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Corporate Tax Incidence:

A Review of Empirical Estimates and Analysis

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Abstract

This paper reviews seven recent studies that have used empirical methods to examine the incidence of the corporate income tax. These regression-based studies follow three general approaches. The first group of studies uses the variation in corporate tax rates across countries to determine the effect of the tax on wages. A second group adopts the same approach, but uses the variation in corporate tax rates across U.S. states instead of focusing on cross-country differences. The third set of studies adopts wage bargaining models to analyze the effect of corporate taxes on wages. In some regards, the empirical approach offers advantages over the general equilibrium models usually used to analyze the incidence of the corporate tax, because the empirical studies are data driven and less rigid than the general equilibrium models. However, the empirical approach also has drawbacks: In order to fully account for the responses of labor and capital in general equilibrium, the reduced form regression analysis has to rely on aggregate data, which do not account adequately for the many factors that affect macro variables. In addition, each of the studies examined in this paper raises methodological concerns. As a consequence, the findings of the empirical studies seem inconsistent with observable data. General equilibrium models, which constrain results to the magnitudes of the economy, may be a more reliable source for specific estimates of the incidence of corporate tax than the empirical studies.

Introduction

The incidence of the corporate income tax has been the focus of intense study since its introduction in 1909. Fifty years ago, many economists analyzed the incidence of the corporate tax by using emerging regression techniques, but their studies yielded contradictory results. With the publication of Arnold Harberger's renowned study in 1962, general equilibrium models became the dominant method of analysis, and a consensus emerged that much of the burden of the corporate tax was borne by capital in a closed economy, in which none of economic sectors were involved in trade with other countries. As economies have become globalized, concern about whether that conclusion still holds within a large open economy has spurred new types of analysis. Some studies extend the general equilibrium models to an open economy setting.[1] With the release of at least seven empirical studies since 2007, there has also been a resurgence of the direct empirical approach to estimating the incidence of the corporate income tax.

The empirical papers fall into three categories. Some studies have taken advantage of data from different countries to conduct cross-country studies; those studies use the variation in corporate tax rates across different economies to identify the effect of the corporate tax on wages. A second set of studies has taken a similar approach, but compares state corporate tax rates rather than corporate tax rates across countries. Studies in the third category use cross-country data, but base the analysis of the corporate tax incidence on a bargaining model that assumes that firms and workers negotiate wages.

While none of the new empirical studies had been published in peer-reviewed journals at the time this review was written, most have been presented at research conferences. The appeal of the empirical approach is obvious. First, an empirical methodology appears to provide real evidence of the incidence of the corporate tax—data from different countries or states are used in an attempt to isolate the effect of the corporate tax on labor and capital. Second, compared with general equilibrium models, empirical studies are less "rigid—with actual data from the experiences of different countries and states, the empirical studies are not constrained by assumptions about the scope of the country's economy or tax system.

[1] See Jennifer Gravelle, Corporate Tax Incidence: A Review of General Equilibrium Estimates and Analysis, Working Paper 2010-03 (Congressional Budget Office May 2010) for a review of the corporate tax incidence estimates generated by open economy general equilibrium models.

Another advantage of empirical studies is the ability to make determinations regarding the statistical significance of the results.

There are nevertheless disadvantages to relying on the empirical approach to study the incidence of the corporate tax. Empirical studies of the corporate income tax face challenges that are common to studies that rely on regression analysis; countries (and even states) may differ in fundamental – but unobservable – ways that affect workers' wages, and if omitted from the analysis measures of incidence may be distorted. For example, it is difficult to control for other features of a country's tax system that affect corporations and their workers; the reasons for changes in their corporate income tax rates may not always be observable. Focusing solely on changes in statutory tax rates would miss changes in other tax policy instruments that could offset the effect of the corporate tax rate change. There are also challenges that are unique to studies of the corporate income tax. In order to fully account for the responses of labor and capital in general equilibrium to changes in corporate income taxes, empirical studies must rely on aggregate measures of wages. However, the reliance on aggregate data increases the likelihood that many of the specific factors determining the wages for the country, or state, are omitted from the analysis.[2]

This paper examines the results from the new empirical approaches. It then compares the advantages and disadvantages of direct empirical analysis and general equilibrium modeling for determining the incidence of the current corporate income tax in a large open economy.

Cross Country Studies

Three recent studies – by Hassett and Mathur (2007), Felix (2007), and Desai, Foley, and Hines (2007) – combine data from the United States with observations from different countries in order to estimate the effect of corporate income taxes on wages. Those studies look not only at differences across

[2] Studies generally rely on measures of wages and not total compensation and thus may not measure fully the changes in total labor income.

countries but also over time – thus reflecting the reductions in corporate tax rates that have occurred in many countries since the mid-1980s.

The three studies face challenges common to all investigations that use cross-sectional data. First, correlation does not imply causation. The studies discussed below find a significant and negative association between wages and top corporate tax rates across countries and generally conclude that increases in those rates cause wages to fall. The finding of a relationship, however, does not necessarily imply that wages are "responsive" to corporate tax rates. For example, countries with a low-wage labor force—and thus a small tax base from earnings—may rely more heavily on taxing large multinational corporations in order to raise necessary revenues. Under those circumstances, corporate taxes and wages would be negatively correlated, but corporate tax rates would increase in response to lower wages, not the reverse.

A second concern is "omitted variable bias," which occurs when a key explanatory variable is left out of the analysis. For example, cultures, traditions, and attitudes may vary significantly among countries, and those differences may help explain why some countries are more prone than others to rely on corporate taxes as a revenue source. Quantifying those differences, however, is challenging. Some of the studies use panel data, and they control for country- or state-specific fixed differences to address that problem.

