R&D and the Rising Foreign Profitability of U.S. Multinational Corporations

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Abstract:

We investigate how R&D contributes to rising foreign profitability in U.S. multinational corporations (MNCs) through wage savings and tax incentives. Our results suggest that although wage savings increase foreign profit margins attributable to *foreign* R&D activities, the shifting of income attributable to *domestic* R&D activities to lower-tax jurisdictions has a larger effect on foreign profit margins. However, additional tests suggest that wage savings are more important than tax incentives in explaining foreign profit margins when the wage discount substantially exceeds the tax differential. Our evidence sheds light on the importance of R&D locations in corporate intangible income shifting that separates the location of economic activity from the location of reported taxable income.

INTRODUCTION

In this paper, we investigate how R&D contributes to rising foreign profitability in U.S. multinational corporations (MNCs) by comparing the relative influence of R&D-related tax incentives and wage savings on foreign pre-tax profit margins. Our research question is motivated by increasing foreign profitability of MNCs (Grubert 2012; Hodge 2011) and recent evidence suggesting tax incentives contribute to this trend. For example, Grubert (2012) finds that foreign profit margins reported on MNCs' tax returns increased over his sample period while domestic profit margins decreased. Moreover, he finds that the increased foreign share of worldwide income largely consists of unrepatriated foreign profits. On one hand, policy makers, public media, and academic researchers believe this trend is driven, in part, by U.S. MNCs' tax-motivated income shifting (e.g., Drucker 2010, Klassen and Laplante 2012a, Senate Hearing 112-781 2012, Senate Hearing 113-90 2013). On the other hand, businesses contend that the trend is driven by sound economic rationale, such as lower production input costs.[1]

Although tax and economic incentives are not mutually exclusive explanations for rising foreign pre-tax profitability, their relative importance is crucial to understand in light of two significant economic phenomena. First, the public widely accuses firms of responding to tax incentives by shifting income attributable to intangible property away from the U.S., where the actual R&D activity that generates these assets takes place. For example, Senator Levin criticized the tax practices of Apple after hearing Senate testimony from the company, stating:

> "[Apple's] profits depend on intellectual property that is nurtured and developed here in the United States. The key to offshore tax avoidance is transferring the profit-generating potential of that valuable intellectual property offshore so that

[1] For example, when asked during a 2013 Senate hearing why 65 percent of Apple's income is foreign, Apple CEO Tim Cook replied that the iPhone has high gross margins, mostly derived from business abroad (Senate Hearing 113-90 2013). Management consultants often use foreign profit margins to evaluate the effectiveness of offshoring business activities such as R&D (Vestring, Rouse, Reinert, and Varma 2005; Bhattacharya, Sirkin and Andrew 2005).

> the profits are directed not to the United States, but to an offshore tax haven (Senate Hearing 113-90 2013, p2)."

In response, firms argue that their growing investments in foreign R&D activities substantiate profits reported overseas (e.g., Senate Hearing 112-781 2012, Senate Hearing 113-90 2013).[2] However, existing literature finds that firms use a physical presence in low-tax jurisdictions to minimize income shifting risk and justify future tax-motivated income shifting (Grubert and Slemrod 1998, Hines and Rice 1994). We thus examine the extent to which income attributable to domestic R&D is shifted to low-tax foreign countries in which the firm has a physical presence, contributing to foreign pre-tax profit margins.

Second, MNCs are increasingly shifting R&D activity to foreign jurisdictions, which results in more income generated and taxed outside the U.S. According to the National Science Foundation (NSF), over the period 2004 to 2009, U.S. MNCs increased domestic R&D employment by less than 5 percent but nearly doubled foreign R&D employment (NSF 2012). MNCs justify offshoring R&D, in part, by the cost savings from foreign R&D labor. Although the U.S. leads the world in many areas of technological advancement, the U.S. R&D labor force in the science, technology, engineering and mathematics (STEM) fields is declining while demand is increasing, bidding up the price of the domestic R&D labor force (Craig, Thomas, Hou and Mathur 2011). As firms look for ways to reduce costs while maintaining innovation, low-wage countries have attracted foreign R&D investments by offering highly skilled workers, especially in the STEM fields, which are key to innovation (Battacharya, Sirkin, and Andrew 2005).[3] To the extent that a firm reduces R&D labor costs by moving R&D activity and the

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[2] During these Senate hearings, both Apple and Microsoft argued that their abnormally high profits in Ireland are attributable to their growing R&D investments and expanding workforces in that country.

[3] For example, 77 global companies, including GE and Intel, have R&D facilities in India where engineering costs are 75 percent lower than in Germany (Vestring, Rouse, Reinert, and Varma 2005).

related income to foreign countries, it enjoys higher foreign profit margins. Thus, we examine the extent to which wage savings from foreign R&D activity contribute to foreign pre-tax profit margins.[4]

We begin by developing a simple model that compares the net benefits of tax-motivated income shifting to those of wage-related R&D income shifting, based on which we can predict the conditions under which one strategy will generate greater pre-tax profit margins than the other.[5] The model incorporates the relative costs of tax and labor for foreign and domestic R&D as well as a non-deductible cost function that is increasing in income shifted and decreasing in economies of scale. Which strategy is more profitable depends on the relative costs and benefits of each strategy, and plausible scenarios exist in which the net benefits of wage-related R&D shifting outweigh those of tax-related income shifting, and vice versa. Thus, which factor contributes more to foreign profit margins remains an open empirical question, the answer to which has direct implications for policy makers. While tax-motivated income shifting suggests implications of tax reform, wage-related increases in foreign profits bear economic implications for the labor force. For example, if tax incentives are the primary driver of increasing foreign profit margins, corporate behavior could be influenced by changes in tax rates and/or transfer pricing rules. If wage savings are the primary driver, policymakers could address the trend by stimulating a larger domestic labor force in STEM fields (Kuenzi, Matthews and Mangan 2006).

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[4] We acknowledge that wage savings is not the only economic incentive for foreign R&D; gaining access to foreign markets, manufacturing capacity, and R&D talent all play important roles. However, because the U.S. has a high average R&D wage and R&D has become increasingly global, the opportunity to lower R&D wages and increase profitability is an important factor to consider. We attempt to control for the effect of other economic factors in empirical tests.

[5] Throughout the paper, we focus on two mechanisms by which income can be shifted to foreign countries. First, firms shift income derived from domestic R&D to lower tax foreign countries (*Tax motivated income shifting*). Second, firms shift R&D along with income to foreign countries with lower wages (*Wage-related income shifting* or *wage-related R&D shifting*). As firms can engage in both mechanisms simultaneously, the focus of our paper is examining which mechanism appears to contribute more to foreign pre-tax profit margins of U.S. MNCs.

To investigate the relative importance of tax incentives and wage savings in rising foreign profitability attributable to R&D activities, we estimate how tax incentives and wage savings influence the association between foreign profit margins (return on sales) and domestic and foreign R&D. These tests follow existing income shifting studies (Collins, Kemsley and Lang 1998, Klassen and Laplante 2012a and 2012b), which identify income shifting as the deviation of foreign profit margins from worldwide profit margins and include measures of tax incentives to estimate tax-motivated income shifting. We extend these models by adding measures of foreign and domestic R&D activity to estimate R&D-related income shifting. To the extent income is shifted overseas without the related expenses incurred to produce that income (i.e., shifting income related to domestic R&D) or in a way that substantially decreases the expenditures necessary to generate that income (i.e., shifting R&D activity to foreign countries to lower wage expense), foreign profitability increases. Our measure of domestic (foreign) R&D activity is the number of domestic (foreign) inventors a firm lists in its patent filings obtained from the Institute for Quantitative Social Science at Harvard University and the National Bureau of Economic Research (NBER).[6] To test our tax (wage savings) incentives prediction, we investigate how tax (wage savings) incentives affect the relation between domestic (foreign) R&D and foreign profit margins, holding constant worldwide profit margins and other factors. We compare the relative importance of the tax and wage savings strategies by testing which of these two effects is larger.

[6] Technologies that are patented in the U.S. Patent and Trademark Office (USPTO) are likely a subset of the actual R&D that a company conducts. Because we use observable patent inventors to measure R&D intensity, our measure should capture the lower bound of actual R&D intensity, making our estimates of profit margins derived from R&D activities conservative. We validate these inventor data using country-level R&D data from the Bureau of Economic Analysis in Appendix A.

Using a sample of 2,760 U.S. MNC firm-year observations over the period from 1993 to 2006, we find that tax-related income shifting from domestic R&D on average contributes more to foreign profit margins than wage savings from foreign R&D. Based on the average foreign sales of 132 companies with foreign R&D in 2005, we estimate a $3.2 billion increase in foreign income associated with average domestic R&D and tax rate differential, which increases foreign profit margins by 0.36 percentage points. However, based on these 132 firms, we estimate only a $348 million increase in reported foreign income associated with average foreign R&D wage savings and foreign R&D in 2005, which increases foreign profit margins by 0.04 percentage points. To mitigate the concern that wage savings and tax rates are correlated with unobservable country-level characteristics that attract R&D activity, thus biasing the coefficient comparison between tax rates and wage savings, we confirm that our results are robust to controlling for fixed effects for each country in which the firm-year has R&D inventors.

Next, we investigate conditions under which the benefits of one strategy outweigh the other. First, we estimate the wage discount and tax rate differential for each observation to identify those for which wage savings likely exceed tax incentives, and vice versa. Consistent with our prediction, we find that wage savings increase R&D-related income shifting but tax incentives do not when wage discounts substantially exceed tax differentials. Conversely, we find that tax incentives increase R&D-related income shifting but wage savings do not when tax differentials exceed or more closely approximate wage discounts. Second, we identify conditions under which the net benefit of each strategy is higher or lower based on its cost function. Specifically, we expect and find that the effect of wage savings on R&D-related income shifting is concentrated in observations with a low cost of conducting foreign R&D, defined as firms whose patents are less concentrated in capital intensive industries. We also expect and find that the effect of tax incentives on R&D-related income shifting is concentrated in firms facing less transfer pricing uncertainty.

This study provides useful information for policy makers and researchers interested in understanding the rising foreign profitability phenomenon. First, we distinguish between two motivations for increasing foreign profitability related to R&D. While most studies in accounting and economics focus on tax incentives (e.g., Collins et al. 1998, Klassen and Laplante 2012a, Grubert 2012), we also explore the role of economic incentives in explaining rising foreign profitability. Differentiating and comparing the relative importance of these two determinants of increased foreign profitability related to U.S. MNC R&D activities is important because each incentive has different policy implications. Our results suggest that, on average, the importance of tax-related income shifting strongly outweighs that of wage savings.

Second, in response to the perception that corporate income shifting erodes tax revenue, many tax authorities and international organizations are increasing their efforts towards curbing this practice. The OECD's Base Erosion and Profit Shifting (BEPS) initiative cites intangible income as a key area requiring special attention to reduce tax avoidance (OECD 2014). For example, the OECD uses customs (trade) data to estimate that the ratio of royalties received to R&D expenditures is six times higher in low tax countries than the average ratio for all other countries and this ratio has increased by 300 percent over the period 2009 to 2012; however, the OECD cites concerns over the reliability of these data due to companies under-reporting and/or mis-reporting intercompany royalties (OECD/G20 2015). Using data on the location of patent inventors, we overcome the data limitations of tracing intangible income to underlying R&D activity and shed light on the importance of intangible income shifting that separates the location of economic activity from the location of reported taxable income (and therefore tax revenue).

Our findings therefore also contribute to policy debates surrounding BEPS' implementation of nexus requirements for so-called "patent box" legislation implemented by France, the United Kingdom, the Netherlands, Spain and others aimed at attracting intangible-related income (Merrill 2016).

Third, we contribute to the income shifting literature by estimating R&D-related income shifting. Existing research uses differences between U.S. and average foreign effective tax rates to test for income shifting. We improve on this methodology by focusing on how R&D-related income shifting is best accomplished for U.S. MNCs given developments in U.S. and foreign tax laws meant to curb income shifting activity. Specifically, because many laws and regulations established during our sample period focus on the location of R&D activity as an impetus for income recognition, we measure tax-related income shifting using the location of foreign inventors and tax rates in inventor countries. We also add to this literature by deepening our understanding of cross-sectional differences in cross-jurisdictional income shifting. Our cross-sectional findings on the magnitude of wage versus tax savings, transfer pricing risk, and financial constraints could be useful to regulators targeting perceived abuse of tax laws.

BACKGROUND AND HYPOTHESES

We study two types of incentives related to foreign profit margins and R&D activities. First, because intellectual property (IP) is a relatively mobile input to production, MNCs can more easily shift intangible income derived from domestic R&D to lower tax foreign jurisdictions than income attributable to tangible goods and services. We therefore study the extent to which the income from IP developed in the U.S., i.e. *domestic R&D*, is shifted to low-tax foreign countries and therefore contributes to increasing foreign profit margins. Second, to the extent firms can lower wage costs by moving R&D and the related income to foreign countries, they can benefit from higher foreign profit margins. We therefore study the extent to which lower foreign wage costs contribute to higher foreign profit margins associated with IP developed by U.S. MNCs in foreign countries, i.e. *foreign* R&D. We discuss our predictions related to each incentive in turn below.

Tax incentives

Prior work finds MNCs respond to tax incentives when setting intercompany transfer prices and reporting geographical income.[7] Because IP is a relatively mobile factor of production and is difficult to value, it is a common mechanism used by MNCs to engage in tax-motivated income shifting (Drucker 2010; Senate Hearing 112-781 2012, Senate Hearing 113-90 2013). As a result, IP-related income shifting is under increased scrutiny by policy makers. The OECD's Base Erosion and Profit Shifting (BEPS) initiative focuses in part on assuring "that transfer pricing outcomes are in line with value creation" with particular attention to intangibles (OECD 2015, p. 1).

