more complicated than the effects of changing the shares of capital ownership. Those complications arise because both national and subnational distributions of the tax burdens are modified by a change in the assumptions about relative capital intensities.

First, suppose that sector two is more capital-intensive than sector one. Suppose that capital's initial share equals 20 percent of the value added in sector two, rather than 18 percent (as in Table 1, the base case). In addition, suppose that sector one accounts for 25 percent of the value added by the first two sectors combined, and that the sector one capital share is only 12 percent rather than 18 percent (as in Table 1, the base case). Under those assumptions, the aggregate capital intensity and output shares of sectors one and two combined are the same as in the base case. All other shares are also unchanged.

Under those alternative assumptions, domestic labor bears a smaller share of the burden (Table 5) than in the base case. Domestic labor bears 59 percent rather than 73.7 percent of the burden. Domestic labor's share of the burden is smaller because the domestic wage rate falls by less than in the base case and the rate of return paid to capital owners falls by slightly more than in the base case (Table 6). The domestic wage rate falls by less mostly because sector one production is more labor-intensive than it is in the base case. As described by Equation (2a), when sector one is more labor-intensive, the wage rate does not have to fall by as much to fully

²⁸ Recall that those sectors are the corporate sectors that produce internationally tradeable outputs. The foreign and domestic outputs of sector one are perfect substitutes and the foreign and domestic outputs of sector two are imperfect substitutes.

offset the increased cost of capital in that sector. In addition, the domestic corporate cost of capital increases by slightly less than in the base case because sector one is now more labor-intensive.²⁹

Also under those alternative assumptions, compared with the base case, domestic owners of capital bear a larger share of the burden imposed on worldwide capital owners (Table 5) because the domestic owners of capital must pay higher consumer prices than before, whereas foreign capital owners pay slightly less for consumer goods than in the base case. Domestic consumer prices now rise by 0.11 percent rather than falling by 0.11 percent, as in the base case (Table 6). In contrast, foreign consumer prices decline by slightly more (-0.18 percent) than in the base case (-0.16 percent).

Overall, when sector two is more capital-intensive than sector one, some of the aggregate burden of the tax is exported (Table 5). Foreign residents bear an aggregate burden equal to 8.7 percent of the revenue. Domestic residents bear an aggregate burden equal to just 94.9 percent of the revenue. The effect that the domestic corporate tax has on the foreign subnational distribution of income is also less pronounced than in the base case.

Alternatively, when sector two is less capital-intensive than sector one, the aggregate international effect is reversed (Table 5). Domestic labor bears a larger share of the burden (90.6 percent) and foreign labor receives a larger benefit (87.8 percent) than in the base case. Compared to the base case, the domestic capital owner's burden is smaller (26.7 percent) and foreign capital owner's burden is larger (78.2 percent). Overall, domestic residents bear 113.9 percent of the domestic corporate tax. Foreign residents benefit by 10.1 percent of the revenue.

²⁹ The importance of labor intensity in sector one is shown by equation (4) and is explained in the discussion that follows that equation.

The effect of the corporate tax on the international distribution of incomes can be understood, in part, by comparing it to the effect of a domestic export tax or subsidy placed on the domestic output of sector two. When sector two is more capital-intensive than sector one, the corporate tax increases the domestic price of output from that sector and decreases the price of output from the corresponding foreign sector. That improvement in the international terms of trade creates a benefit for the domestic residents at the expense of foreign residents. In that way, it has an effect that is similar to an ad valorem tariff placed on the domestic exports from that sector. When sector two is less capital-intensive than sector one, the effect is reversed. The international terms of trade are worsened for domestic residents. Foreign residents are made better off at the expense of domestic residents, similarly to the effect of an domestic export subsidy for the output of sector two. The similarity to either an export tariff or an export subsidy is limited, however, because the corporate tax also affects the allocation of capital and of input and output prices in many other ways that differ from the effects of an export tax or subsidy.³⁰

Relative Size of the Domestic Economy

A change in the assumption about the size of the domestic economy relative to the world economy affects both the incidence and efficiency of a domestic corporate tax. To explore those effects, the tax burden shares can be measured on either an aggregate basis or a per capita basis. Aggregate burdens measure the total effects of the tax on domestic and foreign residents, expressed as shares of total domestic revenue. Per capita burdens are expressed, instead, as per capita shares of the domestic per capita revenue. Domestic burden shares have the same values

³⁰ Melvin (1982) discusses the tariff-like effects of the corporate income tax in a much simpler two-sector trade model with no international capital mobility. That simpler model makes it easier to understand the similarity to the effects of a tariff.

either way, but foreign per capita shares account for the fact that when domestic output is a smaller share of world output, the domestic revenue is smaller and the foreign burden is divided among a larger number of foreign individuals. For example, when the domestic economy is only 1 percent of the world economy, foreign labor's total benefit is about the same as domestic labor's total loss (Table 7), but foreign labor's per capita gain is less than 1 percent of domestic labor's per capita loss (Table 8).³¹ Changes in a very small country cannot have much of an effect on each person in the rest of the world.

Domestic labor bears more than 100 percent of the burden when the domestic economy produces less than 5 percent of world output (Table 8). For such a small economy, both domestic labor and domestic capital owners would be better off under a domestic tax on wages. Whether that small country chooses to impose a corporate income tax has only a small effect on foreign individuals.

When burden is measured on a per capita basis, the shares borne by domestic and foreign labor and capital correlate closely with the relative size of the domestic economy (Table 8). The per capita burdens imposed on individual capital owners, domestic or foreign, are roughly equal to the domestic economy's share of world output.³² Domestic labor's per capita share of the burden is slightly higher than the foreign economy's share of world output. Foreign labor's per capita share of the burden is slightly above the domestic economy's share of world output.