Some methodological issues are specific to the study of incidence. First, some studies use individual or firm level data. However, tax incidence is determined at the economy-wide level. In response to taxes, labor and capital move towards a new equilibrium that determines the overall wage rates and returns to capital in the country. Variations in wages for individuals or firms do not reflect the impact of taxes on wages; rather those wage differentials reflect other factors in markets that are not perfectly competitive, such as local monopoly power. Second, some of the studies ignore the role of other countries' tax systems. Theoretical studies of tax incidence suggest that in an open economy, the effects of a country's taxes on wage rates and returns to capital also depend on other countries' tax rates. For example, if the United States and a foreign country both have a 35 percent tax rate and the foreign country

cuts its tax rate to 25 percent, the foreign country would attract capital flows from the U.S. even though there was no change in the U.S. tax rate. Omitting changes in other countries' tax rates from the analysis can bias the estimate of the home country's tax incidence because of those cross-country effects. Moreover, incidence can vary across countries depending on elasticities, country size, and the capital intensity of the traded sector relative to the capital intensity of the country as a whole.[3]

Hassett and Mathur (2006)

Hassett and Mathur estimate the effect of corporate taxes on wages in manufacturing industries using cross-country data. Their data cover the period from 1981 to 2005 and includes 65 countries. Their basic estimation equation is:

$$\ln(w_a) = c + \beta_1 lnt + \beta_2 lnV + \beta_3 lnCPI + \beta_4 X$$

where w_a is the five year average of the hourly wage in manufacturing, t is the top statutory corporate tax rate, V is value added per worker, CPI is the consumer price index, and X represents a vector of other controls.[4] (The values of the independent variables are for the year at the beginning of the five-year period over which the average wage is calculated.) Hassett and Mathur convert the dependent variable from local currency to U.S. dollars using exchange rates and also include the CPI to control for the nominal values of the dependent variable. They control for other differences among countries and over time, including variables for such factors as level of schooling, degree of computerization, and extent of labor market regulations.[5] Dummy variables control for country fixed effects and time periods.

Hassett and Mathur estimate elasticities of wages to top statutory corporate tax rate ranging between -0.3 to -1.Thus, a 1 percent increase in corporate tax rates is associated with between a 0.3 and 1 percent decrease in wage rates. Those elasticity estimates drop to a range of -0.4 and -0.6 with alternative

[3] See Gravelle (2010) for a discussion of the implications of these factors on estimates of corporate tax incidence.
[4] Hassett and Mathur test different tax specifications, including the average effective and marginal effective corporate tax rates.
[5] Hassett and Mathur note that they tried other specifications, such as including the level of schooling, but do not provide the results from all specifications.

measures of corporate tax rates (including the average effective corporate tax rate and the marginal effective corporate tax rate).

As Gentry (2007) and Gravelle and Hungerford (2008) have noted, those findings show an exceptionally high elasticity and highlight one of the fundamental challenges of reduced form analysis—the lack of constraint on the magnitude of elasticity estimates.[6] To understand how unlikely large responses like those would be in the United States, first consider the analysis from the perspective of a small open economy. A small open economy (with a small corporate income tax) is the most likely case where the general equilibrium model predicts that 100 percent of the corporate tax burden falls on labor. That is, the change in total wages equals the change in total taxes:

$$Ldw = -rKdt$$

where L is (fixed) labor input, dw is change the wage rate, K is the capital stock, r is the return to capital, and dt is the change in the tax rate. That equation can be converted to a form consistent with the elasticity measure used by Hassett and Mathur:

$$dw/w = - (rKt/wL)*dt/t$$

Hassett and Mathur find that a .01 percentage change in the tax (dt/t) yields a percentage change in the wage rate (dw/w) of between -0.003 and -0.01 percent, or a wage elasticity ($e = - [(dw/w)/dt/t)]$) of between 0.3 and 1. However, this implies that in the small open economy model, the ratio of corporate tax revenues to labor income (rKt/wL) would have to be between 0.3 and 1. In 2007, corporate tax revenues were about 2.7 percent of the U.S. gross domestic product (GDP), and labor income was about 57 percent of GDP.[7] That would imply that e equals 0.047—significantly smaller than their lower value of 0.3. Thus, even if the United States were a small open economy with a small corporate tax— the most likely

[6] In those papers, Gentry (2007) and Gravelle and Hungerford (2008) review some of the recent empirical studies that are discussed in this paper.

[7] The estimate of labor income is an underestimate because it does not include self-employment income. While some self-employment income may represent a return on capital, a portion is comparable to compensation for services and should be included in a measure of labor income. Thus, any estimates of the wage effects will be lower-bound estimates. More generally, the omission of self-employment income and non-cash compensation from labor income is a weakness of many of the empirical studies that have examined the incidence of the corporate income tax.

scenario to yield a large corporate income tax burden falling on labor, the magnitudes of aggregate income and revenue would not support Hassett and Mathur's findings. Further, as general equilibrium models show, a larger open economy would not necessarily predict that 100 percent of the corporate income tax falls on labor. Because the United States is considered a large open economy, Hassett and Mathur's results are even more unlikely.

Another way to interpret their results is to look at the implications for the effect of a dollar increase in taxes on wages. Using their lowest estimate of 0.3 and the ratio of labor income to corporate tax revenues of 21.1, their results imply that a $1 increase in corporate taxes would decrease wages by $6.33. That result implies that an extraordinarily large share (over 630 percent) of the burden falls on labor.[8]

Those types of anomalous findings are possibly an unintended consequence of the direct empirical approach used by Hassett and Mathur. Unlike general equilibrium models, which can be empirically calibrated to the economy being modeled, reduced form models are not constrained by actual features of the economy. Hassett and Mathur's results would be consistent with a country in which the corporate tax revenue (rKt) was nearly the same share of GDP as total labor income. Even using their lowest estimate, corporate tax revenues would have to account for nearly a third of the share of GDP that is accounted for by labor income. Ultimately, the models may be picking up a spurious correlation over time and across countries. For example, in general, countries experiencing growth in wages and GDP may regularly cut corporate income taxes in response to favorable economic conditions.

Hassett and Mathur's results are also not robust to changes in the model specification. Gravelle and Hungerford replicate Hassett and Mathur's study, and in the process, identified several statistical drawbacks with the analysis. One drawback is Hassett and Mathur's use of exchange rates as an indicator of the relative buying power (and as the method for converting foreign wages into U.S. dollars). Those rates reflect the supply and demand for countries' currencies, not necessarily the relative buying power of

[8] The incidence estimate uses labor income as a share of GDP, but this share excludes self-employment income as well as indirect taxes and thus the incidence share is underestimated.

wages in the countries. Exchange rates can also be affected by other forces, such as the financial markets or government policies. After replicating Hassett and Mathur's results, Gravelle and Hungerford test their robustness by using purchasing power parity (both in current and constant dollars), which measures the relative value of currency or what the currency can buy in different countries.[9] Those adjustments reduce both the significance and size of the estimates. In particular, for specifications using the effective average and marginal tax rates as measures of corporate tax rates, when measures of purchasing power parity are substituted for currency conversion, the resulting estimates are not statistically significant at conventional levels.[10]

Felix (2007)

Felix takes a similar approach to that used by Hassett and Mathur, but presents additional estimates that include variables controlling for differences in education levels among countries. Felix estimates that a 10 percent increase in the corporate income tax would reduce gross wages by seven percent. As noted in the earlier discussion of Hassett and Mathur's estimates, a value that large is inconsistent with corporate income taxes and labor income in the United States. When Felix controls for education, the estimated wage elasticity to the corporate income tax declines to about 0.4. While that result is at the lower end of the range of Hassett's and Mathur's estimates, it is still large based on the magnitudes of corporate income tax revenues and labor income in the United States. The results are not robust, varying with magnitude and significance depending on the specification.