In the U.S., two common strategies firms use to shift IP income to low-tax countries are cost-sharing arrangements (CSAs) and IP transfers. A CSA is a contractual arrangement wherein participants share the costs and risks of R&D activity in return for sharing the rights to the developed IP. MNCs commonly use CSAs to transfer the rights to domestically developed IP to foreign subsidiaries, allowing the MNC to relocate ownership of and income from IP to low-tax jurisdictions without relocating the R&D activity. For example, Apple's CSAs with its Irish subsidiary allowed the company to shift $74 billion of income to Ireland over the period 2009 to

[7] See, for example, Altshuler, Grubert, and Newlon (2000); Bartelsman and Beetsma (2003); Clausing (2003); Collins and Shackelford (1998); Collins et al. (1998); De Simone (2016); De Simone, Klassen, and Seidman (2016); Devereux and Griffith (1998); Dharmapala and Reidel (2013); Grubert and Mutti (1991); Grubert and Slemrod (1998); Harris (1993); Hines and Rice (1994); Hines (1996); Huizinga and Laeven (2008); Klassen, Lang and Wolfson (1993); Klassen and Laplante (2012a); Markle (2016); and Williams (2015).

2012.[8] The U.S. Treasury has revised CSA regulations several times to curb this practice and to make it more costly for foreign subsidiaries to acquire pre-existing IP from parents (KPMG 2009; Wittendorff 2010), increasingly constraining the ability of MNCs to shift income to foreign jurisdictions lacking significant value-added economic activities.

Transfers of IP ownership from the U.S. to a low-tax foreign subsidiary also allow MNCs to relocate ownership of IP to low-tax foreign jurisdictions without necessarily relocating R&D activity. Tax law requires using the arm's length principle under which sales are priced as if the U.S. parent and foreign subsidiary are unrelated parties, which should negate most tax benefits.[9] However, information asymmetry and the difficulty of valuing unique intangibles often leads to the intercompany price of IP being lower than the net present value of expected future cash flows attributable to the IP (De Simone and Sansing 2017).

The BEPS project and unilateral tightening of regulations by many countries are designed to make it more difficult for companies to shift income to a lower-tax jurisdiction without economic activity there to substantiate those profits. However, anecdotal evidence suggests that firms are still engaging in income shifting on a large scale. This observation, in conjunction with firms moving more R&D offshore suggests that MNCs use foreign R&D in low tax countries to facilitate income shifting from domestic R&D to low tax foreign countries. To the extent that firms use foreign R&D to demonstrate IP development activities offshore, they are better able to substantiate their income shifting transactions under tightening transfer pricing regimes (Grubert and Slemrod 1998). Thus, we investigate the extent to which tax incentives increase MNCs' foreign profit margins related to domestic R&D activity.

[8] Unfortunately, aside from such testimony, disclosures of the incidence and magnitude of CSAs and other IP tax structures are limited.
[9] See e.g. Section 482 of the Internal Revenue Code and related Treasury regulations.

Economic Incentives

R&D spending is a significant expense for many U.S. MNCs. A recent examination of top R&D spenders in the U.S. shows that companies are ramping up their R&D investments. High-tech companies such as Intel, Microsoft and Google spend 20.6 percent, 13.1 percent and 14.9 percent of their revenue in R&D investments (Jaruzelski, Schwartz and Staack 2015). However, more R&D spending does not necessarily buy better financial success. According to a consulting report, based on the 1,000 companies that had the most R&D spending worldwide in 2004, only the top 500 R&D companies achieve better profit margins compared to their peers. Further, for the 1,000 companies on average, there is no statistical relation between profit margins and R&D spending (Jaruzelski, Dehoff, and Bordia 2005). This evidence suggests that firms must carefully manage R&D costs in a way that yields the highest possible returns.

Existing research finds evidence that lower production costs attract corporate investment (e.g., Levine 2011; Lewin, Massini and Peeters 2009). Because R&D relies heavily on human capital to develop ideas and implement design, low wage costs are a magnet for R&D investment. For example, in a survey of business executives, more than 75 percent of respondents plan to open new R&D centers in low cost regions in the next three years (Jaruzelski, Dehoff, and Bordia 2005). Although GE has four major R&D centers worldwide (in New York, Shanghai, Munich, and Bangalore), its workforce in Bangalore, where R&D labor costs are less than ten percent of those in the U.S., is larger than the other three locations combined (Hira 2009).

Foreign countries have outpaced the U.S. in STEM education (Bhattacharya et al. 2005). For example, 41 percent of all degrees awarded by Chinese universities in 2011 are in STEM fields, which is more than three times the rate in the U.S. Brazil was expected to produce more doctorates in engineering than the U.S. by 2016 (Craig et al. 2011). As a result, research documents significant shifts in R&D-related jobs to Asia, Eastern Europe, and other low-cost locations over the past 35 years (Levine 2011; Lewin et al. 2009). The relative decline in availability of skilled human resources able to engage in R&D activities in the U.S. increases domestic R&D wage costs relative to foreign R&D wage costs. In response, firms increasingly seek foreign R&D talents to reduce their R&D costs. We therefore investigate the extent to which foreign wage savings increase MNCs foreign profit margins related to foreign R&D activity.

Hypotheses

To study the relative influence of tax incentives and wage savings on foreign pre-tax profit margins, we develop a simple model of the net benefits of tax-motivated income shifting from domestic R&D and wage-related income shifting from foreign R&D.[10] In either case, assume domestic pre-wage income of $1 attributable to domestic R&D activity is shifted from domestic operations to foreign operations. The firm can move this $1 of income away from domestic operations in two ways: (1) separate the income from the underlying economic activity by shifting just the accounting profits to a foreign jurisdiction (the tax strategy), or (2) move the economic activity generating this income (i.e., R&D labor activity) overseas (the wage strategy). We assume a non-deductible cost function c_i, where i denotes the tax strategy attributable to domestic R&D (p) or the wage strategy attributable to foreign R&D (w). Consistent with prior literature, the cost function of each strategy is increasing in the amount of domestic pre-wage income shifted and decreasing in economies of scale.[11] We let t_j represent the average corporate tax rate in a geography j, where j is d for domestic or f for foreign.

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[10] Although we follow prior literature by using an empirical model of pre-tax foreign returns, to understand the relative size of the incentives for firms to increase foreign returns via wage savings versus income shifting, it is necessary to examine the after-tax (net) benefits of each mechanism.

[11] See for example Hines and Rice (1994); Huizinga and Laeven (2008); and De Simone, Klassen, and Seidman 2016. These studies generally assume $c_i = aM^2/2p$ where a may be a firm-specific a constant, M is the amount

We first consider the incentive to shift income attributable to domestic R&D to foreign jurisdictions.[12] The after-tax return of \$1 of pre-wage income in the US is $\$1(1 - L_d)(1 - t_d)$, where L_j is R&D labor expenses. The after-tax return if that \$1 of income from domestic R&D is shifted to a foreign jurisdiction is $\$1(1 - t_f) - L_d(1 - t_d) - c_p$; although the firm shifts \$1 of accounting profits to its foreign jurisdictions and pays foreign taxes on those profits, it still incurs the cost (and deduction) of R&D labor in the U.S. We calculate the savings from shifting one dollar of pre-wage profits from domestic R&D activity overseas by subtracting the after-tax benefit of keeping profits in the U.S. from the after-tax benefit of shifting:

$$\$1(t_d - t_f) - c_p \qquad (1)$$

We next consider the incentive to generate wage savings by moving R&D labor and the related income to a foreign country. In this case, we focus on the possibility that foreign wages are lower than domestic wages. Therefore, foreign R&D both directly increases pre-tax profits via foreign wage savings and indirectly yields tax savings (penalty) if the resulting income is shifted to a lower- (higher-) tax foreign jurisdiction. Let s represent the discount on foreign wages. Specifically, we define $s = 1 - L_f/L_d$.[13] We assume $L_f \leq L_d$ consistent with foreign wage savings. Holding labor productivity constant across jurisdictions, for every dollar of pre-wage income a firm either earns net income of $\$1 - L_d$ in the U.S. or of $\$1 - L_f$ abroad for R&D labor activities performed. Expressing foreign wages in terms of s, income earned abroad in the wage savings strategy is equal to $\$1 - (1 - s)L_d$. The after-tax benefit of hiring R&D labor and earning

shifted, and p is the amount of true economic profits in the foreign jurisdiction. We discuss the cost functions in more detail below.

[12] Income shifting from domestic to foreign operations could be achieved via an intercompany transaction that either increases foreign revenues with an offsetting increase in domestic costs, or decreases foreign costs with an offsetting increase in domestic revenues.

[13] For example, assume R&D wages can be incurred in the US for \$5 ($L_d = 5$) or in the foreign jurisdiction at an 80 percent discount ($L_f = 80\%*5 = 1$). In this case, $s = (1 - 1/5) = 0.8$, reflecting the 80 percent discount on foreign wages.

profits attributable to that economic activity in the U.S. is $\$(1 - L_d)(1\text{-}t_d)$. Similarly, the after-tax benefit of hiring R&D labor and earning profits attributable to that activity abroad is $\$(1 - (1 - s)L_d)(1\text{-}t_f) - c_w$. The after-tax savings from the wage savings strategy are therefore:

$$\$(1 - L_d)(t_d - t_f) + sL_d(1 - t_f) - c_w \qquad (2)$$

We evaluate the relative magnitude of the savings from each strategy by directly comparing Equations (1) and (2). To allow an apples-to-apples comparison of the two strategies, we assume for now that the cost functions are identical (i.e., $c_p = c_w$). The tax strategy in Equation (1) simplifies to the tax rate differential, $(t_d - t_f)$, and is increasing in the amount by which U.S. taxes exceed foreign taxes or decreasing to the extent foreign taxes are higher than U.S taxes. The wage strategy in Equation (2) has two components: the tax rate differential and the wage discount. The effect of the tax rate differential is smaller for the wage strategy $[\$(1 - L_d)(t_d - t_f)]$ than the tax strategy $[\$1(t_d - t_f)]$ because it is applied to a dollar of pre-wage income less the cost of domestic R&D labor. The wage discount component, $sL_d(1 - t_f)$, is increasing in the discount on foreign wages because lower foreign wages result in higher profit, and decreasing in foreign taxes because of higher foreign pre-tax profits resulting from wage savings. In this comparison, where we hold costs constant, the magnitude of after-tax benefits from the wage strategy exceed the after-tax benefits from the tax strategy if:

$$s > (t_d - t_f)/(1 - t_f) \qquad (3)$$

For example, if the U.S. tax rate is 35 percent and the foreign rate is 15 percent (a tax rate difference of 20 percent), the wage discount must be at least (0.35 – 0.15)/(1 – 0.15) = 23.5 percent for the wage savings strategy to provide a greater incentive than the tax strategy alone. While Equation (3) suggests that the wage discount must be bigger than the tax rate differential to achieve the same after tax benefit, the potential values of the wage discount are much larger than the potential values of the tax rate differential. [14] For example, the maximum tax rate difference is 0.35, whereas the wage discount for India is 0.9055.[15] Moreover, wage savings are permanent, whereas during our sample period, tax savings reverse when earnings are repatriated to the U.S. Thus, plausible scenarios exist in which the net benefits of the wage strategy outweigh those of the tax strategy, and vice versa.

In addition to factors that affect the benefits of each strategy, the costs of each strategy likely vary across firms. To allow for this possibility, we relax the assumption that the costs of the two strategies are the same. Subtracting the after-tax savings of shifting income attributable to domestic R&D given by Equation (1) from the after-tax savings of foreign R&D given by Equation (2) suggests that net benefits of the wage strategy exceed the net benefits of the tax strategy if:

$$L_d[s(1 - t_f) - (t_d - t_f)] > (c_w - c_p) \tag{4}$$

The net benefits of both the tax and wage strategies are decreasing as the costs of these strategies increase. Further, holding the other parameters constant, we can see that the net benefits of the wage strategy exceed the net benefits of the tax strategy as long as the incremental cost of the wage strategy (relative to the cost of the tax strategy) does not fully offset the incremental after-tax benefit of the wage strategy. We note, however, that wage savings from foreign R&D and tax savings from shifting income attributable to domestic R&D may be complementary activities because both can be used to increase profits in lower-tax jurisdictions

[14] Although profitable firms only have an incentive to shift accounting profits into a jurisdiction with a lower tax burden than in the U.S. (i.e., $t_d - t_f > 0$), other factors such as IP protection risk and availability of skilled labor could result in firms locating R&D activities in higher-tax jurisdictions ($t_d - t_f \leq 0$).

[15] The average R&D wage for our sample period is $65,217 in the U.S. and $6,165 in India. Thus, s for India = [1-(6,165/65,217)] = 0.9055. We discuss the calculation of the R&D wage in more detail below.

consistent with Grubert and Slemrod (1998).[16] Which of these strategies influences R&D-related foreign profit margins more depends on the relative cost functions, labor costs, and tax rates, and thus remains an open empirical question. We therefore offer the following hypotheses, stated in the alternative form.

H1a: Tax-motivated income shifting associated with domestic R&D activities contributes more to foreign profit margins than foreign wage savings associated with foreign R&D activities.

H1b: Wage savings associated with foreign R&D activities contribute more to foreign profit margins than tax-motivated income shifting associated with domestic R&D activities.

EMPIRICAL DESIGN

Measures of Domestic and Foreign R&D

We measure domestic and foreign R&D activity using the location of inventors listed on patents filed with the U.S. Patent and Trademark Office (USPTO). The USPTO defines an inventor as an individual that "contributes to the conception of the invention."[17] Because the USPTO raw patent inventor data do not provide unique inventor identifiers, we follow Li et al. (2014) and uniquely identify USPTO patent inventors using a Bayesian supervised learning approach. We determine the location of inventors using the home mailing address of the inventors we identify for each patent filing, and construct two measures of the location of R&D

[16] In order to disentangle the wage savings effect from the income shifting effect, our parsimonious model diverges from the Grubert and Slemrod (1998) model by not incorporating the interaction between the shifting of real operations and income shifting. We acknowledge that moving economic activity abroad likely also enables the firm to shift more accounting profits abroad. We incorporate this notion into our discussion below.