The excess burden, measured as a share of revenue, is largest when the domestic economy is smallest. That excess arises because the corporate tax causes capital to be allocated

³¹ Computations for Tables 7 and 8 use the same assumptions as the base case for the United States. It is assumed that the populations are proportional to the sizes of the economies.
³² Domestic capital owners bear a slightly higher burden than foreign capital owners, because domestic consumer prices increase by more than foreign consumer prices.

inefficiently away from the domestic corporate sector and out of the domestic economy. Both sources of inefficiency become smaller relative to domestic revenue as the domestic economy is assumed to be relatively larger (not shown in Table 8). In the limit, when the domestic economy is the whole world, only the domestic misallocation of capital remains. The excess burden equals 4.8 percent of revenue when the domestic economy is only 1 percent of the world, but only 1.2 percent of revenue when the domestic economy is the whole world. Of course, 1.2 percent of revenue collected if every country imposed the same corporate tax would be much larger than 4.8 percent of revenue collected by a country that makes up only 1 percent of the world economy.

Capital Mobility

Throughout this study, capital is assumed to be perfectly mobile in the sense that the marginal return to investment, excluding producer-level taxes, is the same throughout the world. The question about the true degree of international capital mobility is unresolved, especially since the work of Feldstein and Horioka (1980), who discovered a high and very robust correlation between national investment and national savings, which suggested that capital was not very mobile. However, more recent work suggests that the Feldstein-Horioka result is not as robust as once believed.³³ Moreover, it is not clear exactly what the Feldstein and Horioka implies about the degree of capital mobility.³⁴ However, given that a significant level of uncertainty and disagreement among economists remains, it is important to consider the possible implications of imperfect international capital mobility.

³³ See Coakley, Kulasi, and Smith (1998) and Coakley, Fuertes, and Spagnolo (2004).
³⁴ See Obstfeld and Rogoff (1996), pp. 161-164.

It is possible, as in Mutti and Grubert (1985) and Gravelle and Smetters (2006), to model international capital mobility by assuming that individual investors do not substitute perfectly between foreign and domestic investments. However, that strategy complicates the analysis considerably and is not necessarily the best way to characterize the behavior of the marginal investor in a long-run equilibrium. An alternative and much simpler approach to changing the degree of capital mobility is to imagine that the rest of the world is smaller, in which case there would be fewer opportunities for capital to be reallocated abroad. In that case, any international reallocation of capital away from the domestic economy drives down the marginal return to investment at a higher rate per unit of reallocated capital. That phenomenon causes less capital to be reallocated abroad in response to the domestic corporate tax, in a way that is similar to the effect of assuming that domestic and foreign investments are not perfect substitutes for investors. In effect, the marginal investor is still assumed to be indifferent between domestic and foreign investments that pay the same rate of return, but only for investments in some of the countries – perhaps between the highly industrialized countries. For other countries, they are completely unwilling to substitute between domestic and foreign investments at any relative rates of return.

As capital mobility is reduced in that way, domestic labor's share of the corporate burden becomes smaller and domestic capital's share of the burden becomes larger. For example, when the domestic economy is increased from 30 percent of the world economy to 70 percent of the world economy, domestic labor's share falls from 73.7 percent to 32.5 percent (Table 8). Domestic capital's share of the burden increases from 32.5 percent to 72.7 percent.³⁵ Because

³⁵ In the limit, domestic capital owners bear the full burden of the corporate tax when the domestic economy is the entire world, the tax rate is infinitesimally small (no excess burden), and the gain to land is distributed to labor and capital owners in proportion to their initial income shares. That result coincides with the central case in Harberger (1962) for the closed economy.

capital is less mobile when the domestic economy provides 70 percent of the world's investment opportunities to domestic capital owners, the arc elasticity of the domestic capital stock with respect to the corporate tax falls from -0.32 to -0.13.

The degree of long-run international capital mobility is still an unresolved question. Clearly, the answer to that question is crucial for understanding the long-run incidence of the corporate income tax in an open economy.

Tax Competition

Although many countries impose corporate income taxes, the corporate tax rates have decreased over the past 25 years.³⁶ Country competition caused by international spillover effects might help explain why countries have different corporate tax rates, but it is not clear how those spillovers would explain the observed downward trend in corporate tax rates.

The possibility of tariff-like competition seems to lead in the wrong direction. If the corporate income tax has tariff-like effects that allow countries to export some of their corporate tax burdens, the corporate tax can serve as a substitute for tariff competition when tariffs are limited by international trade agreements. But tariff competition is unlikely to explain the observed downward trends in corporate tax rates. To the extent that the corporate income tax acts as a tariff substitute, tariff competition would motivate countries to increase their corporate tax rates as trade agreements become more binding.

Spillovers that result from a country's net international capital position also do not obviously explain the downward trend in corporate tax rates. On an aggregate basis, residents of

³⁶ See Congressional Budget Office (2005a) and Devereux, Griffith, and Klemm (2002).

a country that is a net international lender would benefit from a reduction in their domestic corporate tax rate (Table 5). By that same aggregate measure, however, residents of a country that is a net international borrower would benefit from an increase in their own corporate tax rate. Countries that have gradually reduced their corporate tax rates include both net international lenders and net international borrowers, so those spillovers probably do not explain the downward trends.

International spillovers that affect the subnational distributions of income might explain part of the observed trend, but even the role of those spillovers is not obvious. If, for some reason, other countries reduce their corporate tax rates first, then a country might reduce its own corporate tax rate to protect its domestic workers from the potential outflow of capital. However, if that is a country's motivation for reducing its corporate tax rate, then it is not clear why the country would wait for other countries to reduce their taxes first. Even if all countries impose a corporate income tax, any one country could improve the welfare of its domestic workers by reducing its corporate tax.

Instead of tax competition, it is possible that international capital mobility has increased over the last 25 or 30 years, and that countries have reduced their corporate tax rates in response to that common trend. Without capital mobility, the corporate income tax is more likely to be borne by the domestic owners of capital. When capital is mobile, a corporate income tax is borne more heavily by domestic labor, especially for a tax imposed by the smallest countries. Some of those smallest countries have reduced their corporate taxes by the most over the past 25 years.³⁷

³⁷ See Congressional Budget Office (2005a).

Perhaps, out of concern for their domestic labor, countries have responded to the changing distributional consequences of corporate tax as capital mobility has increased.