Felix's limited data set makes analysis difficult. While she obtained data for 19 countries covering the period between 1979 and to 2000, seven of those countries contain observations from only one or two

[9] For example, an exchange rate based on purchasing power parity might be based on a comparison of how much the same item—say, a Big Mac—costs in two different countries. In contrast, standard exchange rates are determined by how many dollars another currency can purchase.

[10] Another concern was the lack of complete data. Gravelle and Hungerford test the sensitivity of an earlier version of Hassett and Mathur's results to the method of averaging data for 5 years, by limiting the analysis to only those observations that had complete data for all five years. Elasticities decline as a result, and none of the new findings were significant.

years. Because there is only one year of data for a few of those countries, Felix is not able to control for fixed effects within countries to account for unobservable country characteristics. Additionally, only four countries (Belgium, Italy, Mexico, and the United States) have more than four years of data, and thus those countries dominate the observations.

Desai, Foley, and Hines (2007)

While the two preceding studies use aggregate data for each country, Desai, Foley, and Hines take a different approach by relying on data for separate firms to estimate the incidence of the corporate income tax. Their panel data follow American multinational firms operating in more than 50 countries between 1989 and 2004.[11] Their data set excludes observations from operations located in the United States.

The authors estimate the effect of corporate taxes on wages. The variable for corporate taxes is the ratio of aggregate foreign income tax payments to the sum of aggregate net income and foreign income tax payments. The wage rate is measured as the ratio of total employee compensation, including benefits, to the number of employees. They employ several specifications including annual cross-section estimates and panel estimates that control for country fixed effects.

Desai, Foley, and Hines derive estimates ranging between 45 and 75 percent of the burden of the corporate tax falling on labor. Their baseline case—which uses panel data and controls for country fixed effects —shows 57 percent of the burden falling on labor. Not controlling for country fixed effects increases the share of the burden falling on labor to 71 percent. Using annual cross-sectional data, the authors find that 69 percent of the burden fell on labor in 2004; that estimate drops to 49 percent when they do not control for the workforce's education. They obtain similar results using cross-sectional data from 1989, 1994, and 1999.

[11] The panel set includes data from as many as 52 firms. Because some firms do not appear to have complete data for the entire time span, the number of observations varies, depending on the specification of the estimating equation.

The findings are consistent with estimates of the ratio of the corporate tax burden on labor derived from general equilibrium models of open economies calibrated to the U.S. economy. However, Desai, Foley, and Hines make an assumption that is not compatible with the analysis of tax incidence in the economy.[12] They assume that prices of all goods remain fixed, but in an economy with a variety of firms and products, all prices of goods cannot be assumed to remain fixed—rather only one price can be deemed the numeraire. They argue that trade causes the prices of goods to be fixed and that all commodities have to sell at the same global price. However, our economy has numerous differentiated products and those products also differ from their foreign counterparts; thus, those diverse products can be sold at different prices.

The price restriction in the analytic model forces the burden allocated to capital and labor to equal the total tax burden. As has been shown by open economy general equilibrium models (Gravelle and Smetters, 2006, and Randolph, 2006), the tax burden falling on capital and labor does not have to sum to the total tax burden at the economy-wide level. Some of the tax burden can be either exported or imported, so that more or less than 100 percent of the tax is borne by the domestic country.

While that assumption is problematic at the economy-wide level, Desai, Foley, and Hines also apply the restriction at the firm level. Even though their observations are weighted averages of firms, those firms produce different products and assuming that each firm's price does not change is inconsistent with the ability of individual firms to have different capital intensities. Randolph has demonstrated that if the restriction that the burden allocation must equal the total tax burden exactly is eliminated, the analysis does not yield any statistically significant results.[13] More generally, the firm is not the appropriate unit of observation for assessing corporate tax incidence because changes in wages paid by a firm or the return on capital used by that firm would generally not equal the corporate taxes owed by the same firm.

[12] See Gravelle (2010) for a review of the corporate tax incidence estimates generated by open economy general equilibrium models.

[13] Bill Randolph made this argument in comments given at a conference at the American Enterprise Institute, March 17, 2008.

Cross State Studies

Recently, researchers have turned to data from individual states in the U.S. to estimate the incidence of the corporate income tax. Cross-state studies present many of the same challenges as cross-country studies and also raise some unique concerns. First, and perhaps most importantly, states use apportionment formulas to determine the amount of a multi-state firm's profits that were earned (and thus are taxable) in a given state. Apportionment formulas vary across states. One of the most common is a three factor formula that weighs the state's shares of sales, payroll, and property equally. The double factor formula is a variation of the first formula, with sales weighted twice. A third formula is based solely on sales.[14] Because of apportionment, it is very difficult to obtain an accurate measure of state corporate tax rates that can be used to estimate the incidence of that tax.

Using states as the unit of observation adds another layer of complexity to the analysis because state tax rates and other state variables may not be independent. Instead, those state variables may reflect national factors resulting from tax competition, mobility of workers, and shared social norms. State corporate tax incidence may not yield useful insights into the incidence of the federal tax because of differences in state and national economic conditions. For example, labor and capital are probably more mobile across state lines than over national borders. Additionally, products are probably more substitutable across state lines than internationally. Furthermore, state corporate taxes are quite small compared with the federal tax, and they may be much less of a factor in determining wages at the national level and across states than other forces, such as the history and culture of the state, and the characteristics of its population, or the demands for goods and services provided by the state. While there are limits to the application of the findings from states to the federal corporate tax, those results may still provide some useful information about state policies.

[14] http://www.taxadmin.org/fta/rate/apport.pdf

Felix (2009)

Felix (2009) uses data from the Current Population Survey (CPS), covering years 1977 to 2005, to estimate the tax incidence of state corporate tax rates. Her basic estimating equation is:

$$\ln(wage) = \alpha + \beta(tax\ variables) + \delta(individual\ characteristics) + \gamma(state\ characteristics) + \epsilon$$

The tax variable is the highest corporate statutory tax rate in the state, and the individual wage is calculated as annual salary divided by number of hours worked per year.[15] Felix controls for differences among individuals by including variables for age, gender, race, and education level. She also includes a number of state characteristics including the marginal state income tax rate calculated for each individual using National Bureau of Economic Research's TAXSIM model, the state sales tax rate, and controls for government services (although details on the measurement of that variable are not provided). However, she does not control for state fixed effects, even though the data set appears to contain sufficient observations to estimate that type of specification.