[17] For example, "With regard to the inventorship of chemical compounds, an inventor must have a conception of the specific compounds being claimed. [G]eneral knowledge regarding the anticipated biological properties of groups of complex chemical compounds is insufficient to confer inventorship status with respect to specifically claimed compounds." See http://www.uspto.gov/web/offices/pac/mpep/s2137.html for related regulation and case law interpretation.

activity, *DomR&D* and *ForR&D*.[18] $DomR\&D_{i,t}$ is the number of domestic inventors listed on patents filed by firm *i* in year *t*. $ForR\&D_{i,t}$ is the number of foreign inventors listed on patents filed by firm *i* in year *t.* We use the number of foreign inventors listed in the patent application year, which is close in time to the actual R&D activity and generally still before the R&D activity is transformed into a final technology ready for the market (Hall, Jaffe and Trajtenberg 2001). We scale each of these variables by worldwide sales listed in Compustat for firm *i* in year *t* and use the USPTO-Compustat identifiers published by NBER to link USPTO firms to Compustat global (Hall et al. 2001; Bessen 2009). The NBER link provides matches through 2006 and is widely used by researchers in accounting and finance (e.g., Bernstein, Giroud, and Townsend 2015; Chemmanur, Loutskina, and Tian 2015; Atanassov 2013; Koh and Reeb 2015).[19]

We use these measures of domestic and foreign R&D activity because firm-level data on how much U.S. MNCs spend on R&D in a given country is poorly populated in publicly available datasets, whereas publicly available patent and inventor data are more complete.[20] In

[18] The USPTO requires patent applications to report the home addresses of inventors at the time of patent filings, not the original home addresses of inventors based on their origin of nationalities. Following prior literature, we use inventor locations to capture where U.S. MNCs conduct R&D (e.g., Hines and Jaffe 2000; Zhao 2006; Kerr and Kerr 2015). Because filing patents is costly, firms conducting R&D in multiple locations typically file for patent protection in key product markets or jurisdictions with strong IP protections; for our sample of U.S. MNCs, the U.S. largely meets both criteria. For example, Branstetter et al. (2014) find that MNCs typically file with the USPTO for patentable inventions arising from R&D in China and India except if they relate to products or services unlikely be sold outside the host-country and/or they fail to justify the cost of obtaining U.S. protection. We therefore acknowledge a limitation of using USPTO patent filings is that we potentially underestimate foreign R&D that is low value or specifically designed for local markets, making our estimates more conservative. However, an Orbis search of over 4,000 patents filed by ten randomly chosen firms from our sample yielded only one patent filed with the European Patent Office that did not originate from a patent filed with the USPTO. We therefore conclude that adding patents filed with other sources to our sample would not significantly improve our measure of foreign inventor locations.

[19] Kogan, Papanikolaou, Seru, and Stocffman (2016) provide patent matching data that ends by 2010. While the sample period is more recent, the authors mainly rely on common firm name matching between the Compustat and the USPTO patent filings, which may induce systematic measurement error because USPTO patents can be assigned to a subsidiary with a name differing from that of its parent company in Compustat.

[20] Koh and Reeb (2015) document that 57.8 percent of Compustat firm-years report consolidated R&D. However, there is less coverage of R&D by geographic segment. Our preliminary R&D data search in the Compustat Segment

addition, MNCs have strong incentives to accurately report inventors on patent filings because failure to correctly identify inventors can invalidate a patent and reduce the firm's ability to defend it against infringement (Gibson 2010).[21] As a result, patent inventor locations have been widely used by prior studies to estimate R&D investments in different regions (e.g., Berry 2014; Alcacer and Zhao 2012).

We assess the accuracy of our measures of domestic and foreign R&D activity using aggregated country-year R&D investment amounts reported by the Bureau of Economic Analysis (BEA). In Appendix A, we report the mean, minimum, and maximum number of inventors for each inventor country listed on patent filings using USPTO data from 1999 through 2006 and the mean, minimum, and maximum values of R&D investments by country reported by the BEA for the same time period. All amounts are reported in constant 2005 dollars. We observe a similar pattern in the magnitude of the number of inventors and level of R&D investment by country and find a significant positive correlation between our inventor location figures and BEA R&D investments of 0.89 (p-value < 0.01).

Empirical Model

We study the effect of tax incentives on foreign profit margins by following the approach in Collins et al. (1998). They estimate firm-level foreign return on sales (RoS) as a function of worldwide RoS and tax incentives. This estimate assumes that, absent income shifting incentives, foreign RoS approximates worldwide RoS and thus deviations of foreign RoS from worldwide RoS that are correlated with tax incentives represent shifted income. The coefficients

and ORBIS database published by Bureau van Dijk (BvD) datasets show fewer than 5 of percent firm-years have non-missing geographic level R&D information.

[21] See https://www.uspto.gov/web/offices/pac/mpep/s602.html [R-07.2015] for related regulations.

on other explanatory variables in this model capture the extent to which those measures are associated with income shifting.

Similar to Klassen and Laplante (2012b), we adapt the Collins et al. (1998) annual model into a multi-period model to smooth yearly variations in tax incentive measures that are unrelated to income shifting and to allow income shifting related to R&D activity to occur in years subsequent to the year in which the R&D takes place. Thus, we estimate the average return on sales and other key variables from year *t* to year *t+4*, where year *t* is the patent application year. We also incorporate the notion that tax-motivated income shifting must sum to zero by estimating the effect of tax and non-tax economic incentives on both foreign and domestic RoS (Dyreng and Markle 2016).[22] Thus, we test our hypotheses by estimating the following empirical equations using seemingly unrelated regression analysis:

$$\begin{aligned} ForRoS_{i,(t,\,t+4)} = {} & \beta_0 + \beta_1{*}RoS_{i,(t,\,t+4)} + \beta_2{*}(DomSTR - ForTax)\leq 0_{i,(t,\,t+4)} \\ & + \beta_3{*}(DomSTR - ForTax)>0_{i,(t,\,t+4)} + \beta_4{*}DomR\&D_{i,t} + \beta_5{*}ForR\&D_{i,t} \\ & + \beta_6{*}WageSavings_{i,(t,\,t+4)} + \beta_7{*}DomR\&D_{i,t}{*}(DomSTR - ForTax)\leq 0_{i,(t,\,t+4)} \\ & + \beta_8{*}DomR\&D_{i,t}{*}(DomSTR - ForTax)>0_{i,(t,\,t+4)} + \beta_9{*}ForR\&D_{i,t}{*}WageSavings_{i,(t,\,t+4)} \\ & + \beta_{10}{*}GDP + \beta_{11}{*}GDPGrowth_{i,(t,t+4)} + \beta_{12}{*}HumanCapital_{i,(t,\,t+4)} + \beta_{13}{*}FDI_{i,(t,\,t+4)} \\ & + \beta_{14}{*}IPR_{i,(t,\,t+4)} + \varepsilon_{i,t} \qquad (5) \end{aligned}$$

$$\begin{aligned} DomRoS_{i,(t,\,t+4)} = {} & \gamma_0 + \gamma_1{*}RoS_{i,(t,\,t+4)} + \gamma_2{*}(DomSTR - ForTax)\leq 0_{i,(t,\,t+4)} \\ & + \gamma_3{*}(DomSTR - ForTax)>0_{i,(t,\,t+4)} + \gamma_4{*}DomR\&D_{i,t} + \gamma_5{*}ForR\&D_{i,t} \\ & + \gamma_6{*}WageSavings_{i,(t,\,t+4)} + \gamma_7{*}DomR\&D_{i,t}{*}(DomSTR - ForTax)\leq 0_{i,(t,\,t+4)} \\ & + \gamma_8{*}DomR\&D_{i,t}{*}(DomSTR - ForTax)>0_{i,(t,\,t+4)} + \gamma_9{*}ForR\&D_{i,t}{*}WageSavings_{i,(t,\,t+4)} \\ & + \gamma_{10}{*}GDP + \gamma_{11}{*}GDPGrowth_{i,(t,t+4)} + \gamma_{12}{*}HumanCapital_{i,(t,\,t+4)} + \gamma_{13}{*}FDI_{i,(t,\,t+4)} \\ & + \gamma_{14}{*}IPR_{i,(t,\,t+4)} + \varepsilon_{i,t} \qquad (6) \end{aligned}$$

[22] The Dyreng and Markle (2016) model is not appropriate in our setting because it assumes the location of third-party sales is the true source of income. In contrast, the U.S. and global transfer pricing rules use the location of economic activity, such as R&D, as the fundamental determinant of where income should be reported. We incorporate the spirit of their model's design to constrain the sum of inbound and outbound shifting to zero by simultaneously modeling determinants of domestic and foreign profit margins.

See Appendix B for detailed variable definitions. $ForRoS_{i,(t,\ t+4)}$ is the five-year average foreign return on sales, calculated as the five-year forward-looking sum of foreign pre-tax book income (PIFO) reported in the Compustat Annual database scaled by the five-year forward-looking sum of foreign sales reported in Compustat's segments database. $DomRoS_{i,(t,\ t+4)}$ is the five-year average domestic return on sales, calculated as the five-year forward-looking sum of domestic pre-tax book income (PIDOM) reported in the Compustat Annual database scaled by the five-year forward-looking sum of domestic sales reported in Compustat's segments database. $RoS_{i,(t,\ t+4)}$ is measured similarly but using worldwide pre-tax book income (PI) and worldwide sales (SALE). Because we expect foreign and domestic return on sales to be positively correlated with worldwide return on sales, we expect that β_1 and γ_1 are positive.

Consistent with prior income shifting studies (e.g., Collins et al. 1998; Klassen and Laplante 2012a, 2012b), we separately examine inbound tax incentives and outbound tax incentives. The inbound tax incentive, $(DomSTR - ForTax)\leq 0_{i,(t,\ t+4)}$, equals the difference between the U.S. statutory income tax rate and the future five-year weighted-average foreign inventor country non-missing statutory income tax rate from years *t* to *t+4* if the difference is less than or equal to zero, and zero otherwise. The outbound tax incentive, $(DomSTR - ForTax)>0_{i,(t,\ t+4)}$, equals the difference between the U.S. statutory income tax rate and the future five-year weighted-average foreign inventor country non-missing statutory income tax rate if the difference is more than zero, and zero otherwise. Foreign tax rates are weighted by the share of foreign inventors in each country in year *t* for firm *i*. We obtain corporate statutory income tax rate data from the KPMG Corporate Tax Rate Survey (2006, 2011), and replace ordinary income tax rates with intangible income tax rates for countries enacting preferential intangible income tax regimes, i.e. patent boxes, during our sample period (Evers, Miller and Spengel 2015). We construct the average foreign statutory tax rate based on observable foreign inventor countries to identify countries in which the firm has R&D activity that can be used to justify income recognized in that country.[23] We expect that as the difference between the U.S. and foreign tax rates increases, the tax benefit of shifting income to lower-tax foreign jurisdictions increases and firms report higher (lower) profit margins in foreign (domestic) jurisdictions. We therefore predict β_2 and $\beta_3 > 0$, and γ_2 and $\gamma_3 < 0$. In contrast, implicit tax theory suggests that in equilibrium, a reduction in the explicit tax rate is associated with lower pre-tax returns on investments. Prior studies consistently find that firms face lower pre-tax returns in countries offering higher tax savings (e.g., Collins et al. 1998; Markle, Mills, and Williams 2017). Thus, to the extent that implicit tax incentives dominate explicit tax incentives, we expect negative coefficients on β_2 and β_3, and positive coefficients on γ_2 and γ_3.

$DomR\&D_{i,t}$ and $ForR\&D_{i,t}$ measure domestic and foreign R&D activity as described above. In the absence of tax and economic incentives to shift income outside the U.S., we do not expect *DomR&D* or *ForR&D* to increase or decrease domestic or foreign profit margins above or below worldwide profit margins. Therefore, we do not offer a directional prediction on the coefficients for $DomR\&D_{i,t}$ and $ForR\&D_{i,t}$ in Equations (5) and (6).

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[23] We acknowledge that our tax rate measure based on observable foreign inventor countries could underestimate income shifting to unobservable low-tax foreign countries, thus weakening our results. Klassen and Laplante (2012b) calculate the tax incentive measure using a five-year average foreign effective tax rate whereas we use the statutory tax rate. We believe the statutory tax rate is more appropriate for our study for two reasons. First, we are primarily interested in R&D-related income shifting to foreign countries in which MNCs also conduct R&D. Second, the foreign effective tax rate is endogenous to income shifting strategies, which might bias the coefficient in favor of tax-motivated income shifting. On the other hand, our tax rates based on foreign inventor countries are endogenous to firms' R&D location decisions. In addition to controlling for country-level economic characteristics affecting R&D locations, we confirm that our results are robust to measuring tax incentives using five-year average foreign effective rates. We also find consistent results when we use the minimum forward-looking five-year average statutory tax rate among foreign inventor countries to replace the inventor-weighted forward-looking five-year average foreign inventor country statutory tax rates.

WageSavings$_{i,(t,t+4)}$ is a measure of the savings achieved as a result of moving R&D activity to other countries whose employees earn lower wages on average. We calculate this variable as the five-year weighted-average difference between U.S. R&D labor wages and R&D labor wage in foreign countries in which firm *i* has an inventor listed on a patent application in year t, scaled by worldwide sales. To be consistent with other independent variables, we take the average of wage savings for each country over years *t* through *t+4* and weight foreign wages by the share of foreign inventors in each country. We estimate R&D labor wages based on the annual earnings of an electrical engineer employed by an industrial firm in major metropolitan areas worldwide in 2005 dollars. We obtain the data from UBS Prices and Earnings surveys (UBS 2015). Because the survey is conducted every three years, we follow Muendler and Beckera (2006) by using linear interpolation to fill missing values between two adjacent non-missing years.[24] Results are robust to estimating R&D wages based the average wages of R&D occupations (i.e., engineers, technicians, and computer programmers) from the Occupational Wages around the World (OWW) database. However, the drawback of the OWW database is that the coverage of R&D occupations varies significantly across countries and the changing composition of R&D wages introduces noise. Empirically, we expect foreign profit margins relative to worldwide profit margins to be increasing in the difference between U.S. and foreign wages. Therefore, we expect the coefficient on *WageSavings* to be positive when *ForRoS* is the dependent variable (β_6>0).