Although the model does not explain the observed trends in any obvious manner, the model can be used to explore how those trends might affect the distribution of tax burdens. The potential effects can be observed based on the relation between country size and the per capita burden shares (Table 8). To simplify the analysis, rather than trying to analyze gradual changes in corporate tax rates, suppose that 90 percent of the world output is produced in countries that impose a corporate income tax, and that real tax havens produce the other 10 percent. Initially, on an average per capita basis, workers in the countries that are not tax havens bear only 12.3 percent of the corporate tax burden compared to an equilibrium in which none of those countries imposes a corporate income tax. Workers in the tax-haven countries receive an average per capita benefit equal to 89.7 percent of the per capita revenue.

Although the average labor share of the burden is small in the countries that are not tax havens, that burden can be much larger when it is measured at the margin for a country deciding whether to impose a corporate income tax. For a small country that is not a tax haven, domestic labor's benefit from eliminating its own corporate tax would equal 102 percent of its domestic revenue from the tax: the difference between the average burden of 12.3 percent within the countries that are not tax havens and the average per capita benefit of 89.7 percent within the tax-haven countries. From a distributional perspective, it makes little difference whether that small country is the only country to have a corporate income tax or is just one among many countries that tax corporate income, as long as countries can choose their tax policies independently. That is also true for larger countries. For example, in a country that is not a tax haven and that

produces 20 percent of world output, domestic labor's burden at the margin would equal 82.6 percent (12.3 percent + 70.3 percent) of the domestic corporate tax revenue.

If countries move into the tax-haven group, labor's average per capita benefit falls for residents of the tax-haven countries and rises for residents of the other countries. For example, when the tax-haven group grows from 10 percent to 30 percent of world production, labor's average per capita benefit falls from 89.7 percent to 70.3 percent for residents of the tax havens. Labor's average per capita burden rises from 12.3 percent to 32.5 percent for residents of the countries that are not tax havens.

Although the model does not obviously provide a theory of tax competition that would explain the observed trends in corporate tax rates over the past 25 or 30 years, the analysis does suggest that those trends can shift the burdens of the corporate income tax in an open economy. Such shifts might help explain country motivations that underlie the observed international trends in corporate tax policies.

VIII. Conclusions

The analysis shows how the domestic owners of capital can escape most of the corporate income tax burden when capital is reallocated abroad in response to the tax. But, as in Bradford (1978), capital owners worldwide do not escape the tax. Reallocation of capital abroad drives down the personal return to investment so that capital owners worldwide bear approximately the full burden of the domestic corporate income tax. Foreign workers benefit because an increased foreign stock of capital raises their productivity and their wages. Domestic workers lose because their productivity falls and they cannot emigrate to take advantage of higher foreign wages.

Under basic assumptions of the numerical application, the outcome is also similar to the implications of the simpler model of Bradford in the sense that the full worldwide burden falls on domestic owners of productive inputs.

Burdens are measured by substituting factor shares and output shares that are reasonable for the U.S. economy. Given those values, when capital is perfectly mobile and the tax does not affect the world prices of traded goods, domestic labor bears slightly more than 70 percent of the long run burden of the corporate income tax. The domestic owners of capital bear slightly more than 30 percent of the burden. Domestic landowners receive a small benefit. At the same time, the foreign owners of capital bear slightly more than 70 percent of the burden, but their burden is exactly offset by the benefits received by foreign workers and landowners. When capital is less mobile internationally, domestic labor's burden is lower and domestic capital's burden is higher. Burdens can also be affected by the domestic country's ability to influence the world prices of some traded corporate outputs, but the signs and magnitudes of those changes depend upon the relative capital intensities of production in the corporate sectors that produce internationally tradable goods.

That distribution of burdens is quite different from the predictions of Harberger's (1962) closed-economy analysis, which implies that domestic capital owners bear the entire U.S. corporate income tax in the long run. Those closed-economy predictions still apply to the world as a whole. But in an open economy, the tax causes income to be redistributed internationally between foreign and domestic owners of capital, and intranationally between the labor and capital owners resident within each country. Foreign owners of capital bear the domestic

corporate income tax roughly in proportion to their ownership of the world capital stock. Foreign labor benefits by about that same amount.

In addition to its effects on the domestic and foreign subnational distributions of income, a corporate income tax can redistribute the aggregate national incomes between domestic and foreign residents. For example, to the extent that the taxing country is a net international lender, its corporate income tax can transfer national incomes away from domestic residents toward foreign residents. Alternatively, when the taxing country is a net international borrower, the international transfer is reversed. Part of the aggregate tax burden is exported to foreign residents. But only capital owners are affected by the aggregate international transfers that occur when the country is either a net international lender or borrower; labor's burden is unaffected.

Similarly, the corporate income tax can redistribute national incomes in a way that is like an *ad valorem* tariff on exports, as in Whalley (1980). However, the size and direction of that effect depend upon the relative capital intensities of production for internationally tradable corporate outputs that are imperfect substitutes for their foreign produced counterparts. When that production is more capital-intensive than production of the other tradable corporate outputs, a corporate income tax shifts national income toward domestic residents from abroad. In effect, domestic residents benefit from their own country's ability to exert some market power in international trade by imposing a corporate income tax. As shown in Melvin (1982) and Gravelle and Smetters (2006), domestic labor's share of the tax burden can be lower when the domestic country has such market power. However, if production of the imperfect substitutes is instead less capital-intensive than production of the other tradable corporate outputs, the tariff-

like effects of the corporate income tax are reversed: The tax shifts national incomes toward foreign residents and increases domestic labor's burden.