Felix finds that the corporate income tax is significantly and negatively correlated with wages and concludes that a 1 percentage point increase in the state corporate income tax rate would decrease wages by between .14 and .36 percent. These results translate into a wage elasticity of -0.0094 to -.024 and imply quite large burdens on labor. State corporate income tax revenues in 2007 were about 0.38 percent of GDP, and labor income was about 57 percent of GDP, yielding a ratio of labor income to corporate tax revenues of 150; using that ratio and the range of elasticities, a $1.00 increase in the state corporate income tax rate would decrease average hourly wages by $1.41 to $3.60, suggesting not only that 100 percent of the burden falls on labor, but also that up to 360 percent could fall on labor.[16]

Felix also looks at these results over time by using averages of the data for five different historical periods: 1977-1981, 1982-1986, 1987-1991, 1997-2001, and 2002-2005. She finds that the

[15] To compute the number of hours worked in a year, Felix takes the product of two variables reported in the CPS: the number of hours usually worked per week and the number of weeks worked.

[16] These amounts are also understated, due to the exclusion of self-employed income in calculating labor income as a share of GDP, and to the exclusion of fringe benefits.

corporate income tax effect on wages appears to have initially decreased and then risen, with a drop in the most recent period. Felix's findings in this study also contradict the results found in her paper with Hines (2009), discussed below.

Using the CPS presents certain challenges. One challenge is that individuals cannot be matched to the state in which they work but instead are matched to the state in which they live. For some large metropolitan areas, such as New York City or Washington, DC, residents may not necessarily work in the state in which they live and thus the corporate tax rates in their state of residence would not be applicable to the firms they work for. Thus ultimately, this paper is addressing the question of whether workers who reside in states with high or low corporate tax rates states earn high or low wages. A second drawback is that the CPS is not a panel data set; that is, it does not follow the same households over time. As a result, changes in wages across years may represent changes in the composition of the state's population. The estimates based on those different populations could reflect changes in the movement of individuals across states and may thus be unrelated to state corporate taxes.

Yet another challenge is the specification of the corporate income tax rate. Felix's analysis uses the highest statutory corporate income tax rate in each state, but due to state tax apportionment that tax rate may differ from what firms actually pay in state taxes. For example, Louisiana has one of the highest top corporate income tax rates. However, a firm that employs workers residing in Louisiana but sells all of their goods in other states would not pay any corporate taxes in Louisiana because that state apportions income subject to corporate income tax solely on the basis of where sales occur. Under those circumstances, there probably is little relationship between the low wages of the Louisiana workers and the high corporate tax rates in their home state.

As noted above, Felix's results are less extreme than some studies, but they still show very high correlation between high corporate income tax and lower wages. Given the ability for capital and products to move freely across states, there may be more ability for capital to escape the burden of the state corporate income tax. Similarly, mobile labor could also avoid the consequence of lower wages. However, it is uncertain that international mobility mirrors mobility across states. Thus the results of the

cross-state studies are probably not indicative of an overall measure of federal corporate income tax incidence.

Carroll (2009)

Like Felix, Carroll (2009) uses data from the states to test the tax incidence of the state corporate tax. Whereas Felix relied on data for individuals to estimate the effect of the state corporate tax on wages, Carroll uses pooled cross sectional data from the Bureau of Labor Statistics at the state level from 1970 to 2007 to better allow for general equilibrium effects. Carroll also relies on two different measures of the state corporate income tax rate: first, the top statutory rate (combining the federal and state corporate income tax rates) and second, an average corporate income tax rate (state corporate income tax collections divided by personal income). His measure of wages is average hourly earnings, which exclude the changes in employment levels that a measure of the wage bill would include. His basic estimation equation is:

$$\log(real\ average\ hourly\ earnings\ for\ production\ workers) =$$
$$\alpha + \beta \log(statutory\ corporate\ tax\ rate) + \gamma \log(average\ corporate\ income\ tax\ rate) +$$
$$\delta \log(real\ Gross\ State\ Product\ per\ worker) + \theta(control\ variables)$$

Carroll's analysis includes controls for the state share of population with at least a four-year college degree, the share of workforce that is unionized, the share of the population that is working age, and population density. His baseline specification also includes a five-year lag of the corporate income tax rates.

Carroll finds that a 1 percent increase in the statutory corporate income tax rate and in the average corporate income tax rate reduces production workers' wages by 0.138 percent and 0.014 percent, respectively. Based on the latter result, he finds that a $1 increase in the tax revenue would decrease wages by $2.50. Both results are significant within standard confidence intervals. Varying some of the assumptions—allowing for different lengths of lagged tax rates and averaging wages over five years—has

small effects on the coefficient estimate and the significance of the statutory rate variable, but does not change the estimates on the average tax rate.

Similar to Felix's estimates, Carroll's lowest elasticity estimate, which uses the average tax rate, suggests that a large share of the corporate tax burden (250 percent) would fall on labor. Again, while a standard closed economy model can result in 100 percent of the burden falling on labor, and depending on capital intensities it is theoretically possible for more than 100 percent of the burden to fall on labor in an open economy setting, such a large share is unprecedented among estimates from general equilibrium models.[17]

One concern with Carroll's analysis is the measurement of the average corporate tax rate. As noted above, he computes the average tax rate as the ratio of corporate income tax collections to personal income in the state. Because the denominator of that variable includes wage income, the negative relationship Carroll finds could simply reflect an increase in the wages of production workers; that is, an increase in the wages of production workers would raise personal income in the state, all else equal. Even if corporate tax collections do not change at the same time, the "average tax rate" would fall due to the rise in the denominator. Ultimately, this measure of a tax rate is endogenous with the dependent variable and is not a true measure of the corporate income tax rate.