Consistent with our model of income shifting incentives and R&D, we expect that U.S. MNCs shift more profits attributable to domestic R&D activities to foreign countries as foreign

[24] For example, consider the case where both year *t* and year *t+4* have non-missing values. To fill the missing wage in year *t+1*, we use the interpolated average of (3/4*$wage_t$+1/4*$wage_{t+4}$). To fill year *t+2*, we use the interpolated average of (2/4*$wage_t$+2/4*$wage_{t+4}$). To fill year *t+3*, we use the interpolated average of (1/4*$wage_t$+3/4*$wage_{t+4}$).

tax rates decrease relative to U.S. tax rates. We test this prediction by interacting *DomR&D* with the inbound and outbound tax-motivated income shifting incentives and expect a positive coefficient on the interaction with outbound shifting incentives variable when *ForRoS* is the dependent variable ($\beta_8 > 0$ in Equation 5), and a negative coefficient when using *DomRoS* as the dependent variable ($\gamma_8 < 0$ in Equation 6). Because the total amount of consolidated worldwide pre-tax income is unaffected by income shifting (i.e., the choice to locate income is a zero-sum game from a pre-tax income perspective), one dollar of domestic profit shifted out coincides with one dollar of foreign profit shifted in. Empirically, we test whether the sum of the tax coefficients across Equations (5) and (6) ($\beta_2 + \beta_8 + \gamma_2 + \gamma_8$) equals zero.

Consistent with our model of wage savings incentives and R&D, we also expect that when foreign wage savings are high, MNCs report higher foreign profit margins related to foreign R&D activity. We test this prediction by interacting *ForR&D* with *WageSavings* and expect a positive coefficient on this variable when *ForRoS* is the dependent variable ($\beta_9 > 0$). Because an increase in foreign profit margins as foreign wage savings increases does not necessarily reduce domestic profit margins to the extent that foreign R&D boosts domestic profits from R&D, we make no prediction for this variable (γ_9) when *DomRoS* is the dependent variable and do not test whether the sum of the two coefficients across Equations (5) and (6) equals zero.

Our hypotheses concern the relative effect of the tax incentive and the wage savings on the relation between R&D and foreign profit margins. H1a predicts that tax-motivated income shifting associated with domestic R&D activity contributes more to foreign profit margins than wage savings associated with foreign R&D, whereas H1b predicts that the wage savings effect contributes more to foreign profit margins than the tax effect. To facilitate a comparison of the coefficients, we standardize all independent variables to have a mean of zero and a standard deviation of one, and multiply standardized independent variables to generate interaction terms.[25] This process allows us to test our hypotheses by comparing the relative magnitudes of the coefficients on the interaction terms β_8 and β_9 in Equation (5). We include year fixed effects to control for unobserved economic shocks and industry fixed effects to control for heterogeneity across industries. To mitigate the influence of outliers, we winsorize continuous financial variables at 1 and 99 percent. Additionally, we cluster standard errors by firm to control for potential serial correlation induced by multi-year averages.

We follow Huang, Krull, and Ziedonis (2015) and include variables that control for other economic determinants that might jointly determine the profitability measures and domestic or foreign R&D activity: economy size ($GDP_{i,(t,\ t+4)}$), economic growth ($GDPGrowth_{i,(t,\ t+4)}$), R&D human capital ($HumanCapital_{i,(t,\ t+4)}$), foreign direct investment ($FDI_{i,(t,\ t+4)}$), and intellectual property protection ($IPR_{i,(t,t+4)}$). Each variable is the five-year forward looking equally-weighted average for countries in which the firm lists an inventor on a patent application.[26] $GDP_{i,(t,\ t+4)}$ is the natural log of gross domestic product in 2005 constant dollars and controls for country size. $GDPGrowth_{i,(t,t+4)}$ is the annual percent change in gross domestic product and is included to control for economic growth.[27] $HumanCapital_{i,(t,\ t+4)}$ measures R&D human capital estimated as the logarithm of one plus the number of researchers per million of inhabitants in inventor

[25] Preacher (2003) suggests that standardized interaction terms should be based on the product of standardized terms, rather than on a standardized product term.

[26] Our main results are robust to weighting control variables by the number of inventors in each country. However, some inventor-weighted control variables are highly correlated. For example, the correlation between inventor-weighted *GDP* and *IPR* is 0.99 (p-value<0.01). We thus use equally-weighted measures to avoid multi-collinearity.

[27] In addition to cost savings, companies conducting R&D in countries like China and India also try to tap into growing markets. To control for the confounding impact of foreign growth on the relation between R&D wage savings and foreign profitability, we include the interaction between *GDPGrowth* and foreign R&D. In these untabulated tests, we continue to find consistent results for the coefficient on *ForR&D*WageSavings* (β_9=0.028, p=0.00).

countries. This measure controls for available talent within a R&D location.[28] $FDI_{i,t+4}$ is foreign direct investment scaled by GDP. This measure controls for investment risk in a country as well as how open the economy is to outside investment (Asiedu 2002; Busse and Hfeker 2007). $IPR_{i,(t,t+4)}$ is the intellectual property rights index from Allred and Park (2007) and controls for the effect of intellectual property rights on a firm's willingness to conduct research in a particular country. While we expect *GDP*, *GDPGrowth*, *HumanCapital*, *FDI*, and *IPR* to attract R&D activities, it is unclear how these factors influence foreign profit margins. For example, firms are more likely to have successful innovations with better local R&D resources, but to the extent that increased demand for talent drives up local R&D costs, foreign profit margins might not rise.[29]

Sample Construction

Table 1 summarizes our sample construction process. We start with a sample of U.S. firms in the Compustat database from 1993 to 2006. We begin our sample period in 1993 because that is when our corporate tax rate data first become available (KPMG 2006, 2011). Our sample period ends in 2006 because this is the last year NBER provides patent match data with Compustat. We measure domestic and foreign R&D activity by using the location of inventors listed on patent applications. Thus, we merge the Compustat data with patent data from the Institute for Quantitative Social Science at Harvard University (Li et al. 2014) using the match file provided by NBER and the U.S. Patent and Trademark Office (USPTO) (Bessen 2009). This step results in 14,674 firm-year observations with available patent inventor locations. We also

[28] Prior research suggests that the availability of human talent to conduct R&D should complement the effect of wage savings in driving foreign R&D profitability (Lewin et al. 2009). In untabulated results, we estimate equation (1) on two subsamples partitioned at the median foreign R&D expenditure. We estimate a significantly positive coefficient on $ForR\&D_{i,t}*WageSavings_{i,(t,t+4)}$ in the above-median foreign R&D subsample (β_9=0.055, p=0.00), but a statistically insignificant coefficient in the below-median foreign R&D subsample (β_9=-0.013, p=0.66).

[29] We also considered controlling for scientific research capacity based on the number of scientific and engineering journals by country and year, however this measure is highly correlated with GDP (ρ=0.87). Results are robust to including this variable.

require firm-years to have non-missing foreign segment information to calculate foreign profit margins. We exclude firm-years that have negative five-year summed pre-tax domestic or foreign income, as these firms likely have non-optimal income shifting outcomes such as losses in low-tax countries and profits in high-tax countries (Stock 2013), and outlier firms with foreign or domestic returns on sales greater than one.[30] These steps are consistent with existing income shifting studies (Collins et al. 1998; Klassen and Laplante 2012b). We then eliminate firm-years that do not have sufficient country level data for multivariate regressions, resulting in a final sample of 2,760 firm-year observations.

Figure 1 illustrates the time trends associated with foreign profitability and R&D investments. In Panel A, we graph the annual averages of residuals from regressing foreign pre-tax return on sales on worldwide pre-tax return on sales and industry fixed effects. Consistent with Grubert (2012), we find that foreign profit margins are increasing relative to worldwide profit margins during our sample period. The focus of our study is to examine how R&D contributes to rising foreign profitability, and thus to the rising deviation of foreign profit margins from worldwide profit margins in our sample. Panels B and C show time trends for R&D employees. In Panel B, we graph foreign R&D employees as a percentage of worldwide R&D employees over time according to benchmark survey data reported by the BEA. In Panel C, we graph foreign inventors as a percentage of worldwide inventors from the USPTO patent file. Both panels show a consistent trend of increasing foreign R&D over time during our sample period. Panels D and E of Figure 1 show the tax rate and wage savings over our sample period.

[30] To eliminate outliers, Dyreng and Markle (2016) keep observations where the sum of foreign and domestic sales is within one percent of total sales or the sum of foreign and domestic pre-tax income is within one percent of total pre-tax income. Our main results remain robust when we use the same sample restriction but we lose 40 percent of the sample. We implement the spirit of Dyreng and Markle (2016) by excluding outlier observations that have domestic, foreign, or worldwide RoS above one.

Both panels reflect increasing trends in these measures. These results are consistent with our expectation of a relation between foreign profits and tax- and wage-related incentives over time. Our empirical analyses allow us to compare the relative importance of these factors.

Table 2 describes the composition of the 2,760 firm-year observations in our sample. Panel A reports the industry composition of sample firm-years. The most represented industries are computer and electronics manufacturing, and machinery manufacturing, followed by chemical manufacturing. Indeed, a majority of sample firms are manufacturing firms. The industry composition is similar to Klassen and Laplante (2012b). Panel B provides descriptive information for the same sample by inventor country in ascending order by R&D wages. The U.S. has one of the highest R&D wages, ranked fourth after Switzerland, Japan, and Luxembourg. In contrast, emerging markets such as Ukraine, Bulgaria, Philippines, and India offer much lower R&D wages and have lower corporate income tax rates but enforce weaker IP protections. We also report the wage discount, *s*, and the tax rate differential scaled by one less the foreign tax rate, $(t_d - t_f)/(1 - t_f)$, as given in Equation (3). The mean wage discount ranges from -10 percent to 93 percent, whereas the mean scaled tax rate differential ranges from -10 percent to 32 percent. Moreover, the wage discount is greater than the scaled tax rate differential in all but six foreign countries.

Table 3 Panel A provides summary statistics for our sample. Sample firms on average report 11.8 percent worldwide pre-tax RoS and 11.2 percent foreign pre-tax RoS. Weighted-average foreign inventor country statutory tax rates are 3.1 percent less than the U.S. statutory tax rate. Weighted-average R&D wage savings are 0.012, suggesting that the average R&D wage savings per one thousand workers by shifting R&D jobs overseas could account for 1.2 percent of worldwide sales on average.[31]

Panel B of Table 3 provides Pearson correlations between all regression variables. As predicted, foreign and domestic five-year average pre-tax RoS are positively correlated with worldwide five-year average pre-tax RoS (0.64 and 0.74, respectively). Consistent with foreign profit margins responding to tax incentives, foreign pre-tax RoS is also positively correlated with the differential tax rate of foreign operations. Consistent with economic incentives motivating foreign R&D activity, foreign wage savings are positively correlated with foreign R&D activity (0.32). While some country level control variables have high correlations (e.g., the correlation between *GDP* and intellectual property rights is 0.81), we find consistent results when we exclude *GDP* from the regressions. However, failing to include *GDP* could lead to correlated omitted variables bias.

RESULTS

Hypothesis Tests

To benchmark against existing literature, we first estimate Equation (5) without the R&D and non-tax incentive variables, resulting in an equation similar to Collins et al. (1998) and Klassen and Laplante (2012a, 2012b). Column (1) of Table 4 reports these results. Consistent with these studies, we find a positive and significant coefficient on outbound tax incentives, *(DomSTR–ForTax)>0* (β_3=0.166; $p<0.01$), suggesting that lower taxes in foreign inventor countries compared to the U.S. are associated with outbound income shifting. However, different

[31] As described in Appendix B, the numerator of *WageSavings* is in dollars and the denominator is in thousands. Therefore, we interpret this measure as per 1,000 workers. We state the numerator and denominator in different units to avoid very small means of this variable. Moreover, during our sample period wage savings are permanent, whereas tax savings reverse when earnings are repatriated to the U.S.

from prior studies, we find a negative and significant coefficient on inbound tax incentives *(DomSTR–ForTax)≤0* (β_2=-0.081; p=0.097). Consistent with implicit taxes requiring higher before-tax returns in high foreign tax rate countries (Collins et al. 1998, Markle et al. 2017), the negative coefficient suggests that the implicit tax effect outweighs the inbound income shifting effect. Our result for inbound income shifting is different from Klassen and Laplante (2012a, 2012b) because we use statutory tax rates rather than effective tax rates to calculate *ForTax*. Mills and Newberry (2004) find similar evidence that implicit taxes have a stronger impact on pre-tax income related to statutory tax rates than that related to effective tax rates, and they suggest that the evidence is consistent with effective tax rates being influenced by corporate worldwide tax planning activities.[32] In untabulated results, we use foreign effective tax rates to calculate the tax rate differential and find a positive coefficient on the outbound tax incentive (β_2=0.089; p<0.01), consistent with Klassen and Laplante (2012a, 2012b). The results in Column (1) suggest that tax incentives play a role in higher foreign profit margins relative to worldwide margins, but it remains unclear how much income related to domestic R&D is shifted abroad and how non-tax foreign economic factors contribute to higher foreign profit margins.

We provide evidence to answer these questions in the remaining columns of Table 4 by estimating the effect of tax and non-tax incentives on foreign profit margins attributable to R&D activities. First, Column (2) presents results of estimating Equation (5) based on unstandardized variables. We expect that U.S. MNCs shift more profits attributable to domestic R&D activities to foreign jurisdictions as outbound tax incentives increase. Indeed, we observe a positive and

[32] To the extent that firms are able to shift income from high-tax foreign countries to low-tax foreign countries, the implicit tax effect will be mitigated. This could explain why the coefficients on inbound tax incentives are statistically insignificant in most subsequent regressions. However, we are not able to capture income shifting among foreign countries because we can only observe aggregated foreign income.

significant coefficient on the interaction between domestic R&D activity and outbound tax incentives (*DomR&D$_{i,t}$*(DomSTR–ForTax)>0$_{i,(t, t+4)}$*). We also expect firms to report higher foreign profit margins via foreign R&D as foreign R&D wage savings increase. Consistent with this expectation, we find a positive and significant coefficient on the interaction between foreign R&D activity and wage savings (*ForR&D$_{i,t}$*Wagesavings$_{i,(t, t+4)}$*).