This study also examines how replacement of the corporate income tax by any of four alternative taxes would affect the distribution of tax burdens:

- Replacement by a general tax on income generated by the use of capital within all domestic sectors – a tax that does not distinguish between corporate and noncorporate investments – shifts about 13 percent of the tax burden away from domestic labor toward domestic capital owners.
- Replacement by a tax on domestic labor income shifts the entire domestic resident capital owners' burden toward domestic labor. That shift increases domestic labor's share of the burden by about 26 percent of the tax revenue.
- Replacement by a tax on the worldwide capital income of domestic residents – a tax that achieves capital export neutrality – shifts the entire amount of domestic labor's burden toward the domestic owners of capital. That shift increases the domestic resident capital owners' share of the burden by about 68 percent of the tax revenue. Worldwide, both labor and capital owners benefit slightly from an increased investment efficiency under that replacement tax, but the largest changes are in the redistribution of tax burdens toward the domestic owners of capital away from domestic labor, and away from foreign owners of capital toward foreign labor.
- Replacement by any of the last three domestic personal taxes would eliminate foreign labor's benefit and the foreign resident capital owners' burden, equal to about 70 percent of the tax revenue.

The model does not provide a theory of international tax competition, but its predictions offer insights into how the tax burdens are redistributed when more than one country imposes a corporate income tax. When more countries impose the tax, the international effects are less pronounced on average within those taxing countries and more pronounced within the other countries, the tax havens. If the tax havens account for only a small share of world production, labor's burden is also small on average for residents of the countries that are not tax havens. But labor's benefit can be large on average for residents of the tax havens. The benefit from reducing the tax can also be large at the margin for workers resident in any small country that is not a tax haven. That marginal benefit equals the difference between labor's burden from residing in a country that is not a tax haven and labor's benefit from residing in a tax haven. When countries are added to the tax-haven group, the average corporate tax burdens within the existing tax-haven countries are shifted toward workers and away from their resident capital owners. As more countries become tax havens, workers living in the countries that are not tax havens acquire an increasing average share of the burden. The average burdens are reduced for capital owners in those countries. For a country at the margin of deciding whether to impose or change the corporate income tax, however, it makes almost no difference to domestic residents whether other countries impose corporate income taxes.

Appendix: Other Studies

Harberger

The model developed in this study is based on Harberger (1995), but the results appear quite different from that study. That earlier study predicted that "labor will bear 2 to 2½ times the full burden of the U.S." corporate income tax.³⁸ This study predicts that domestic labor would bear about 74 percent of the corporate income tax under share assumptions appropriate for the U.S. economy. The wide gap between those predictions is explained partly by a difference in assumptions about capital intensities and output shares. But most of the difference arises because the burdens are measured differently. The Harberger (1995) conclusion is based only on changes in the sources of income, whereas this study combines the effects on both sources and uses. A recent study by Harberger (2006) concludes that domestic labor bears 96 percent of the burden. That study reaches a conclusion different from Harberger (1995) mainly because the later study combines the effects on both sources and uses in its measure of burden, but also because the later study makes slightly different assumptions about the U.S. economy.

Harberger (1995) does not fully specify the capital intensities and output share assumptions necessary to examine the effects on both sources and uses. However, the capital intensities and output shares can be specified in a way that is consistent with Harberger's (1995) assumptions: that labor employed in the first two sectors accounts for one-fourth of the domestic labor force; that capital used in the first two sectors accounts for one-half of all capital used in the corporate sectors; and that domestic capital accounts for three-eighths of the world's capital stock. Otherwise, the parameter values (Table A1) have been completed with share assumptions

³⁸ Harberger (1995), p. 65.

made by Gravelle and Smetters (2006), most critical of which is the assumption that labor receives about 70 percent of the value of total output. Compared to the base case in this study (Table 1), the capital intensity is assumed to be higher in the first two sectors (manufacturing). Also, in contrast to the base case, sector three (utilities) is assumed to be less capital intensive than the first two sectors.³⁹

The Harberger (1995) results can be reproduced for a very small economy when the tax rate is infinitesimal (Table A2). Focusing only on the sources of income, domestic labor bears 200 percent of the burden of the corporate income tax. However, the domestic consumer's benefit equals 95.8 percent of the tax revenue, so when the sources and uses are combined, domestic labor bears only 132.9 percent of the burden – still a very large share. But the source-side measure of burden has little meaning by itself. As discussed in an earlier section of this study, the source-side measure is meaningful only if it is combined with the other domestic source-side burdens as a way of measuring changes in the relative distribution of income paid to different domestic factor owners. Further, the source-side burden cannot be compared directly to the source-side burdens of foreign residents because domestic and foreign consumer prices change by different amounts.⁴⁰ The relative real incomes of foreign and domestic residents are therefore functions of those different changes in consumer prices.

When the effects on sources and uses are combined, predictions about burdens of the corporate income tax are not changed substantially by the assumptions in Table A1 (compared

³⁹ Alternatively, the first three sectors can be assumed to have the same relative capital intensities as in Table 1, but the capital intensity of sector five must be much lower for the Harberger (1995) assumptions to be satisfied. Either way, those assumptions do not appear to be reasonable for the U.S. economy. Sector three includes utilities and transportation, both of which are more capital-intensive than the manufacturing in sectors one and two. Sector five includes housing and retail services, for which production is much more capital intensive than manufacturing.
⁴⁰ Under the assumptions in Table A1, the domestic consumer's burden is -95.8 percent of the revenue, while the foreign consumer's burden is -0.04 percent of the revenue.

with Table 1). When the domestic economy equals 37.5 percent of the world economy and the tax rate equals 6.25 percent, the combined measures of burden (Table A2) under the assumptions in Table A1 are much closer to the burdens predicted under the assumptions of the base case in this study (Table 1). Under the assumptions consistent with Harberger's (1995) application, domestic labor bears 87.1 percent of the burden. Domestic capital owners bear 21.3 percent of the tax. Although 87.1 percent and 73.7 percent are different, both numbers imply that domestic labor bears most, but not more than 100 percent, of the corporate income tax.

Harberger (1995, 2006) assumes that worldwide capital income is reduced by exactly 100 percent of the revenue from the corporate income tax. However, although capital owners worldwide bear slightly more than 100 percent of the corporate tax burden when effects on both the sources and uses of income are combined, that outcome does not occur when the measure of burden is based only on the sources. According to Equation (4), the reduction in worldwide capital income would not generally equal 100 percent of the revenue when the corporate income tax is imposed only on some domestic sectors. Under the assumptions (Table A1) consistent with Harberger (1995), worldwide capital income is reduced by 133.4 percent (50 percent + 83.4 percent) of the revenue when the 6.25 percent corporate income tax is imposed in the large economy (Table A2). Remarkably, when effects on the sources and uses of income are combined, capital owners worldwide bear 104.6 percent of the burden (21.3 percent + 83.3 percent).