Carroll's analysis has other limitations. He attempts to address the issue of formula apportionment by relying on the average state corporate tax rate, which is intended to capture the effects of changes in the statutory rate as well as changes in the definition of the tax base due to formula apportionment as well as other factors. However, as noted above, the average state corporate tax rate is not a true measure of the average corporate income tax rate. Even if the average tax rate had been measured accurately, that rate could increase—for example, if corporate income collections increased because the state's apportionment formula was changed to give greater weight to sales—without any change in the statutory corporate income tax rate. The statutory tax rate suffers from the same problems as

[17] Harberger (2006) estimated that 130 percent of the corporate tax was borne by labor in a model that assumed that the corporate sector was very capital intensive and was the sector that produced tradable goods. See Gravelle (2010) for a comparison of recent corporate tax burden estimates from general equilibrium models.

noted in Felix's analysis—it does not accurately represent the tax rate the corporation faces after apportionment. The focus on the wages of production workers makes it difficult to capture general equilibrium effects, because those effects would also flow through to nonproduction workers and their wages. Lastly, although the use of aggregate state level data helps identify general equilibrium effects, isolating the factors that affect wages at such a high level of aggregation is extremely difficult.

Bargaining Model Approaches

Among the recent empirical studies on the incidence of the corporate income tax, two studies—Arulampalam, Devereux, and Maffini (2011) and Felix and Hines (2009)—have taken a decidedly different approach. Those studies adopt a bargaining model approach to determining tax incidence, assuming that bargaining between the firm and the employees determines wages. That approach suggests that corporate taxes could affect wages by a mechanism other than the general equilibrium forces on the supply and demand of labor and capital.

There are some general limitations to relying on a bargaining model approach to determining tax incidence. Van Reenen (1996) observes that employees and employers rarely engage in direct bargaining over wages. Rather, bargaining may be more likely to occur between organized groups of unionized workers and their employers over contracts for a fixed period of time or covering total compensation and working conditions.

If we expect that bargaining happens due to the presence of unions and not because individuals try to negotiate on their own, then the results from the bargaining models used by Arulampalam, Devereux, and Maffini and Felix and Hines have a limited application because relatively few U.S. workers belong to a union. In 2009, only about 12 percent of wage and salary workers belonged to a union. (That percentage increases to 13.7 percent if workers who are not affiliated with a union but whose jobs are covered by a union contract are included in the counts.) Moreover, union membership is much more prevalent among public service employees than among private sector workers: 37 percent of public

sector employees are members of a union, compared with 7 percent of private sector workers.[18] Arulampalam, Devereux, and Maffini do not provide a mechanism in their analysis that would explain how an individual who may not belong to a union engages in bargaining with his or her employer. To the extent that Felix and Hines focus their empirical analysis on union labor, the analysis relates to a narrow section of the labor force.

In addition, these approaches assume that a large share of firms are not competitive and thus earn excess profits or rents (profit over the normal required return) over which firms and workers bargain. While it is unlikely that all industries function in perfectly competitive markets, not all of those industries will necessarily generate continual levels of excess profits. For example, the volatile airline industry is not viewed as perfectly competitive, but its firms do not consistently maintain excess profits.[19] Moreover, the application of the bargaining approach presumes that the excess profit firms must use organized labor and thus must bargain away the excess profits and taxes with unions. Given the low rates of union membership in private industry, it is hard to imagine that firms with excess profits necessarily rely on union labor. Firms that have excess profits and are not forced to share with labor may absorb the corporate income tax by reductions in the firm's return to equity.

Lastly, the analysis is not a general equilibrium analysis of the tax incidence, but a partial analysis of one method through which adjustments to a tax may be made. As the authors of these studies note, no attempt is made to account for the standard forces determining tax incidence—changes in the relative supply and demand of factors used in the taxed sector. Care must be taken not to infer an estimate of the long-run economy-wide tax incidence from the results of these studies. Even if we assume that all the firms that use union labor are those that also have excess profits, these workers still account for a very small portion of the labor force. Tax incidence is determined on a large market scale, not at the individual firm level. It is determined by changes in the supply and demand for capital and labor that affect the rates of returns and wages. Localized absorption of part of a tax via a reduction in the union premium on wages

[18] http://www.bls.gov/news.release/union2.nr0.htm

[19] Borenstein and Rose (2007) provide an overview of airline industry and market structure.

cannot be expanded to general incidence on labor. Felix and Hines are more explicit about the limitations of their analysis, in that they admit that their results are limited to the tax incidence on union labor. In addition, however, their results do not fully measure the long-run incidence of the corporate tax on union wages because they do not account for potential shifts in the demand for union labor–for example, if firms replace union labor with non-union labor or substitute capital for labor.

Arulampalam, Devereux, and Maffini (2011)

Arulampalam, Devereux, and Maffini (2011) construct a model in which the wage rate, *w*, and the size of the labor force, *N*, are determined through bargaining between the firm and the workers in the company. The firm makes unilateral decisions regarding the size of the capital stock, *K*. Both workers and the firm have alternative opportunities: employees can quit and either take a new job or receive unemployment benefits, while firms can move the capital to another location. The wage rate, then, depends on the amounts that workers could earn outside the firm and that firms could earn at that location, as well as other locations.

Generally, they find that the wage is a weighted average of the outside wage and a share of the after-tax profit per employee, excluding the amount that the firm could earn at another location. The equation is:

$$w = \mu\overline{w} + (1-\mu)\left[\frac{F(K,N) - (1-m)rK}{N} - \frac{t\emptyset}{(1-t)N} - \frac{\pi *}{(1-t)N}\right]$$

where *w* is the wage rate, μ is the bargaining power of the firm (and $1\text{-}\mu$ is the bargaining power of labor), and $\overline{w}$ is the wage rate at other jobs (or unemployment benefits). The second term in the equation:

$$\left[\frac{F(K,N)-(1-m)rK}{N} - \frac{t\emptyset}{(1-t)N} - \frac{\pi *}{(1-t)N}\right]$$

measures after-tax profit per employee, which is disaggregated into gross profit net of the tax on nondeductible capital expenditures, the effective tax per employee, and the firm's potential profit at another location. Specifically, the first term in the brackets:

$$\left(\frac{F(K,N)-(1-m)rK}{N}\right)$$

is the amount of profit (gross of wages) per employee, where *K* is the capital stock, *N* is the number of workers, *m* is the effective marginal tax rate, and *r* is the return on capital. The second term:

$$\left(\frac{t\emptyset}{(1-t)N}\right)$$

is the firm's taxes per worker, where *t* equals the statutory corporate tax rate and $\emptyset$ is represents a collection of other factors that can affect a firm's tax position, such as size of interest payments and the existence of losses and is divided by *(1-t)* to gross up the value to pre-tax amount. The last term:

$$\left(\frac{\pi*}{(1-t)N}\right)$$

is the pre-tax value per worker that the firm could earn in some other endeavor. The equation above can be rewritten to define wages as the sum of the outside wage rate plus a share of excess profits:

$$w = \overline{w} + (1-\mu)\left[\frac{F(K,N)-(1-m)rK}{N} - \overline{w} - \frac{t\emptyset}{(1-t)N} - \frac{\pi*}{(1-t)N}\right]$$

In their empirical analysis, Arulampalam, Devereux, and Maffini deviate from this equation and instead estimate an equation in which wages are a function of taxes and the value added per employee. For this analysis, they use data from 55,082 companies located in nine European countries over the period 1996 to 2005. Their basic estimation equation is:

$$lnw = lnVA + lnT + lnZ + lags$$

where *w* is the annual average wages per employee calculated as the cost of employees divided by the total number of employees as the company level, *VA* is value added per employee, *T* is the per-employee

taxes as reported in the firm's financial statement, and *Z* is a vector of other control variables associated with wage bargaining such as union density, and *lags* include lagged values of value added, taxes, and wages of up to two years. In one specification, they include an alternative wage, which they measure as the minimum wage per employee in the sector and country in a particular year.