We next estimate the economic significance of the results in Column (2). The coefficient on *DomR&D$_{i,t}$*(DomSTR–ForTax)>0$_{i,(t, t+4)}$* is 1.070 (p=0.02). Focusing on firm-years with foreign R&D activities, this coefficient suggests that a firm with average *DomR&D$_{i,t}$* and *(DomSTR - ForTax)>0$_{i,(t, t+4)}$* increases reported foreign RoS attributable to domestic R&D activity by 0.36 percentage points (1.07*0.052*0.065). Given the sample average foreign sales of $6.6 billion, this estimate suggests an additional $24 million per firm-year of tax-related income shifting to foreign countries attributable to domestic R&D. Based on a sample of 132 firms with foreign inventors in 2005, this result translates into a total annual increase of domestic R&D-related income shifting of $3.2 billion. In contrast, the coefficient on *ForR&D$_{i,t}$*WageSavings$_{i,(t,t+4)}$* is 1.348 (p<0.01). This coefficient suggests that a firm with average foreign R&D intensity and foreign R&D wage savings increases reported foreign profits from foreign R&D by 0.04 percentage points (1.348*0.013*0.020). Based on the sample average foreign sales of $6.6 billion and a sample of 132 firms in year 2005, this result suggests that wage savings increase foreign income by a total of $348 million in year 2005 (0.04%*6.6 billion*132 firms). This amount is about 11 percent of the $3.1 billion foreign income increase we estimate associated with tax-motivated income shifting.[33]

[33] Alternatively, we interpret the economic magnitude using standard deviations. Focusing on firms with foreign R&D, a firm with a one standard deviation increase of *DomR&D$_{i,t}$* and *(DomSTR - ForTax)>0$_{i,(t, t+4)}$* increases reported foreign RoS attributable to domestic R&D activity by 0.65 percentage points (1.07*0.102*0.060). Given

Columns (3) and (4) present results of estimating Equations (5) and (6), respectively, using standardized variables so that we can directly compare tax and non-tax effects. Our main variables of interest for testing H1a and H1b are the interaction terms ($DomR\&D_{i,t}*(DomSTR–ForTax)>0_{i,(t, t+4)}$ and $ForR\&D_{i,t}*WageSavings_{i,(t,t+4)}$).[34] In Column (3), we find that the coefficient on the interaction between domestic R&D and outbound tax incentives (β_8 = 0.076, p=0.02) is three times greater in magnitude than the coefficient on the interaction between foreign R&D and wage savings (β_9 = 0.025, p<0.01). These two coefficients are marginally statistically different at a significance level of ten percent. This result is consistent with H1a and the economic interpretation of Column (2) that tax motivated income shifting associated with domestic R&D contributes more to foreign profit margins than foreign wage savings associated with foreign R&D. In our cross-sectional tests, we explore different situations in which we expect one effect to be stronger than the other.

Next, consistent with the expectation that the total increase of foreign profits and decrease of domestic profits associated with tax incentives sum to zero, we find that the sum of all tax incentive variables ($\beta_3 + \beta_8 + \gamma_3 + \gamma_8$) is not significantly different from zero (the sum of coefficients is 0.029, p=0.25). These results suggest that firms shift income attributable to domestic R&D activity to foreign countries in response to tax incentives in foreign R&D countries, consistent with policymakers' concerns (OECD/G20 2015).

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the sample average foreign sales of $6.6 billion and a sample of 132 firms with foreign R&D in 2005, this translates into a total annual increase of domestic R&D-related income shifting of $5.7 billion. On the other hand, a firm with a one standard deviation increase of foreign R&D intensity and foreign R&D wage savings increases reported foreign profits from foreign R&D by 0.22 percentage points (1.348*0.029*0.055). Based on sample average foreign sales of $6.6 billion and a sample of 132 firms with foreign R&D in 2005, this result suggests that wage savings increase foreign income by a total of $1.9 billion.

[34] In supplemental tests, we estimate *WageSavings* following the definition of the wage savings parameter *s* in the theoretical model. Specifically, we scale the difference between the U.S. and foreign inventor countries' wages using forward five-year average U.S. wages. In untabulated results, the estimated coefficient on $WageSavings_{i,(t,t+4)}$ is 0.040 (p=0.41), and the estimated coefficient on $ForR\&D_{i,t}*WageSavings_{i,(t,t+4)}$ is 0.069 (p=0.00).

Other estimated coefficients are generally as predicted. Specifically, we find a positive and significant relation between worldwide pre-tax RoS and foreign and domestic pre-tax RoS. Surprisingly, we find a negative coefficient on foreign wage savings when foreign RoS is the dependent variable. Because we interact foreign wage savings with foreign R&D intensity, the negative coefficient on foreign wage savings suggests that firms without foreign R&D are not able to tap into lower foreign R&D wage; as foreign R&D cost savings grow, opportunity costs rise thereby decreasing foreign profits. For control variables, we find a negative association between *HumanCapital* and domestic *RoS*, suggesting that this other economic factor influences domestic profits margins.

To address the concern that both wage savings and tax rates are correlated with unobservable country-level characteristics, thus biasing the coefficient comparison between tax rates and wage discount, we confirm that results are robust to the inclusion of inventor country fixed effects. In untabulated tests including fixed effects for each country in which the firm-year has R&D inventors, we continue to estimate positive and significant coefficients on the interactions between $DomR\&D_{i,t}$ and $(DomSTR–ForTax)>0_{i,(t,\ t+4)}$ (0.066, p-value < 0.01) and between $ForR\&D_{i,t}$ and $WageSavings_{i,(t,t+4)}$ (0.022, p-value < 0.05). Further, the magnitudes of these coefficients are similar to those reported in our main results.

Cross-Sectional Tests

We conduct additional tests that exploit cross-sectional differences in our sample by identifying situations where we expect wage savings from foreign R&D to contribute more to foreign profit margins than tax-motivated income shifting attributable to domestic R&D, and vice-versa. We separately estimate Equation (5) for samples partitioned by variables of interest and use seemingly unrelated regressions to compare key coefficients across samples. In the first test, we focus on situations where wage savings are greater than tax incentives and vice versa. We begin by estimating the wage discount, *s*, and tax rate differential scaled by one minus the foreign rate, $(t_d\text{-}t_f)/(1\text{-}t_f)$, for each country-year as given by Equation (3). We subsequently measure for each firm-year the percentage of foreign inventor countries with a wage discount greater than the tax expression ($s > (t_d\text{-}t_f)/(1\text{-}t_f)$), and sort firm-years into terciles based on this percentage. We define firm-years in the top (bottom two) tercile(s) as having high (low) wage savings. We expect the coefficient on $ForR\&D_{i,t}*WageSavings_{i,(t,t+4)}$, β_9, to exceed the coefficient on $DomR\&D_{i,t}*(DomSTR–ForTax)>0_{i,(t,\ t+4)}$, β_8, when estimating Equation (5) for firm-years having high wage savings relative to tax incentives, and the opposite for firm-years having low wage savings relative to tax incentives.

We report results of these tests in Table 5. Column (1) reports results of estimating Equation (5) on the subsample of firm-years for which we expect tax incentives to be more important, and Column (2) reports results on the subsample of firm-years for which we expect wage savings to be more important. In Column (1) where we expect wage saving to be low relative to tax incentives, we find that the coefficient on *DomR&D*(DomSTR–ForTax)>0*, β_8, is positive and significant, whereas the coefficient on *ForR&D*WageSavings*, β_9, is not significant. Moreover, β_8 is significantly larger than β_9 ($\beta_8 - \beta_9$ = 0.191; p<0.01), suggesting that tax-motivated income shifting dominates wage savings in increasing R&D-related foreign profit margins when wage discounts are low. In contrast, in Column (2), we find that β_9 is positive and significant but β_8 becomes insignificant, providing evidence that tax incentives play an insignificant role in R&D-related profit margins for firms with higher wage discounts. Further, β_9 is greater than β_8, though this difference is not significant ($\beta_9 - \beta_8$ = 0.014; p=0.71). Finally, to the extent that wage discounts increase and tax differentials decrease as we move from Column

(1) to Column (2), we find that the decrease in magnitude of the effect of tax incentives is significantly different from the increase in magnitude of the effect of wage savings ($p<0.01$). These results suggest that, while on average tax incentives are more important in explaining R&D-related foreign profit margins than wage savings, scenarios exist in which wage savings are more important in explaining R&D-related foreign profit margins than tax incentives.

In our second set of cross-sectional tests, we focus on factors affecting the cost of the wage savings strategy but not the cost of the tax strategy and vice versa. First, we expect capital-intensive technologies to have higher costs of delegating R&D to a foreign jurisdiction. As these costs increase, we expect foreign profits to be less influenced by foreign R&D and wage savings incentives. To test this prediction, we construct an index to measure the ease of shifting R&D abroad. This index weights firm patents related to computer, chemical, drug, electrical, and mechanical inventions based on the ease with which the underlying R&D activities contributing to such inventions can be shifted abroad (Lewin et al. 2009).[35] We then classify firms in the bottom tercile of this index as having high R&D shifting costs. We expect the wage savings incentive, but not the income shifting incentive, to be less important for firms with high R&D shifting costs compared to firms with low shifting costs; we therefore expect the difference in coefficient on *ForR&D*WageSavings* (β_9) between the low and high wage savings incentive samples to be more pronounced than the difference in the coefficient on *DomR&D*(DomSTR–ForTax)>0* (β_8).

Table 6, Column (1) reports results for firm-years having an ease of R&D shifting index in the bottom two terciles, and Column (2) reports results for firm-years in the top tercile.

[35] Specifically, the R&D cost function index is equal to 5*computer patent percentage + 4*chemical patent percentage + 3*drug patent percentage + 2*electrical patent percentage + 1*mechanical patent percentage. Patents that are more capital intensive (more difficult to delegate) receive a lower weight in the R&D cost function index.

Consistent with our predictions, we find that foreign income attributable to wage savings and foreign R&D is concentrated in the low R&D shifting cost subsample. We find a positive and significant β_9 in Column (1) but not in Column (2). This difference in β_9 across the two columns is statistically significant ($p=0.01$). Moreover, the difference in β_8 across subsamples is not significantly different, suggesting that the cost of moving R&D abroad related to the wage strategy decrease the effect of wage savings on foreign profit margins.

Second, we bifurcate our sample based on relative jurisdictional transfer pricing uncertainty. To the extent a country has a volatile likelihood of challenging a firm's transfer pricing, firms face increased uncertainty and therefore a higher cost of tax-motivated income shifting to subsidiaries in that country (Gallemore and Labro 2015; Mescall and Klassen 2016). Specifically, we expect the coefficient on *DomR&D*(DomSTR–ForTax)>0*, β_8, to be larger when transfer pricing uncertainty is low than when it is high. Building on the country-year-specific likelihood of transfer pricing transactions being challenged by tax authorities developed by Klassen and Mescall (2016), we construct three metrics of transfer pricing uncertainty: (1) the country specific standard deviation of the likelihood of being challenged during the sample period, (2) the percentage of foreign inventor countries in the top tercile of that country-specific standard deviation, and (3) the five-year rolling average standard deviation of the likelihood of being challenged for each country.[36] We also use factor analysis to construct an index value of transfer pricing uncertainty by dichotomizing these three metrics. We create dummy variables equal to one if the value of each metric is in the top tercile and equal to zero otherwise. We use

[36] We thank Devan Mescall and Ken Klassen for providing the data on transfer pricing regimes.

iterated factor analysis that repeats the fitting processes to get better estimates of the communalities and use varimax rotation to have orthogonal factors (Tinsley & Tinsley, 1987).[37]

We report the results of these tests in Columns (3) and (4) of Table 6. Column (3) reports results for firm-years with a transfer pricing uncertainty index value (income shifting costs) below the sample median, and Column (4) reports results for firm-years above the sample median.[38] We find that tax-motivated income shifting attributable to domestic R&D is more important in the low transfer pricing cost subsample than in the high cost subsample. Specifically, we find positive and significant coefficients (β_8) in Columns (3) and (4), but the magnitude of the coefficient in Column (3) is nearly twice that in Column (4), though this difference in coefficients is not statistically significant at the 10 percent confidence level (p=0.22). However, the difference in magnitudes of β_8 between the low and high transfer pricing uncertainty samples is more pronounced than the difference in magnitudes of β_9 between these two samples at a 10 percent significance level. Overall, we take these results as evidence that the estimated cost functions of each strategy predictably influence the relative importance of these strategies in foreign profit margins.

Overall, the results of our cross-sectional tests provide evidence that both tax and wage incentives are important in explaining rising foreign profit margins, and which incentive plays a larger role depends on the magnitude of the costs and benefits of each strategy.

Robustness and Additional Tests

[37] Our approach of converting nonbinary variables into binary values to construct common factor scores is similar to Francis, Nanda, and Olsson (2008). The eigenvalue of the factor is 1.688. The factor loading for each metric is 0.844, 0.472, and 0.822 after rotation.
[38] To have consistent cutoffs of samples across tables, we focus on the tercile cutoff for each individual measure. For the common factor score of dichotomized individual measures based on tercile cutoffs, we use the median cutoff.

In untabulated robustness tests, we confirm that results are robust to including an additional control for scientific capacity, and to restricting the sample to firms with foreign R&D. We add the interaction between tax incentive (*DomSTR - ForTax*) and foreign R&D (*ForR&D*) in Equation (5) and continue to find evidence consistent with our main results; the coefficient on the interaction between tax incentives and foreign R&D is insignificant at the 10% confidence level, suggesting that the tax incentive plays little role in increasing foreign profit margins related to foreign R&D.