According to Equation (14), the 100 percent share assumption made by Harberger (1995, 2006) would be true for a small general tax on capital imposed on all domestic sectors. Under the general replacement tax (not shown in Table A2) imposed in the large economy, worldwide

capital income falls by 101.6 percent of the revenue regardless of whether the sources and uses are combined in the measure of tax burden. The worldwide excess burden from that tax is 1.6 percent of the revenue.

For comparison, under the share assumptions from Table 1, worldwide capital income falls by 119.3 percent (35.8 percent + 83.5 percent) of the revenue when the 6.25 percent corporate income tax is imposed in the large economy (Table A2). Capital owners worldwide bear 104.7 percent (32.5 percent + 72.2 percent) of the burden when sources and uses are combined. Under the general replacement tax imposed in the large economy (not shown in Table A2), worldwide capital income falls by 102.5 percent of the revenue regardless of whether sources and uses are combined.

Gravelle and Smetters

Under the basic assumptions, the numerical results of this study are very close to the results in Gravelle and Smetters (2006) when those authors assume that international capital mobility is perfect, and that there is a nearly perfect demand substitution between the domestic and foreign internationally tradeable goods produced in the corporate sector. In that case, their simulations predict that domestic labor bears 73 percent of the burden, domestic capital owners bear 35 percent, foreign capital owners bears 67 percent, foreign labor bears -69 percent, and the worldwide excess burden equals about 5 percent of the revenue.⁴¹ In the base case (Table 3), the model used in this study predicts that domestic labor bears 74 percent, domestic capital owners

⁴¹ Gravelle and Smetters, Table 2.

bear 33 percent, foreign capital owners bear 72 percent, foreign labor bears -71 percent, and the excess burden equals about 4 percent of the revenue.

It is not surprising that the results of the two studies are so close. Even though the model applied in this study has an additional sector (sector one), the predictions should approximate the Gravelle and Smetters model when the tax rate is small and the authors assume that capital mobility is perfect and the internationally traded corporate goods are perfect substitutes. Further, both studies make the same assumptions about the sizes of sectors and the intensities of factor inputs.⁴²

The two studies produce very different results when there is a low degree of demand substitution between the foreign and domestic corporate tradeable goods. In that case, the predictions of the five-sector model used in this study do not depend directly on that degree of demand substitutability.⁴³ In contrast, the four sector model used by Gravelle and Smetters predicts that labor bears only 21 percent of the burden if capital is perfectly mobile and the international output demand substitution elasticity equals 1.

How the output demand substitution elasticity affects the predictions of the four sector model of Gravelle and Smetters can be readily understood in terms of the five-sector model used in this study. First, suppose that sector one of the five-sector model produces no output, and that sector four (agriculture) produces the numeraire. Now, the wage rate is determined in sector two. Unlike the base case in this study, both the domestic sector two output price and the domestic

⁴² Other assumptions might differ slightly between the studies, but the effects of those assumptions appear to be small. For example, when the partial substitution elasticity between capital and labor is increased to equal 1, the model used in this study predicts that the excess burden will equal about 6 percent; the burden shares are virtually unaffected.

⁴³ The only exception occurs if the demand substitution is (nearly) perfect and the capital intensities differ in the first two sectors. In that event, the more capital-intensive domestic sector will stop producing in response to the corporate tax; the foreign country will produce all of that good. The domestic wage rate will be determined in the remaining domestic corporate tradeable sector.

wage rate can change when the corporate cost of capital is increased by the tax. If the demand substitution elasticity between the foreign and domestic corporate tradable goods is very high, the domestic wage rate must fall sufficiently to fully offset an increase in the corporate cost of capital, as in the five-sector economy. However, if the demand substitution elasticity is small, the domestic output price can increase in sector two. In that case, the domestic wage rate does not have to fall as much in order to offset the increased corporate cost of capital. Domestic consumer prices will increase compared to equilibria when the demand substitution elasticity is high, offset somewhat by improved international terms of trade for the domestic economy. However, the real burden for domestic labor will be smaller than when the output demand substitution elasticity is higher. Further, because that demand substitution elasticity does not affect the international allocation of capital, domestic capital owners will bear a slightly larger burden because they will have to pay higher consumer prices than when the demand substitution elasticity is higher.

When the demand substitution elasticity is low for outputs of the corporate tradable sector, each country has some potential market power in international trade, even though competition is perfect at the level of the individual firm. In part, the domestic corporate tax can act like a domestic tariff on exports from the corporate sector. Under either the corporate tax or such a tariff, the domestic national income is increased at the expense of a decrease in the foreign national income. Domestic capital owners still earn roughly the same nominal return under the corporate tax as when the demand substitution elasticity is higher, but they must pay higher consumer prices, so the domestic capital owners' burden is higher when the substitution elasticity is lower. Domestic labor's burden is decreased by the rise in domestic national income when the

substitution elasticity is low. When the output demand substitution and capital mobility are perfect, foreign residents overall do not bear any burden of the tax. However, when the output demand substitution elasticity is only 1, the Gravelle and Smetters model predicts that the tariff-like effect allows the domestic economy to export about half of the total burden of its corporate income tax to foreigners.

The Gravelle and Smetters model, in effect, allows the authors to measure how the corporate tax might affect the distribution of burdens through its effects on international trade when the domestic country has some world monopoly power. The analysis in this study indicates that the trade effects and burdens will be different when there are additional corporate sectors that produce goods with higher rates of output demand substitutability between the domestic and foreign varieties. A recent study by Erkel-Rousse and Mirza (2002) estimated import price elasticities based on bilateral trade equations. They estimate larger elasticities for certain products such as rubber (-6.5) and non-metallic products (-6.6) than for other products such as beverages (-1.7) and food products (-1.0). Further, even their average elasticity estimate is fairly large: They estimate an average elasticity of -3.8 for all industries. Reasonable long-run elasticities are likely to be even larger.⁴⁴

⁴⁴ See also McDaniell and Balistreri (2003) for a survey of trade elasticities.