Under this specification, they find that a $1 increase in corporate income taxes reduces wages by 49 cents in the long run. They also find that a $1 decline in value added has a smaller effect on wages than a $1 decline in corporate income taxes. However, this estimation equation does not reflect, specifically, the bargaining model presented, and despite including some control variables and lagged values of the key variables, the resulting estimation equation probably suffers from endogeneity. As shown in the derivation below, the endogeneity arises from the link between wages and the components that define value added, which include wages and taxes.

Arulampalam, Devereux and Maffini's first equation that defines profits:

$$\pi = F(K, N) - wN - rK - T \quad (1)$$

Arulampalam, Devereux, and Maffini refer to *F(K,N)* as a revenue function and interpret *F* as the value added by workers. To simplify the relationship between wages, taxes, and value added, the cost of intermediate goods *(INT)* is added to this identity and *PQ*, the total revenue for the firm, is substituted for *F(K,N).* Additionally, they define *r* as the cost of capital, where *r* is defined as the sum of the after-tax return on capital *(R)* and depreciation (δ).

$$\pi = PQ - wN - (R + \delta)K - Int - T \quad (1a)$$

Consider the equation for T:

$$T = t\{F(K, N) - wN - \alpha rK - \phi\} \quad (2)$$

where *t* equals the corporate tax rate, α represents a measure of the generosity of depreciation allowances, and ϕ represents other features of the tax code that affect final tax liability, such as loss carry forwards, and interest payments. Without loss of generality, α could be applied to depreciation alone, and for

simplicity of exposition, ϕ can be dropped. Doing so and allowing for deduction of the cost of intermediate goods yields the equation:

$$T = t\{PQ - wN - \alpha\delta K - Int\} \quad (2a)$$

If α equaled 1, the firm's tax liability would depend on the level of depreciation. If, instead, α were greater than 1, its tax liability would decline due to more generous depreciation allowances, and the converse would be true if α were less than 1. When applied to the total cost of capital, α would need to equal $\delta/(R+\delta)$, to be the same as economic depreciation.

In the profit equation, the tax equation can replace *T*. If, for simplicity, α is assumed to equal 1, then:

$$\frac{\pi}{1-t} = PQ - wN - Int - \frac{R}{1-t}K - \delta K \quad (3)$$

Rearranging yields:

$$wN = PQ - Int - (R+\delta)K - \pi - \frac{tR}{1-t}K - \frac{t}{1-t}\pi \quad (4)$$

Value added is defined as revenue net of the cost of intermediate goods and investment. Investment equals the sum of the growth in new investment, g and the costs of replacement for depreciation, δ:

$$VA = PQ - Int - (g+\delta)K \quad (5)$$

Substituting into the wage equation for revenue less intermediate goods yields, equation 4:

$$wN = VA - (R-g)K - \pi - tax \quad (6)$$

where tax is defined as the sum of the two tax payments $tR/(1-t)*K$ and $t/(1-t)*\pi$.

Consider again the authors' estimation equation:

$$lnw = lnVA + lnT + lnZ + lags$$

The equation is estimated per employee, so equation (6) is scaled down to a per-employee version. Equation (6) can be substituted for wages that were determined by the two identities defining profits and value added into the estimating equation:

$$\ln(VA - (R-g)K - \pi - tax) = \beta_1 lntax + \beta_2 lnVA + lnZ + lags(VA, tax, wages) \quad (7)$$

Thus, the results do not provide evidence that the corporate income tax is shifted to workers. The authors note that by controlling for value added, they are able to isolate the direct effect of the tax on wages through bargaining. They also rely on the presence of other factors that determine taxes, □, a key parameter of identification, to provide variability in taxes independent of valued added. However, that variability and the addition of other control variables and lagged variables may not be sufficient to override the inherent relationship between value added, wages, and taxes. The departures from the predicted measures above are likely due to omitted variables, the addition of lagged variables, and the instrumentation of the tax variable, all of which provide some departure from the link between value added, wages, and taxes. It is, therefore, not surprising that the results show value added per worker is strongly positively correlated with wages, and that tax payments are strongly negatively correlated with wages.

The estimation method does not include a measure of profits or of the excess profits that firms and workers are supposed to be bargaining over. Because the estimated elasticities are applied to the full amount of value added—rather than profits—to determine the bargaining distribution, the authors may be overestimating labor's bargaining power. With its inclusion of lagged values, the estimation model also assumes some dynamic behavior, but as Gravelle and Hungerford point out, that is a departure from the authors' original bargaining model. The dynamic features of the estimation model may have been intended to capture long-run incidence, but including only two-year lags may not be sufficient for consideration of a long-run effect and key variables (wages, for example) that should be allowed to adjust over the long run are kept fixed.

The paper raises other estimation issues. First, the authors include the industry minimum wage as a proxy for labor's alternative wage, but there is no reason to assume that the minimum wage is the opportunity wage for most workers or a measure of the marginal product of capital. A better measure might have been the average industry wages or the wages in non-union industries. Second, they also report their incidence estimates at medians, and as Gravelle and Hungerford show, estimating these at the mean, the common method for reporting regression estimates, greatly reduces the incidence estimate.

Third, estimating the equation in logarithmic form constrains their analysis in several ways. Using the logarithmic form, they are unable to include negative tax liabilities, implying theoretically that gains from the tax system are not bargained over. Additionally, the use of logarithms forces the elasticities to be constant. According to general equilibrium models of tax incidence, incidence elasticities should vary according to capital intensity of the industry. Beyond this, these firms are observed not only over different industries but different countries, so the assumption of a constant elasticity is restrictive.