In further untabulated tests, we evaluate the impact of patent value on tax- and wage-related income shifting. We expect firms with more valuable patents to have higher income shifting and wage savings opportunities. We construct a patent value index as the common factor score of three variables: (1) An indicator variable equal to one if the firm has at least one patent citation, as existing research suggests that citations of a patent by later patents indicate that the patent is innovative and influential (Trajtenberg 1990; Hall, Jaffe and Trajtenberg 2005). (2) An indicator variable equal to one if the firm files at least one patent with the European Patent Office (EPO) and the Japanese Patent Office (JPO), (also known as triadic patent families) because patent protection is only valid in the country that grants protection and firms have a one-year waiting period to gauge the value of patents before paying additional legal and filing expenses to seek protection abroad.[39] This process suggests that more valuable patents are more likely to be filed in several countries (Dernis and Khan 2004). (3) An indicator variable equal to one if the firm has at least one patent citation received by patents developed by foreign inventors, signifying that the foreign R&D is valuable. Consistent with our expectation, we find that the

[39] Under the Patent Cooperation Treaty (PCT), the date of initial patent application is referred to as the priority date. As long as inventors file patent protection with any member country of the PCT within one year, the inventor will have priority over any other similar patent application filed after the priority date.

effect of income shifting and wage savings incentives on R&D-related foreign profit margins is concentrated in firm-years with high-value patents, both with respect to economic and statistical significance. This result suggests firms are more likely to use the wage and tax savings strategies for valuable patents that create more opportunities for savings.

CONCLUSIONS

We investigate the extent to which R&D increases foreign profitability of U.S. MNCs through tax and non-tax channels. Using a publicly available dataset of patent inventor locations, we disaggregate R&D activity into domestic and foreign activity. We then test the effect of tax incentives on the responsiveness of foreign profit margins to domestic R&D activity, and the effect of wage savings on the responsiveness of foreign profit margins to foreign R&D activity. Our findings suggest that while both tax incentives and wage savings contribute to outbound R&D-related income shifting, tax incentives contribute about three times more to foreign profit margins attributable to R&D activity than non-tax incentives.

Our research question is timely and important due to increasing global concern over multinational base erosion and profit shifting activities. In the U.S., much recent debate centers around whether the U.S. should coordinate with OECD, G20, and EU efforts to curb MNC international tax planning. Our analysis of R&D activities disaggregated by location, as well as of tax and non-tax channels through which R&D increases foreign profit margins, informs this debate. Our research findings also inform the policy discussion to promote R&D investments in the U.S. Business leaders have been advocating for more R&D tax credits to increase domestic R&D investments (Center for American Progress 2012; Zerbe 2011). While one objective of expenditure-related R&D incentives is to increase tax revenues as innovation generates new sales, under the tax laws in place during our sample period, a significant proportion of that income is shifted outside the U.S. and avoids U.S. While recent tax legislation that decreased the U.S. tax rate to 21 percent and moved to a territorial tax system redirects income shifting incentives, our results provide insight into the importance of those tax changes for firms' R&D and income shifting activity.

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Appendix A. Validation of R&D Patent Inventor Measures using BEA R&D Investment Data

	Sample period from 1999 to 2006					
	Number of patent inventors from the USPTO			R&D investments from BEA in 2005 constant dollars (millions)		
	Mean	Min	Max	Mean	Min	Max
Argentina	7	3	13	31	21	47
Australia	321	151	381	446	315	696
Austria	222	103	255	126	36	303
Belgium	412	198	553	577	385	931
Brazil	45	28	61	353	219	556
Canada	2226	1411	2668	2449	1937	2820
Chile	2	1	3	8	5	11
China	482	55	851	605	368	735
Colombia	5	2	7	9	5	12
Costa Rica	2	2	3	7	6	8
Czech Republic	22	10	43	27	3	69
Denmark	232	122	378	106	64	152
Dominican Repub	1	1	1	1	1	1
Egypt	3	2	4	4	2	5
Finland	1263	650	2045	106	68	187
France	2610	997	3580	1775	1471	2248
Germany	9222	4395	12806	4099	3511	4792
Greece	9	5	12	18	7	40
Honduras	1	1	1	0	0	0
Hong Kong	51	41	67	205	98	319
Hungary	28	5	43	27	15	39
India	406	179	508	160	23	327
Indonesia	3	1	7	3	1	5
Ireland	158	79	187	675	289	1040
Israel	818	699	967	746	448	901
Italy	886	454	1242	637	580	730
Japan	38330	14042	50620	1735	1661	1837
Korea, South	515	137	1045	289	116	719
Luxembourg	8	7	8	178	97	260
Malaysia	111	59	163	218	166	267
Mexico	73	49	92	298	273	342
Netherlands	587	216	822	467	392	545
New Zealand	46	16	95	18	7	37
Nigeria	1	1	1	2	2	2
Norway	134	66	196	41	21	100
Philippines	21	5	33	42	21	55
Poland	17	5	33	39	14	72
Portugal	5	1	8	20	9	31
Russia	86	39	119	19	1	79

Saudi Arabia	2	2	2	0	0	0
Singapore	641	461	920	630	432	832
South Africa	8	1	15	28	16	51
Spain	202	77	357	265	199	355
Sweden	915	372	1499	1393	896	1652
Switzerland	718	456	942	573	266	917
Taiwan	1723	1131	2432	145	68	377
Thailand	23	2	98	24	8	46
Turkey	5	2	7	17	7	35
United Kingdom	2696	990	3664	4800	4014	5539
United States	88947	53590	102952	159864	145547	178657
Venezuela	3	1	7	23	7	46

Correlation	
	Number of inventors
R&D investments	0.89
	(0.000)

We obtain BEA R&D country-level investment data 1999-2006 from the NSF Science and Engineering Indicators 2012 and report these figures in 2005 constant dollars. The BEA does not report R&D investment observations less than $500,000. We obtain the number of inventors listed on patent filings from the intersection of Compustat firms and USPTO-Harvard patent inventor location dataset. We exclude from the sample observations required to be suppressed to avoid disclosure of confidential information.

Appendix B. Variable Definition

Variable	Description	Source
$ForRoS_{i,(t, t+4)}$	Five-year average foreign profit margin of firm *i* from year *t* to year *t+4*, measured by the sum of foreign pre-tax income from year t to *t+4* divided by the sum of foreign sales over the same five-year period ($\sum_{t=1}^{4} PIFO_{i,t}/\sum_{t=1}^{4} Sale\_For_{i,t}$)	Compustat, Compustat Segment
$DomRoS_{i,(t, t+4)}$	Five-year average domestic profit margin of firm *i* from year *t* to year *t+4*, measured by the sum of domestic pre-tax income from year t to *t+4* divided by the sum of domestic sales over the same five-year period ($\sum_{t=1}^{4} PIDOM_{i,t}/\sum_{t=1}^{4} Sale\_Dom_{i,t}$)	Compustat, Compustat Segment
$RoS_{i,(t, t+4)}$	Five-year average worldwide profit margin of firm *i* from year *t* to year *t+4*, measured by the sum of worldwide pre-tax income from year *t* to *t+4* divided by the sum of worldwide sales over the same five-year period ($\sum_{t=1}^{4} PI_{i,t}/\sum_{t=1}^{4} Sale_{i,t}$)	Compustat, Compustat Segment
$(DomSTR – ForTax)_{i,(t, t+4)}$	Five-year weighted-average statutory income tax rate difference between the U.S. and foreign inventor countries for firm *i* from non-missing years *t* to year *t+4*. The variable is equal to (five-year average U.S. income tax rates – the weighted five-year average foreign income tax rates). Foreign income tax rates in each country are weighted by the share of foreign inventors in that country.	KPMG Corporate Tax Rate Survey (2006, 2011; Evers et al. (2015))
$(DomSTR - ForSTR)>0_{i,(t, t+4)}$	Five-year average outbound income shifting tax incentive for firm *i* from year *t* to year *t+4*. The variable is equal to $(DomSTR – ForSTR)_{i,(t, t+4)}$ if the value is more than zero, zero otherwise.	KPMG Corporate Tax Rate Survey (2006, 2011); Evers et al. (2015)
$(DomSTR - ForSTR)\leq 0_{i,(t, t+4)}$	Five-year average inbound income shifting tax incentive for firm *i* from year *t* to year *t+4*. The variable is equal to $(DomSTR – ForSTR)_{i,(t, t+4)}$ if the value is less than or equal to zero, zero otherwise.	KPMG Corporate Tax Rate Survey (2006, 2011); Evers et al. (2015)
$DomR\&D_{i,t}$	Domestic R&D intensity, equal to (the number of domestic inventors of firm *i* in year *t*)/ worldwide sales in year *t*.	Harvard inventor database, NBER patent database
$ForR\&D_{i,t}$	Foreign R&D intensity, equal to (the number of foreign inventors of firm *i* in year *t*)/ worldwide sales in year *t*.	Harvard inventor database, NBER patent database
$WageSavings_{i,(t,t+4)}$	Five-year weighted-average foreign R&D wage savings for firm *i* from non-missing years *t* to year *t+4*. The variable is equal to (five-year average U.S. R&D wage – the weighted five-year average foreign R&D wage)/(worldwide sales in year *t* in thousands). The R&D wage is in 2005 constant dollars. R&D wages in each country are weighted by the share of foreign inventors in that country.	UBS Prices and Earnings Open data
$GDPGrowth_{i,(t, t+4)}$	Five-year average economic growth (GDP growth rate) of worldwide inventor countries for firm *i* from year *t* to year *t+4*.	World Bank
$HumanCapital_{i,(t, t+4)}$	Five-year average R&D human capital of worldwide inventor countries for firm *i* from year *t* to year *t+4*. R&D human capital is measured by the natural logarithm of (1+the number of researchers per million people in country *j* in year *t*). The number researchers is replaced as zero if missing.	World Bank
$FDI_{i,(t, t+4)}$	Five-year average foreign direct investment (FDI) ratio of worldwide inventor countries for firm i from year t to year t+4. The FDI ratio is foreign direct investments in country j scaled by the country's GDP size.	World Bank
$IPR_{i,(t, t+4)}$	Five-year average intellectual property rights of worldwide inventor countries for firm i from year t to year t+4.	Allred and Park (2007)
$GDP_{i,(t, t+4)}$	Five-year average GDP size of worldwide inventor countries for firm i from year t to year t+4. GDP size is the natural logarithm of GDP value in 2005 constant dollars.	World Bank

Figure 1. Time Trends of Foreign Pre-Tax Profit Margins and Investments in R&D

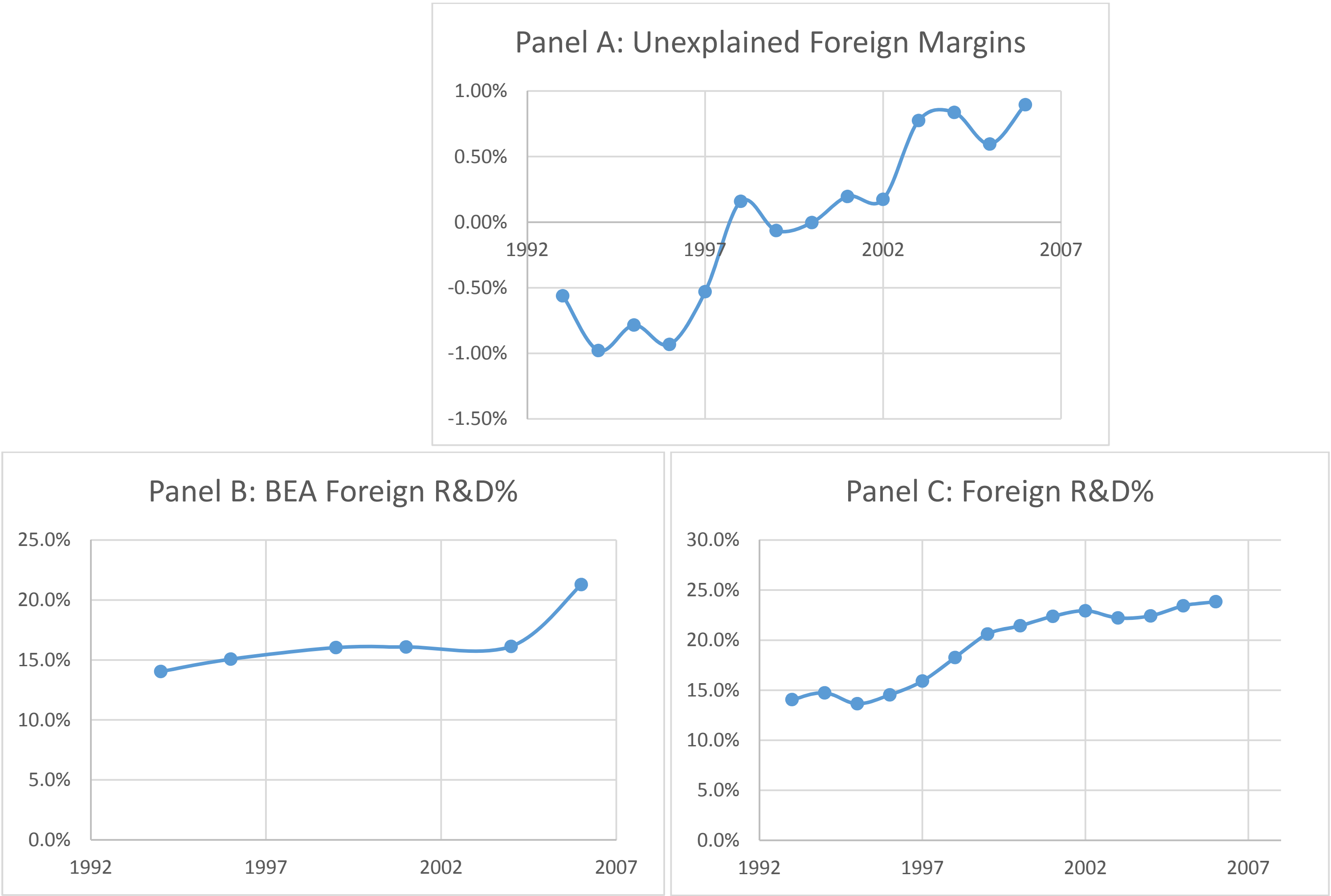
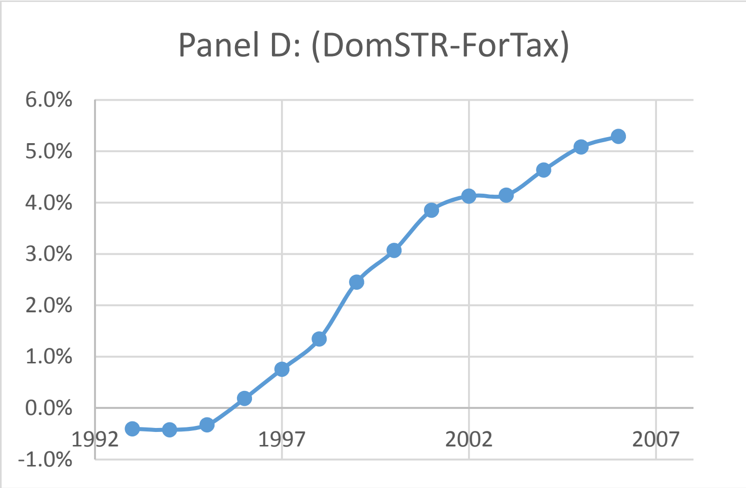
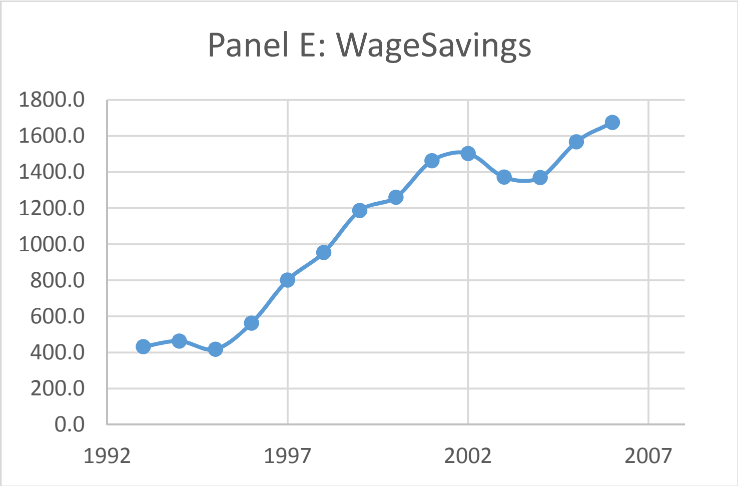