Table 1: Initial Assumptions

	Share of Value Added in Sector			Share of Output
	Labor	Capital	Land	
Corporate Sectors				
Sectors 1 and 2: Tradeable	82%	18%	...	28%
Sector 3: Nontradeable	76%	24%	...	45%
Non-Corporate Sectors				
Sector 4: Tradeable, agriculture	49%	17%	34%	3%
Sector 5: Nontradeable	47%	53%	...	24%
Total	70%	29%	1%	100%
Domestic economy's share of world output		30%		
Domestic ownership share of world capital		30%		
Partial elasticity of substitution, capital and labor		0.6		

Source: Based on Gravelle and Smetters (2006).

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Table 2: Economic Changes under Corporate and General Taxes

	Corporate Tax		General Tax	
	Domestic	Foreign	Domestic	Foreign
Tax rate (tax-exclusive)				
Corporate sectors	6.25%	0.0%	3.35%	0.0%
Noncorporate sectors	0.0%	0.0%	3.35%	0.0%
Capital stock changes				
Corporate sectors	-3.7%	0.85%	-1.7%	0.73%
Noncorporate sectors	0.036%	0.85%	-1.7%	0.73%
Total (weighted by capital shares)	-2.0%	0.85%	-1.7%	0.73%
Input price changes				
<u>Cost of capital</u>				
Corporate sectors	5.0%	-1.2%	2.3%	-0.99%
Noncorporate sectors	-1.2%	-1.2%	2.3%	-0.99%
Wage rate	-1.1%	0.25%	-0.51%	0.22%
Land rent	2.2%	0.21%	-0.43%	0.18%
Consumer price changes				
<u>Corporate sectors</u>				
Sector 1: Tradeable, numeraire	0.0%	0.0%	0.0%	0.0%
Sector 2: Tradeable, unique	0.0%	0.0%	0.0%	0.0%
Sector 3: Nontradeable	0.37%	-0.085%	0.17%	-0.07%
<u>Non-corporate sectors</u>				
Sector 4: Tradeable, agriculture	0.0%	0.0%	0.0%	0.0%
Sector 5: Nontradeable	-1.1%	-0.5%	0.99%	-0.42%
Total (Laspeyres)	-0.11%	-0.16%	0.31%	-0.13%
Private income changes (real)				
Labor	-0.99%	0.41%	-0.82%	0.35%
Capital	-1.1%	-1.0%	-1.3%	-0.86%
Land	2.3%	0.37%	-0.74%	0.32%
Total (weighted by income shares)	-0.978%	0.00%	-0.963%	0.00%
Tax revenue (percentage of output)	0.944%	0.00%	0.944%	0.00%
National income (percentage of revenue)	-3.70%	0.00%	-2.05%	0.00%
Worldwide income (percentage of revenue)	-3.70%		-2.05%	

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Table 3: Burdens of the Corporate Income Tax

	Labor	Capital	Land	Total
Domestic Taxes on Capital Income at Producer Level; Burdens as Shares of Revenue				
<u>Corporate Tax</u>				
Domestic	73.7%	32.5%	-2.5%	103.7%
Foreign	-71.3%	72.2%	-0.9%	0.0%
Worldwide	2.4%	104.7%	-3.4%	103.7%
<u>General Tax</u>				
Domestic	61.0%	40.3%	0.8%	102.0%
Foreign	-61.0%	61.8%	-0.8%	0.0%
Worldwide	0.0%	102.0%	0.0%	102.0%
Replacement Taxes; Differential Burdens as Shares of Revenue				
<u>General Tax</u>				
Domestic	-12.7%	7.8%	3.3%	-1.7%
Foreign	10.3%	-10.4%	0.1%	0.0%
Worldwide	-2.4%	-2.7%	3.4%	-1.7%
<u>Domestic Labor Income</u>				
Domestic	26.3%	-32.5%	2.5%	-3.7%
Foreign	71.3%	-72.2%	0.9%	0.0%
Worldwide	97.6%	-104.7%	3.4%	-3.7%
<u>Worldwide Capital Income of Domestic Residents</u>				
Domestic	-73.7%	67.5%	2.5%	-3.7%
Foreign	71.3%	-72.2%	0.9%	0.0%
Worldwide	-2.4%	-4.7%	3.4%	-3.7%
<u>Domestic Personal Income or Consumption</u>				
Domestic	-3.8%	-3.4%	3.5%	-3.7%
Foreign	71.3%	-72.2%	0.9%	0.0%
Worldwide	67.5%	-75.6%	4.4%	-3.7%

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Table 4: Burdens of the Corporate Income Tax at an Infinitesimal Tax Rate

	Labor	Capital	Land	Total
Domestic Taxes on Capital Income at Producer Level; Burdens as Shares of Revenue				
<u>Corporate Tax</u>				
Domestic	71.0%	31.3%	-2.4%	100.0%
Foreign	-68.7%	69.6%	-0.9%	0.0%
Worldwide	2.3%	101.0%	-3.3%	100.0%
<u>General Tax</u>				
Domestic	59.7%	39.5%	0.8%	100.0%
Foreign	-59.7%	60.5%	-0.8%	0.0%
Worldwide	0.0%	100.0%	0.0%	100.0%
Replacement Taxes; Differential Burdens as Shares of Revenue				
<u>General Tax</u>				
Domestic	-11.3%	8.1%	3.2%	0.0%
Foreign	9.0%	-9.1%	0.1%	0.0%
Worldwide	-2.3%	-1.0%	3.3%	0.0%
<u>Domestic Labor Income</u>				
Domestic	29.0%	-31.3%	2.4%	0.0%
Foreign	68.7%	-69.6%	0.9%	0.0%
Worldwide	97.7%	-101.0%	3.3%	0.0%
<u>Worldwide Capital Income of Domestic Residents</u>				
Domestic	-71.0%	68.7%	2.4%	0.0%
Foreign	68.7%	-69.6%	0.9%	0.0%
Worldwide	-2.3%	-1.0%	3.3%	0.0%
<u>Domestic Personal Income or Consumption</u>				
Domestic	-1.1%	-2.3%	3.4%	0.0%
Foreign	68.7%	-69.6%	0.9%	0.0%
Worldwide	67.6%	-71.9%	4.3%	0.0%