Felix and Hines (2009)

Felix and Hines also apply a bargaining perspective to the study of corporate income tax incidence. They present a straightforward model of the union premium and use cross-state data to estimate the effect of corporate income taxes on that premium. If labor and firms bargain over their respective shares of excess profits, then corporate income taxes—by reducing total profits—should reduce the union wage premium. Their analysis is based on a sample of full-time private sector workers in 2000, derived from the ongoing rotation group of the monthly Current Population Survey (CPS). That data set contains information on hourly wages, union status, and state of residence; the information on residence reveals variations in corporate tax rates across states. The final sample contained 57,426 individual records.

In their basic regression models, Felix and Hines control for employer industry, the worker's occupation, employment by a nonprofit firm, and residence in a metropolitan area. The regressions also include several demographic characteristics such as age, marital status, years of education, and race. In subsequent specifications, they add dummy variables for the state of residence and the presence of right-to-work laws. They also make adjustments for state apportionment of the corporate tax. They use the highest marginal state corporate income tax rate adjusted for the deductibility of federal taxes.

Felix and Hines highlight two key findings from their analysis. First, union membership is correlated with higher wages. Second, a 1 percent increase in the state corporate tax rate is associated with roughly a 0.36 percent reduction in union wage premiums.

In focusing on those findings, the authors overlook another important regression result. The reduction in the union wage premium occurs because non-union wages increase more than union wages; both union and nonunion wages appear to increase with higher corporate income taxes. Their measure of the union effect is also understated since they rely only on the interactive effects. Thus, they back out the union wage premium by effectively taking the difference between the coefficients on two interactive variables: the variable measuring interaction between union status and corporate income tax (with a coefficient of -1.18) and on the variable measuring interaction between union status, corporate income tax, and the ratio of labor to capital (LK) (with a coefficient of 4.22). Evaluating at the sample mean of the labor-to-capital ratio (0.194) yields the estimate that a 1 percent increase in the state corporate tax rate is associated with a decline of the union wage premium of 0.36 (1.18 – 4.22*0.194) percent.

To determine the effect of the corporate income tax on the union premium, the effects for nonunion and union wages are calculated separately below. The effect of a 1 percent higher corporate income tax causes nonunion wages to increase by 0.75 percent. For union wages, it is 0.75 - 1.18 + 4.22*LK. Evaluating the labor-to-capital ratio at the mean for union workers yields an estimate of 0.19. (If this equation were evaluated at 0.194, the mean for all workers, the result would be 0.38 and the differential effect of corporate tax on union members in industries with average labor-to-capital ratios would be 0.36 (0.75 – 0.38), which is what the authors compute.) Following this approach, a 1 percent increase in the state corporate tax rate increased nonunion hourly wages by 0.75 percent (from $16.25 to $16.37) and union hourly wages by 0.187 percent (from $17.81 to $17.83).

While the wage differential, or union premium, has declined from $1.56 to $1.46, both union and nonunion wages have gone up, but union wages increased more slowly than nonunion wages. The authors also use the results concerning the fall in the wage premium to estimate that 54 percent of the tax is offset

from the fall in union wages. However, this estimate does not reconcile with the result that union wages increased.

There are other limitations to their analysis that stem from the difficulties of relying on cross-state data. As with cross-country data, the effect on wages depends on the tax rates in both the workers' state of residence and in other states; as with international comparisons, those effects should vary by the size of the state and other factors. Felix and Hines' main regression includes a number of controls for individual demographic characteristics, but they include fewer controls for state characteristics (the controls include the personal income tax rate and sales tax rate but no other factors that may be specific to the state). In an alternative specification, they control for state differences by including dummy variables for the states, but since they have only one year of data across all states they exclude the corporate income tax variable and rely instead on the corporate tax interaction terms.

Their analysis is also based on the link between the union premium and corporate income taxes. Due to data limitations, Felix and Hines' results rely on corporate taxes linked to wages according to state of residence. As previously discussed, firms are not always located in the state where their workers reside. For most specifications, the authors also assume firms are located entirely within an individual state, which probably is not true for many large firms. In a few specifications, Felix and Hines assume all firms operate in multiple states, and they attempt to correct for state apportionment. In their correction, they subtract the share of sales tax from the state's corporate income tax rate. However, that approach, for which the authors provide a detailed model for support, relies on an assumption that a firm's operations are spread equally across states, which may not be appropriate because firms may have an incentive to arrange various activities in states depending on the rates and apportionment rules. It is not clear that their adjustment adequately corrects for state apportionment.

As with cross-section studies in general, the problem of omitted variables arises, affecting the estimates of the effects of corporate taxes on both union and nonunion wages. Since both wages actually increased with corporate taxes, but nonunion wages rose by more, it may be that nonunion wages are more volatile than union wages. To the extent that unions are national, then each union would want to

push wages up to ensure that in any given state their union members are not treated unfairly relative to the same union members in other states. This effect should tend to equalize union wages across states, but would leave nonunion wages to the whim of the market. Finally, it is not clear why in this study, wages increased with corporate income taxes, whereas they decreased in Felix's study that used state data.

Comparison of Direct Empirical Methods with Empirically Calibrated CGE Models

With the recent resurgence of reduced form empirical analysis, questions arise about what evidence to rely on for estimates of the corporate tax incidence. As discussed above, there are a number of limitations with the current direct empirical analysis. However, computable general equilibrium (CGE) models are not without their faults. This section discusses the relative merits and disadvantages of each approach.

CGE Models

There are three major benefits to using CGE models to measure corporate tax incidence. First, CGE models provide an understanding of the essential economic structure needed to identify incidence. These models must be calibrated for a number of underlying parameters, and well-estimated models use empirical values for substitution elasticities and capital intensities, internally restricting the incidence results to estimates that conform to the economy. Second, CGE models allow users to conduct sensitivity analysis when there is some uncertainty regarding the choice of assumptions, such as the openness of the economy and the mobility of capital and products. Although the models' complexity makes it difficult, any results can be traced to the factors that are most influential and assessed for reasonableness. Lastly, by their very nature, the modeling approach provides perfect controls. Any other government policies or changes in taxes are perfectly accounted for. The model thereby removes the complicating factors and creates a vacuum within which the question of corporate tax incidence can be answered. Determining tax

incidence, particularly in our complex global economy, is complicated, and a clear structural economic model to track the effects of such a tax is extremely helpful.