Figure 1. Time Trends of Foreign Pre-Tax Profit Margins and Investments in R&D, Cont'd





Panel A shows annual averages of the residuals from regressing foreign pre-tax return on sales on worldwide pre-tax return on sales and industry fixed effects based on a sample of 2,760 firm-year observations used in multivariate regressions. Panel B shows the percentage of worldwide R&D employees that are foreign based on the BEA survey benchmark years of 1994, 1999, 2004 and 2009. We calculate midpoint years (1996, 2001 and 2006) using the average value of the two adjacent benchmark years. Panels C, D and E are based on the 14,674 firm-year observations with inventor countries from the intersection of Compustat and the patent inventor location dataset. Panel C shows the average percentage of worldwide inventors that are foreign by year. Panel D shows the five-year weighted average statutory income tax rate difference between the U.S. and foreign inventor countries by year. Panel E shows the five-year weighted average wage cost difference between the U.S. and foreign inventor countries by year.

Table 1
Sample Construction

Income shifting sample	**Obs**
Compustat firm-year observations with available patent inventor information between year 1993 and 2006	14,674
Less: firm-years with missing multiyear financial information	(3,996)
Less: firm-years with negative five-year summed pre-tax domestic or foreign income and firm-years with five-year average foreign ROS, domestic ROS, or worldwide ROS above one	(1,626)
Less: firm-years with missing country information	(6,292)
Total firm-year observations	2,760

The sample includes 2,760 firm-year observations from the intersection of Compustat and the patent inventor location dataset from the Institute for Quantitative Social Science at Harvard University with sufficient information for estimation.

Table 2
Sample Composition

Panel A: Industry breakdown

NACIS group	Name	Frequency	Percent
334	Computer and electronics manufacturing	629	22.8%
333	Machinery manufacturing	384	13.9%
325	Chemical manufacturing	363	13.2%
336	Transportation equipment manufacturing	218	7.9%
511	Publishing (including software)	192	7.0%
339	Miscellaneous manufacturing (including medical equipment)	151	5.5%
335	Electrical equipment manufacturing	115	4.2%
332	Fabricated metals manufacturing	80	2.9%
311	Food manufacturing	66	2.4%
541	Professional and scientific services	66	2.4%
322	Paper manufacturing	63	2.3%
213	Mining	60	2.2%
327	Nonmetallic Mineral Product Manufacturing	36	1.3%
326	Plastics and Rubber Products Manufacturing	33	1.2%
331	Primary metals manufacturing	26	0.9%
337	Furniture manufacturing	24	0.9%
324	Oil products manufacturing	23	0.8%
Multiple	Other industries	231	8.4%
		2,760	100%

The sample includes 2,760 firm-year observations from the intersection of Compustat and the patent inventor location dataset from the Institute for Quantitative Social Science at Harvard University with sufficient information for estimation. Industries that have less than 0.5 percent frequency are aggregated into Other Industries.

Table 2, Cont'd
Sample Composition

Panel B: Descriptive Statistics by Country						
Country	R&D Ranking	CTR	$(t_d - t_f)/(1 - t_f)$	R&D Wage	*s*	IPR
Ukraine	47	0.27	18%	4,352	93%	3.68
Bulgaria	26	0.19	26%	4,827	93%	3.79
Philippines	32	0.33	10%	5,563	91%	3.73
India	13	0.36	6%	6,165	91%	2.68
Indonesia	42	0.34	9%	6,311	90%	2.37
Russia	24	0.25	20%	7,733	88%	3.68
Egypt	43	0.27	17%	7,904	88%	2.55
Lithuania	49	0.15	29%	9,453	86%	3.70
China	9	0.33	10%	10,128	84%	3.54
Poland	31	0.26	19%	11,104	83%	3.75
Czech Republic	33	0.29	15%	11,665	82%	3.25
Thailand	35	0.30	14%	11,669	82%	2.42
Mexico	29	0.34	9%	13,441	79%	2.99
Hungary	38	0.12	32%	13,633	79%	3.93
Venezuela	40	0.33	10%	14,492	78%	3.08
Colombia	45	0.35	8%	16,391	75%	3.30
Malaysia	22	0.28	17%	18,278	72%	3.20
Chile	46	0.16	28%	19,947	69%	4.48
Brazil	27	0.34	9%	22,396	66%	3.06
Turkey	36	0.33	10%	23,534	64%	3.40
Greece	34	0.36	7%	27,406	58%	3.96
Portugal	44	0.31	13%	27,818	57%	4.06
Taiwan	21	0.25	20%	28,546	56%	3.35
Argentina	39	0.35	8%	29,423	55%	3.29
Korea, South	12	0.30	15%	34,732	47%	4.14
New Zealand	30	0.33	10%	36,716	44%	3.68
Cyprus	48	0.18	27%	37,483	43%	3.48
Spain	18	0.35	8%	38,896	40%	4.21
Italy	10	0.44	-7%	38,908	40%	4.48
Australia	15	0.32	11%	39,129	40%	4.27
Israel	7	0.35	8%	41,713	36%	3.91
Hong Kong	25	0.17	28%	43,736	33%	3.65
United Kingdom	4	0.31	13%	45,845	30%	4.52
Sweden	16	0.28	17%	46,570	29%	4.45
Finland	28	0.29	16%	48,228	26%	4.53
South Africa	37	0.38	4%	48,728	25%	3.75
Ireland	17	0.00	40%	49,026	25%	4.39
Netherlands	14	0.34	9%	49,410	24%	4.60
Norway	19	0.28	17%	51,811	21%	3.96

Austria	23	0.30	14%	52,431	20%	4.29
Belgium	11	0.39	2%	52,679	19%	4.58
France	6	0.25	20%	54,219	17%	4.56
Canada	5	0.40	1%	56,682	13%	4.44
Germany	3	0.43	-6%	59,077	9%	4.58
Denmark	20	0.31	13%	65,092	0%	4.59
USA	1	0.40	0%	65,217	0%	4.86
Luxembourg	41	0.34	10%	68,044	-4%	3.98
Japan	2	0.45	-10%	70,657	-8%	4.52
Switzerland	8	0.25	21%	71,791	-10%	4.20

This table reports descriptive statistics by inventor country for the sample of 2,760 firm-year observations from the intersection of Compustat, the KPMG Corporate Tax Rate Survey and the patent inventor location dataset from the Institute for Quantitative Social Science at Harvard University with sufficient information for estimation. *R&D Ranking* is the ranking of countries by their number of inventors. *R&D Wage* is the annualized R&D wage in each inventor country (in dollars). *CTR* is the corporate income tax rate or intangible income tax rate if available. The tax rate differential scaled by one minus the foreign tax rate $(t_d-t_f)/(1-t_f)$ is defined by Equation (3). The wage discount *s* is equal to one less R&D wage in a foreign country, scaled by domestic R&D wage. *IPR* is the intellectual property protection rights. For each inventor country, we report the average R&D Wage, CTR, and IPR for the whole sample period.

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Table 3
Summary Statistics

Panel A: Univariate statistics						
Variable	mean	p25	p50	p75	sd	N
$RoS_{i,(t, t+4)}$	0.118	0.064	0.099	0.153	0.076	2,760
$ForRoS_{i,(t, t+4)}$	0.112	0.051	0.089	0.143	0.087	2,760
$DomRoS_{i,(t, t+4)}$	0.134	0.051	0.096	0.165	0.131	2,760
$(DomSTR - ForTax)_{i,(t, t+4)}$	0.031	0.000	0.000	0.070	0.070	2,760
$(DomSTR - ForTax)\leq0_{i,(t, t+4)}$	-0.008	0.000	0.000	0.000	0.027	2,760
$(DomSTR - ForTax)>0_{i,(t, t+4)}$	0.039	0.000	0.000	0.070	0.060	2,760
DomR&D	0.045	0.004	0.016	0.049	0.102	2,760
ForR&D	0.008	0.000	0.001	0.005	0.029	2,760
$WageSavings_{i,(t,t+4)}$	0.012	0.000	0.000	0.005	0.055	2,760
$GDP_{i,(t, t+4)}$	15.175	14.349	15.234	16.178	1.021	2,760
$GDPGrowth_{i,(t, t+4)}$	2.814	2.260	2.789	3.566	1.001	2,760
$HumanCapital_{i,(t, t+4)}$	0.077	0.016	0.028	0.087	0.143	2,760
$FDI_{i,(t, t+4)}$	0.029	0.015	0.024	0.036	0.021	2,760
$IPR_{i,(t, t+4)}$	4.633	4.490	4.708	4.875	0.268	2,760

This table reports descriptive statistics on the sample of 2,760 firm-year observations from the intersection of Compustat and the patent inventor location dataset from the Institute for Quantitative Social Science at Harvard University with sufficient information for estimation. All variables are defined in Appendix B. Firm-level financial variables including $ForRoS_{i,(t, t+2)}$and $RoS_{i,(t, t+2)}$ are winsorized at the 1^{st} and 99^{th} percentiles.

Table 3, Cont'd
Summary Statistics

Panel B: Correlations

		$RoS_{i(t,t+4)}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	$ForRoS_{i,(t, t+4)}$	0.640	1										
		(0.00)											
(2)	$DomRoS_{i,(t, t+4)}$	0.740	0.150	1									
		(0.00)	(0.00)										
(3)	$(DomSTR - ForTax)\leq0_{i,(t, t+4)}$	0.0900	0.0700	0.0600	1								
		(0.00)	(0.00)	(0.00)									
(4)	$(DomSTR - ForTax)>0_{i,(t, t+4)}$	0.180	0.230	0.0900	0.200	1							
		(0.00)	(0.00)	(0.00)	(0.00)								
(5)	DomR&D	0.110	0.0200	0.130	0.0400	0.0700	1						
		(0.00)	(0.26)	(0.00)	(0.03)	(0.00)							
(6)	ForR&D	0.0700	0.110	0.0600	-0.100	0.0700	0.100	1					
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)						
(7)	$WageSavings_{i,(t,t+4)}$	0.0800	0.0400	0.110	0.0800	0.170	0.240	0.320	1				
		(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)					
(8)	$GDP_{i,(t, t+4)}$	-0.140	-0.170	-0.100	0.0900	-0.510	-0.0900	-0.230	-0.140	1			
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)				
(9)	$GDPGrowth_{i,(t, t+4)}$	0	-0.0200	-0.0100	0.0200	-0.0200	0.0600	0.0100	0.0700	-0.0700	1		
		(0.79)	(0.29)	(0.77)	(0.21)	(0.37)	(0.00)	(0.54)	(0.00)	(0.00)			
(10)	$HumanCapital_{i,(t, t+4)}$	0.0800	0.120	0.0200	0.0600	0.360	0.0500	0.0900	0.0200	-0.520	-0.0500	1	
		(0.00)	(0.00)	(0.30)	(0.00)	(0.00)	(0.01)	(0.00)	(0.30)	(0.00)	(0.01)		
(11)	$FDI_{i,(t, t+4)}$	0.140	0.170	0.0900	0.130	0.520	0.0500	0.130	0.140	-0.520	-0.0100	0.490	1
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.51)	(0.00)	
(12)	$IPR_{i,(t, t+4)}$	-0.120	-0.120	-0.0900	0.230	-0.350	-0.110	-0.190	-0.140	0.810	-0.140	-0.280	-0.300
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

This table reports pairwise Pearson correlations on the sample of 2,760 firm-year observations from the intersection of Compustat and the patent inventor location dataset from the Institute for Quantitative Social Science at Harvard University with sufficient information for estimation All variables are defined in Appendix B. Firm-level financial variables including $FRoS_{i,(t, t+2)}$ and $RoS_{i,(t, t+2)}$ are winsorized at the 1st and 99th percentiles.