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Table 5: International Spillover Effects of a Domestic Corporate Income Tax

	Burden as a Share of Revenue			
	Labor	Capital	Land	Total
Base Case (from Table 3)				
Domestic	73.7%	32.5%	-2.5%	103.7%
Foreign	-71.3%	72.2%	-0.9%	-0.0%
Worldwide	2.4%	104.7%	-3.4%	103.7%
Domestic Country is a Net International Lender				
Domestic	73.7%	37.9%	-2.5%	109.1%
Foreign	-71.3%	67.0%	-0.9%	-5.2%
Worldwide	2.4%	105.0%	-3.4%	104.0%
Domestic Country is a Net International Borrower				
Domestic	73.7%	27.1%	-2.5%	98.3%
Foreign	-71.3%	77.4%	-0.9%	5.2%
Worldwide	2.4%	104.4%	-3.4%	103.4%
Sector 2 is More Capital-Intensive than Sector 1				
Domestic	59.0%	37.5%	-1.6%	94.9%
Foreign	-57.0%	67.0%	-1.3%	8.7%
Worldwide	2.0%	104.5%	-2.9%	103.7%
Sector 2 is Less Capital-Intensive than Sector 1				
Domestic	90.6%	26.7%	-3.5%	113.9%
Foreign	-87.8%	78.2%	-0.5%	-10.1%
Worldwide	2.8%	104.9%	-4.0%	103.7%

Table 6: Economic Changes under a Corporate Income Tax When Capital Intensities Differ

	Capital Intensity in Sector Two Compared with Sector One					
	Same Intensity		Higher Intensity		Lower Intensity	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
Tax rate (tax-exclusive)						
Corporate sectors	6.25%	0.00%	6.25%	0.00%	6.25%	0.00%
Non-corporate sectors	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Capital stock changes						
Corporate sectors	-3.67%	0.85%	-3.46%	0.76%	-3.92%	0.96%
Noncorporate sectors	0.04%	0.85%	0.25%	0.76%	-0.21%	0.96%
Total (weighted by capital shares)	-1.98%	0.85%	-1.77%	0.76%	-2.23%	0.96%
Input price changes						
<u>Cost of capital</u>						
Corporate sectors	5.02%	-1.16%	5.07%	-1.11%	4.96%	-1.21%
Noncorporate sectors	-1.16%	-1.16%	-1.11%	-1.11%	-1.21%	-1.21%
Wage rate	-1.10%	0.25%	-0.69%	0.15%	-1.57%	0.38%
Land rent	2.17%	0.21%	1.55%	0.34%	2.86%	0.05%
Consumer price changes						
<u>Corporate sectors</u>						
Sector 1: Tradeable, numeraire	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sector 2: Tradeable, unique	0.00%	0.00%	0.46%	-0.10%	-0.52%	0.13%
Sector 3: Nontradeable	0.37%	-0.08%	0.69%	-0.15%	0.00%	0.00%
<u>Non-corporate sectors</u>						
Sector 4: Tradeable, agriculture	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sector 5: Nontradeable	-1.13%	-0.50%	-0.91%	-0.52%	-1.38%	-0.46%
Total (Laspeyres)	-0.11%	-0.16%	0.11%	-0.18%	-0.35%	-0.13%
Private income changes (real)						
Labor	-0.99%	0.41%	-0.80%	0.33%	-1.22%	0.51%
Capital	-1.05%	-1.00%	-1.22%	-0.93%	-0.87%	-1.09%
Land	2.27%	0.37%	1.45%	0.52%	3.21%	0.18%
Total (weighted by income shares)	-0.98%	0.00%	-0.90%	-0.04%	-1.07%	0.04%
Tax revenue (percentage of output)						
National income (percentage of revenue)	0.94%	0.00%	0.94%	0.00%	0.94%	0.00%
Worldwide income (percentage of revenue)	-3.70%	0.00%	5.06%	-8.75%	-13.85%	10.13%
	-3.70%		-3.69%		-3.72%	

Table 7: Corporate Tax Burden Shares and Relative Economy Size, Burdens Measured on an Aggregate Basis^a

	Share of World Output	Burden as a Share of Revenue			Total
		Labor	Capital	Land	
Domestic	1%	104.3%	2.6%	-2.1%	104.8%
Foreign	99%	-101.9%	103.2%	-1.3%	0.0%
Domestic	5%	100.0%	6.8%	-2.1%	104.7%
Foreign	95%	-97.6%	98.9%	-1.3%	0.0%
Domestic	10%	94.7%	12.0%	-2.2%	104.5%
Foreign	90%	-92.3%	93.5%	-1.2%	0.0%
Domestic	20%	84.1%	22.3%	-2.3%	104.1%
Foreign	80%	-81.7%	82.8%	-1.1%	0.0%
Domestic	30%	73.7%	32.5%	-2.5%	103.7%
Foreign	70%	-71.3%	72.2%	-0.9%	0.0%
Domestic	50%	52.9%	52.7%	-2.7%	103.0%
Foreign	50%	-50.5%	51.2%	-0.7%	0.0%
Domestic	70%	32.5%	72.7%	-3.0%	102.2%
Foreign	30%	-30.1%	30.5%	-0.4%	0.0%
Domestic	90%	12.3%	92.4%	-3.2%	101.5%
Foreign	10%	-10.0%	10.1%	-0.1%	0.0%
Domestic	~100%	2.3%	102.2%	-3.3%	101.2%
Foreign	~0%	0.0%	0.0%	0.0%	0.0%

^a Total burdens divided by total domestic revenue

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Table 8: Corporate Tax Burden Shares and Relative Economy Size, Burdens Measured on a Per Capita Basis^a