Of course, there are significant drawbacks as well. Most importantly, by their fundamental nature, CGE models force a rigidity on the results that may not adequately represent the economy. With open economies, this rigidity may be particularly problematic. Incorporating the many important aspects of the international economy adds complexity to the model. None of the current CGE models address all of those complicated aspects of a global economy. In fact, even the most extensive open-economy models assume one domestic economy and one foreign economy. To allow for multiple countries—or to account for other complexities of a global economy—would make it nearly impossible to extract or make sense of the results. Even with models that are still simple enough to be simulated, the model can easily become so dense that the results cannot be traced easily to the factors that explain them, and their reliability cannot be easily assessed. Additionally, a commonly noted fault of these models is that they must rely on assumptions of underlying parameters, raising concerns that the choice of assumptions reflects the beliefs of the analyst. Those concerns become greater when the analysis lacks any discussion of how realistic those assumptions are. Lastly, CGE models provide little way of getting a "confidence interval" around results. They require very knowledgeable analysts and significant research to determine if the results of a particular simulation are plausible.

Even though these models produce varying results, as shown in Gravelle (2010), sensitivity analysis from those models and central estimates of the underlying parameters models can be combined to provide more "average" estimates of the corporate tax incidence. Gravelle (2010) also provides an alternative measure of corporate tax incidence that draws from the new view of property tax incidence. Under that alternative, a worldwide average corporate income tax is assumed to fall entirely on capital, and deviations from that average represent taxes on profits within each country. Ultimately, CGE models cannot be relied on alone; rather, direct empirical research should be used in combination with CGE models to test and validate the results and help better refine the underlying structure and parameters.

Direct empirical approach

All of the direct empirical studies discussed above use reduced form regression techniques. Even those studies that begin with structural models, such as the studies based on bargaining models, ultimately rely on reduced form estimation. Those approaches may be viewed as providing more "real" evidence of the incidence of the corporate tax, and there are certainly benefits to relying more directly on data. Perhaps the most significant benefit of the direct empirical estimation is that this approach is not rigid. There is no need to restrict the analysis to one domestic country and one foreign country or to assume other countries have no corporate taxes. Essentially, that approach allows the data to speak for itself. This lack of rigidity also allows information to come from more than just the U.S. perspective. In some sense, the direct empirical approach could be viewed as trying to estimate an overall general incidence of the corporate tax without assuming countries differ in the way that incidence falls. Second, the direct empirical estimation allows analysts to measure the confidence range around the results. Any estimates can be looked at within a confidence interval.

There are, however, considerable drawbacks to the current empirical research. While the lack of rigidity may be an important benefit, it is also easily the most significant drawback. The results from cross-country studies of the corporate income tax incidence are extremely volatile and at times so large as to be improbable. As noted earlier, results from Hassett and Mathur and Felix could not possibly align with the U.S. economy. It was, in fact, this type of volatility that made an earlier generation of economists turn away from regression-based approaches and rely on the Harberger model. The direct approach is fraught with issues of omitted variable bias. It is difficult to control for any other policies the countries have and the reasons for changes in their corporate tax rates. The papers generally focus solely on changes in the statutory rate, but other changes to the corporate income tax base could offset that effect partially or even completely. For example, a country might adopt a revenue-neutral policy in which an increase in the corporate income tax rate is paired with the introduction of a tax credit; in combination, the two policies leave the effective tax rate unchanged, but the analysis of the empirical papers would

pick up only the increase in the statutory rate. Lastly, with all regression approaches, correlation is not synonymous with causality.

As noted earlier, tax incidence depends on all tax rates, including those of foreign countries. Both approaches do not directly account for the effect other countries' tax rates have on the overall incidence of the corporate income tax. However, while the general equilibrium models do not expressly include other countries' tax rates or changes in them, the results from modeling own-country rates can be used to glean information on the total tax incidence if other countries change their tax rates. Randolph (2006) conducted sensitivity estimates by country size, which can be used to determine the foreign tax incidence effect from countries of different sizes. Moreover, excluding other countries' tax rates does not create errors within the general equilibrium approach since the own-country tax incidence is being measured effectively in a vacuum. Alternatively, the exclusion of other countries' tax rates under the direct empirical approach not only prevents the determination of the full incidence but also creates errors in the estimates of own-country tax incidence.

Similar to cross-country studies, cross-state studies are subject to all the limitations associated with cross-sectional empirical studies, plus some limitations that are unique to studies of state corporate income tax. State apportionments of corporate taxes and the inability to match individuals with the states in which they work confound the ability to adequately pair up corporate taxes with the demand for products and the use of labor. The use of state data to estimate the effect of the state corporate taxes on wages relies on the evidence provided from the impact of a small state corporate tax on a large aggregate variable. The omitted variable bias is a serious concern. Moreover, analysis of the state corporate taxes is not sufficient to make conclusions about federal corporate tax incidence because movements of products, capital, and labor between states can differ significantly from the international mobility of those factors.

Adoption of a bargaining framework does not resolve many of those estimating issues—and in fact raises other concerns. Theoretically, that approach does not provide reliable estimates of tax incidence because of the narrow bargaining view that corporate income tax burdens are shared between firm and union labor and the disregard of the long-run general equilibrium.

Conclusion

The direct empirical approach to estimating general tax incidence faces a fundamental challenge. To adequately allow for general equilibrium forces on the relative demands for capital and labor, corporate tax incidence analysis cannot be done at the individual or firm level because it is not the individual's wage at the taxed firm, but rather the new equilibrium wages of the labor force and returns to capital in the economy that exhibit the burden of the corporate tax. However, analysis using state or country wages cannot adequately control for the determinants of wages at such an aggregate level or control for causes in the changes of corporate tax rates.

Even though the majority of the studies conclude that labor bears a substantial burden of the corporate tax, the various methodological limitations put the reliability of those specific estimates into question. Indeed, trying to address the long-run incidence of general corporate income tax is a daunting task, and these studies have made attempts at using the data available to provide insight into that question. However, it remains unclear where incidence will fall in an open economy.

Direct empirical research would best aid the analysis of tax incidence to help inform the choice of parameters used in CGE models. The continuing use of direct empirical analysis of the corporate income tax would also be useful to further the development of empirical techniques and encourage the acquisition of enhanced data with which to test the validity of the estimates provided by CGE models. However, the current research has not provided clear answers to the general question of the allocation of the corporate income tax burden, and it remains extremely difficult to use aggregate information to determine a narrow and uncertain factor. In light of the volatile results from recent direct empirical analyses, more reliable estimates of the corporate income tax incidence may be derived by primarily relying on general equilibrium models that at least constrain the results in magnitude and provide a structural framework in which to understand tax incidence.

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