Table 4
R&D, Tax and Non-Tax Incentives, and Reported Foreign Profit Margins

Dependent variable	$ForRoS_{i,(t, t+4)}$		$ForRoS_{i,(t, t+4)}$	$DomRoS_{i,(t, t+4)}$
	(1)	(2)	(3)	(4)
$RoS_{i,(t, t+4)}$	0.647***	0.638***	0.559***	0.782***
	(0.000)	(0.00)	(0.00)	(0.00)
$(DomSTR - ForTax) \leq 0_{i,(t, t+4)}$	-0.081*	-0.037	-0.016	0.010
	(0.097)	(0.57)	(0.41)	(0.50)
$(DomSTR - ForTax) > 0_{i,(t, t+4)}$	0.166***	0.098**	0.102***	-0.085***
	(0.000)	(0.03)	(0.00)	(0.00)
$DomR\&D_{i,t}$		-0.086***	-0.048*	0.041
		(0.00)	(0.08)	(0.22)
$ForR\&D_{i,t}$		0.043	0.020	0.029
		(0.77)	(0.69)	(0.61)
$WageSavings_{i,(t,t+4)}$		-0.146**	-0.086**	0.086**
		(0.01)	(0.02)	(0.05)
$DomR\&D_{i,t} * (DomSTR - ForTax) \leq 0_{i,(t, t+4)}$		-0.337	-0.011	0.016
		(0.80)	(0.80)	(0.65)
$DomR\&D_{i,t} * (DomSTR - ForTax) > 0_{i,(t, t+4)}$		1.070**	0.076**	-0.064**
		(0.02)	(0.02)	(0.04)
$ForR\&D_{i,t} * WageSavings_{i,(t,t+4)}$		1.348***	0.025***	-0.020*
		(0.00)	(0.00)	(0.09)
$GDP_{i,(t,t+4)}$		-0.003	-0.033	-0.080
		(0.52)	(0.52)	(0.19)
$GDPGrowth_{i,(t,t+4)}$		-0.000	-0.006	0.001
		(0.86)	(0.86)	(0.97)
$HumanCapital_{i,(t,t+4)}$		0.001	0.002	-0.043*
		(0.95)	(0.95)	(0.07)
$FDI_{i,(t,t+4)}$		0.026	0.006	0.008
		(0.85)	(0.85)	(0.78)
$IPR_{i,(t,t+4)}$		0.003	0.009	0.037
		(0.78)	(0.78)	(0.29)
Year fixed effects?	Yes	Yes	Yes	Yes
Industry fixed effects?	Yes	Yes	Yes	Yes
N	2,760	2760	2760	2760
R-square	0.48	0.50	0.50	0.60
p-values from the following coefficient comparisons:				
Col (3) β_8 = *Col (3)* β_9			(0.10)*	
Col (3) β_8 + *Col (4)* γ_8 = 0			(0.43)	
Col(3) $\boldsymbol{\beta_3}$ **+ Col(3)** $\boldsymbol{\beta_8}$ **+ Col(4)** $\boldsymbol{\gamma_3}$ **+ Col(4)** $\boldsymbol{\gamma_8}$ **= 0**			**(0.25)**	

This table reports results of estimating Equations (5) in Columns (2) and (3) and of Equation (6) in Column (4) clustering standard errors by firm.

$$ForRoS_{i,(t, t+4)} = \beta_0 + \beta_1 * RoS_{i,(t, t+4)} + \beta_2 * (DomSTR - ForTax) \leq 0_{i,(t, t+4)} + \beta_3 * (DomSTR - ForTax) > 0_{i,(t, t+4)} + \beta_4 * DomR\&D_{i,t} + \beta_5 * ForR\&D_{i,t} + \beta_6 * WageSavings_{i,(t,t+4)} + \beta_7 * DomR\&D_{t,i} * (DomSTR - ForTax) \leq 0_{i,(t, t+4)} + \beta_8 * DomR\&D_{t,i} * (DomSTR - ForTax) > 0_{i,(t, t+4)} + \beta_9 * ForR\&D_{i,t} * WageSavings_{i,(t, t+2)} + \Sigma Controls + \varepsilon_{i,} \quad (5)$$

$$DomRoS_{i,(t, t+4)} = \gamma_0 + \gamma_1 * RoS_{i,(t, t+4)} + \gamma_2 * (DomSTR - ForTax) \leq 0_{i,(t, t+4)} + \gamma_3 * (DomSTR - ForTax) > 0_{i,(t, t+4)} + \gamma_4 * DomR\&D_{i,t} + \gamma_5 * ForR\&D_{i,t} + \gamma_6 * WageSavings_{i,(t,t+4)} + \gamma_7 * DomR\&D_{t,i} * (DomSTR - ForTax) \leq 0_{i,(t, t+4)} + \gamma_8 * DomR\&D_{t,i} * (DomSTR - ForTax) > 0_{i,(t, t+4)} + \gamma_9 * ForR\&D_{i,t} * WageSavings_{i,(t, t+4)} + \Sigma Controls + \varepsilon_{i,} \quad (6)$$

In Columns (3) and (4), we standardize all variables to have a mean of zero and a standard deviation of one. At the bottom of the table, we compare coefficients within Column (3) and use seemingly unrelated regressions to compare coefficients across Columns (3) and (4). All variables are defined in Appendix B. Firm-level financial variables including $ForRoS_{i,(t, t+2)}$ and $RoS_{i,(t, t+2)}$ are winsorized at the 1st and 99th percentiles. P-values are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

Table 5
Cross-Sectional Tests: Magnitude of Wage Savings Versus Tax Incentives

Dependent variable is $ForRoS_{i,(t, t+4)}$		
	S > (t_d-t_f)/(1-t_f)	
	(1) Low Wage Savings Incentive	(2) High Wage Savings Incentive
RoS $_{i,(t, t+4)}$	0.498***	0.633***
	(0.00)	(0.00)
(DomSTR - ForTax) ≤ $0_{i,(t, t+4)}$	-0.027	0.103
	(0.17)	(0.21)
(DomSTR - ForTax) > $0_{i,(t, t+4)}$	0.114***	0.028
	(0.00)	(0.52)
$DomR\&D_{i,t}$	0.008	-0.079
	(0.82)	(0.12)
$ForR\&D_{i,t}$	-0.069***	0.059
	(0.00)	(0.38)
$WageSavings_{i,(t,t+4)}$	0.007	-0.099**
	(0.95)	(0.02)
$DomR\&D_{i,t}$*(DomSTR - ForTax) ≤ $0_{i,(t, t+4)}$	-0.032	0.271
	(0.46)	(0.13)
$DomR\&D_{i,t}$*(DomSTR - ForTax)> $0_{i,(t, t+4)}$	0.151***	0.007
	(0.00)	(0.84)
$ForR\&D_{i,t}$*$WageSavings_{i,(t,t+4)}$	-0.040	0.021*
	(0.56)	(0.06)
Controls?	Yes	Yes
Year and Industry fixed effects?	Yes	Yes
N	1,840	920
R-square	0.49	0.57
p-values from the following coefficient comparisons:		
Low β_8 = Low β_9	**(0.00)*** **	
High β_8 = High β_9	**(0.71)**	
Low β_8 = High β_8	(0.00)***	
Low β_9 = High β_9	(0.36)	
Low β_8 - High β_8 = Low β_9 - High β_9	**(0.00)*** **	

This table reports results of estimating Equation (5) for subsamples based on relative wage savings incentives clustering standard errors by firm.

$$ForRoS_{i,(t,\ t+4)} = \beta_0 + \beta_1{*}RoS_{i,(t,\ t+4)} + \beta_2{*}(DomSTR - ForTax){\leq}0_{i,(t,\ t+4)} + \beta_3{*}(DomSTR - ForTax){>}0_{i,(t,\ t+4)} + \beta_4{*}DomR\&D_{i,t} + \beta_5{*}ForR\&D_{i,t} + \beta_6{*}WageSavings_{i,(t,t+4)} + \beta_7{*}DomR\&D_{t,i}{*}(DomSTR - ForTax){\leq}0_{i,(t,\ t+4)} + \beta_8{*}DomR\&D_{t,i}{*}(DomSTR - ForTax){>}0_{i,(t,\ t+4)} + \beta_9{*}ForR\&D_{i,t}{*}WageSavings_{i,(t,\ t+2)} + \Sigma Controls + \varepsilon_{i,} \quad (5)$$

We standardize all variables to have a mean of zero and a standard deviation of one. In all columns, the dependent variable is the five-year average foreign RoS. Equation (3) suggests wages savings will have a larger effect on R&D-related income shifting than tax incentives when $s > (t_d - t_f)/(1 - t_f)$, and vice versa. We calculate the differential tax rate scaled by one minus the foreign tax rate ((t_d-t_f)/(1-t_f)) using U.S. and foreign inventor country corporate statutory tax rates. The wage discount s is one less the R&D wage in a foreign country, scaled by the domestic R&D wage. At the bottom of the table, we compare coefficients using seemingly unrelated regressions across Columns (1) and (2). All variables are defined in Appendix B. Firm-level financial variables including $ForRoS_{i,(t,\ t+2)}$ and $RoS_{i,(t,\ t+2)}$ are winsorized at the 1st and 99th percentiles. P-values are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

Table 6
Cross-Sectional Tests: R&D Shifting Cost and Transfer Pricing Uncertainty

Dependent variable is $ForRoS_{i,(t, t+4)}$				
	R&D Shifting Cost		Income Shifting Cost	
	(1) Low	(2) High	(3) Low	(4) High
$RoS_{i,(t, t+4)}$	0.536***	0.632***	0.462***	0.623***
	(0.00)	(0.00)	(0.00)	(0.00)
$(DomSTR - ForTax) \leq 0_{i,(t, t+4)}$	-0.002	-0.057	-0.025	-0.045
	(0.93)	(0.14)	(0.26)	(0.14)
$(DomSTR - ForTax) > 0_{i,(t, t+4)}$	0.103***	0.076*	0.105***	0.078***
	(0.00)	(0.10)	(0.00)	(0.00)
$DomR\&D_{i,t}$	-0.047	-0.079	0.021	-0.049
	(0.11)	(0.25)	(0.44)	(0.13)
$ForR\&D_{i,t}$	0.020	0.036	-0.027	-0.012
	(0.69)	(0.70)	(0.67)	(0.56)
$WageSavings_{i,(t,t+4)}$	-0.064**	-0.070	-0.046	-0.081***
	(0.03)	(0.22)	(0.12)	(0.00)
$DomR\&D_{i,t}*(DomSTR - ForTax) \leq 0_{i,(t, t+4)}$	-0.024	0.061	-0.052	-0.016
	(0.58)	(0.59)	(0.22)	(0.77)
$DomR\&D_{i,t}*(DomSTR - ForTax) > 0_{i,(t, t+4)}$	0.074**	0.068	0.120***	0.065***
	(0.02)	(0.43)	(0.00)	(0.01)
$ForR\&D_{i,t}*WageSavings_{i,(t,t+4)}$	0.025***	-0.034	0.007	0.029***
	(0.00)	(0.16)	(0.41)	(0.00)
Controls?	Yes	Yes	Yes	Yes
Year and Industry fixed effects?	Yes	Yes	Yes	Yes
N	1840	920	1510	1250
R-square	0.52	0.52	0.42	0.62
p-values from the following coefficient comparisons:				
Low β_8 = Low β_9	(0.12)		(0.00)***	
High β_8 = High β_9	(0.18)		(0.42)	
Low β_8 = High β_8	(0.93)		**(0.22)**	
Low β_9 = High β_9	**(0.01)*****		(0.01)***	
Low β_8 - High β_8 = Low β_9 - High β_9	**(0.50)**		**(0.09)***	

This table reports results of estimating Equation (5) for low and high transfer pricing uncertainty subsamples clustering standard errors by firm.

$$ForRoS_{i,(t,t+4)} = \beta_0 + \beta_1*RoS_{i,(t,t+4)} + \beta_2*(DomSTR - ForTax)\leq 0_{i,(t,t+4)} + \beta_3*(DomSTR - ForTax)>0_{i,(t,t+4)} + \beta_4*DomR\&D_{i,t} + \beta_5*ForR\&D_{i,t} + \beta_6*WageSavings_{i,(t,t+4)} + \beta_7*DomR\&D_{t,i}*(DomSTR - ForTax)\leq 0_{i,(t,t+4)} + \beta_8*DomR\&D_{t,i}*(DomSTR - ForTax)>0_{i,(t,t+4)} + \beta_9*ForR\&D_{i,t}*WageSavings_{i,(t,t+2)} + \Sigma Controls + \varepsilon_{i,} \quad (5)$$

We standardize all variables to have a mean of zero and a standard deviation of one. In all columns the dependent variable is the five-year average foreign RoS. In Columns (1) and (2), a firm-year has high (low) R&D shifting cost if its ease of R&D index value is at the bottom tercile (top tercile). The R&D cost index value is equal to 5*computer patent percentage + 4*chemical patent percentage + 3*drug patent percentage + 2*electrical patent percentage + 1*mechanical patent percentage. In Column (3) and (4), a firm-year has high (low) income shifting cost if the transfer pricing uncertainty index value is above the sample median. The uncertainty index value is a factor score of the country specific standard deviation of the likelihoods of being challenged during the sample period, the percentage of foreign inventor countries in the top tercile of that country-specific standard deviation, and the five-year rolling average standard deviation of the likelihoods of being challenged for each country, all of which are dichotomized to equal one at the top tercile. At the bottom of the table, we compare coefficients using seemingly unrelated regressions across Columns (1) and (2), and (3) and (4), respectively. All variables are defined in Appendix B. Firm-level financial variables including $ForRoS_{i,(t,t+2)}$ and $RoS_{i,(t,t+2)}$ are winsorized at the 1st and 99th percentiles. P-values are reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.