	Share of World Output	Per Capita Burden Shares			Total
		Labor	Capital	Land	
Domestic	1%	104.3%	2.6%	-2.1%	104.8%
Foreign	99%	-1.0%	1.0%	0.0%	0.0%
Domestic	5%	100.0%	6.8%	-2.1%	104.7%
Foreign	95%	-5.1%	5.2%	-0.1%	0.0%
Domestic	10%	94.7%	12.0%	-2.2%	104.5%
Foreign	90%	-10.3%	10.4%	-0.1%	0.0%
Domestic	20%	84.1%	22.3%	-2.3%	104.1%
Foreign	80%	-20.4%	20.7%	-0.3%	0.0%
Domestic	30%	73.7%	32.5%	-2.5%	103.7%
Foreign	70%	-30.5%	30.9%	-0.4%	0.0%
Domestic	50%	52.9%	52.7%	-2.7%	103.0%
Foreign	50%	-50.5%	51.2%	-0.7%	0.0%
Domestic	70%	32.5%	72.7%	-3.0%	102.2%
Foreign	30%	-70.3%	71.2%	-0.9%	0.0%
Domestic	90%	12.3%	92.4%	-3.2%	101.5%
Foreign	10%	-89.7%	90.9%	-1.2%	0.0%
Domestic	~100%	2.3%	102.2%	-3.3%	101.2%
Foreign	~0%	0.0%	0.0%	0.0%	0.0%

^a Local per capita burdens divided by domestic per capita revenue.

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Table A1: Shares Consistent with Harberger (1995)

	Share of Value Added in Sector			Share of Output
	Labor	Capital	Land	
Corporate sectors				
Sectors 1 and 2: Tradeable	71%	29%	...	25%
Sector 3: Nontradeable	82%	18%	...	40%
Non-corporate sectors				
Sector 4: Tradeable, agriculture	49%	17%	34%	3%
Sector 5: Nontradeable	57%	43%	...	32%
Total	70%	29%	1%	100%
Domestic economy's share of world output		37.5%		
Domestic ownership share of world capital		37.5%		
Partial elasticity of substitution, capital and labor		0.6		

Sources: Based on Harberger (1995) and Gravelle and Smetters (2006).

Table A2: Reconciliation with Harberger (1995)

	Sources and Uses	Burden as a Share of Revenue			Total
		Labor	Capital	Land	
Small Economy, Infinitesimal Tax Rate, Shares from Table A1					
Domestic	separate	200.0%	0.0%	-4.2%	-95.8%
Foreign	separate	-129.3%	129.3%	0.4%	-0.4%
Domestic	combined	132.9%	-27.8%	-5.1%	...
Foreign	combined	-129.6%	129.2%	0.4%	...
Large Economy, 6.25 Percent Tax Rate, Shares from Table A1					
Domestic	separate	156.4%	50.0%	-4.1%	-99.1%
Foreign	separate	-83.4%	83.4%	0.3%	-0.3%
Domestic	combined	87.1%	21.3%	-5.1%	...
Foreign	combined	-83.6%	83.3%	0.3%	...
Large Economy, 6.25 Percent Tax Rate, Shares from Table 1					
Domestic	separate	81.6%	35.8%	-2.3%	-11.3%
Foreign	separate	-44.1%	83.5%	-0.5%	-38.9%
Domestic	combined	73.7%	32.5%	-2.5%	...
Foreign	combined	-71.3%	72.2%	-0.9%	...

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In addition to writing more than 90 scholarly articles in economics and finance, Professor Hubbard is the author of a leading textbook on money and financial markets. His commentaries have appeared in *Business Week*, the *Wall Street Journal*, the *New York Times*, the *Financial Times*, the *Washington Post*, *Nikkei* and the *Daily Yomiuri*, as well as on television (on PBS's *Nightly Business Report*) and radio (on NPR's *Marketplace*).

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Prior to joining GE in 1988, he was a partner in the law firm of Dewey, Ballantine in Washington, D.C. and New York City. From 1976 to 1981 Mr. Samuels served as the Deputy Tax Legislative Counsel and Tax Legislative Counsel of the U.S. Department of Treasury in Washington, D.C.

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Lawrence H. Summers

Lawrence H. Summers is Charles W. Eliot University Professor at Harvard University. He served as the 27th president of Harvard University from July 2001 until June 2006. From 1999 to 2001 he served as the U.S. Secretary of the Treasury following his earlier service as Deputy and Under Secretary of the Treasury and as Chief Economist of the World Bank. Prior to his service in Washington, Summers was a professor of economics at Harvard and MIT. His research contributions were recognized when he received the John Bates Clark Medal, given every two years to the outstanding American economist under the age of 40, and when he was the first social scientist to receive the National Science Foundation's Alan T. Waterman Award for outstanding scientific achievement. He is a member of the National Academy of Science. He received his BS from MIT and his PhD in economics from Harvard. Among his other activities, Lawrence Summers writes a monthly column for the *Financial Times*, coedits the *Brookings Papers on Economic Activity*, and serves as a managing director of D. E. Shaw, a major alternative investment firm. He also serves on a number of not-for-profit and for-profit boards.

Eric Toder

Eric Toder is a Senior Fellow at the Urban Institute and Urban-Brookings Tax Policy Center, where he specializes in retirement policy and tax policy issues. Between 2001 and 2004, he served as Director, National Headquarters Office of Research, at the Internal Revenue Service. Dr. Toder previously held a number of positions in tax policy offices in the U.S. government and overseas, including service as Deputy Assistant Secretary for Tax Analysis at the U.S. Treasury Department, Deputy Assistant Director for Tax Analysis at the Congressional Budget Office, and consultant to the New Zealand Treasury. He received his Ph.D. in economics from the University of Rochester in 1971.

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Alan D. Viard is a resident scholar at the American Enterprise Institute for Public Policy Research. Prior to joining AEI, Alan Viard was a senior economist at the Federal Reserve Bank of Dallas and an assistant professor of economics at Ohio State University. He has also worked for the Treasury Department's Office of Tax Analysis, the White House's Council of Economic Advisers, and the Joint Committee on Taxation of the U.S. Congress.