

Li, Chen

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Signing a Bilateral Investment Treaty: A tradeoff between investment protection and regulation

Chen Li^{*†}

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Abstract

We develop a theoretical model of bilateral investment treaties (BITs) to analyze their effects on firm profits and government welfare with heterogeneous firms. We explicitly model the trade-off between attracting foreign direct investment (FDI) and protecting the government's scope to regulate. We show that BITs can improve overall efficiency by internalizing externalities, but with firms gaining at the government's expense. The efficiency improvement is stronger for more productive industries. We also show that attracting new FDI through a BIT may decrease welfare, while the protection of existing FDI unambiguously raises it. We propose redesigning BITs by including a fee on firm profits, in order to redistribute gains from a BIT such that a pareto-improvement for both firms and the government results. In an empirical exercise, we estimate the expected annual cost for Germany resulting from an EU-US BIT to be \$27mn, and the compensating fee to be 0.5% of firm profits.

JEL classification: *F21, F23, F53, F55*

Keywords: *Bilateral Investment Treaty, Investor-State Dispute Settlement, Foreign Direct Investment, TTIP, Multinationals, Regulatory Takings*

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[†]Affiliations: Ludwig Maximilian University Munich, Seminar for Comparative Economics. DFG Research Training Group 1928, Microeconomic Determinants of Labour Productivity. Email: chen.li@econ.lmu.de

1 Introduction

1.1 Motivation

Bilateral investment treaties (BITs) have come under the spotlight during the debate surrounding the Transatlantic Trade and Investment Partnership (TTIP), as the inclusion of a BIT between the United States and the European Union constitutes an important part of TTIP.

A BIT protects foreign direct investment (FDI) from expropriation by the government in the investment's host state.¹ For the vast majority of BITs, expropriation entitles the investor to take legal action and demand monetary compensation for lost investments and profits. Investor-state dispute settlement (ISDS) takes place at arbitration tribunals in a third country, e.g. the International Center for Settlement of Investment Disputes (ICSID) in Washington.² The investor's rights under a BIT are confined to monetary compensation, and do not extend to enforcing the withdrawal of the original state action. In addition, BITs also often include most-favoured nation clauses, and they guarantee fair and equitable treatment and free transfer of capital without restrictions. The aim of BITs is to provide a safe and secure investment climate for foreign multinationals, with countries signing BITs in the hope of attracting FDI and protecting their investments abroad. Up to 2014, there were 2,311 ratified BITs. Table 1 ranks countries by the number of ratified BITs. European countries dominate, with Germany and Switzerland having signed the most BITs with other countries.

However, BITs are not without controversy: A major concern is the possibility of large compensation payments that the host state might face after regulating an industry, even if the regulation was intended for public benefit. These concerns are based on high-profile cases such as *Occidental vs. Ecuador*, where the claimant was ultimately awarded \$1.8bn due to the unilateral termination of oil drilling rights by the government, or *Vattenfall vs. Germany*,³ where

¹For definitions of expropriation, see section 1.2.

²The appointment of an arbitration tribunal in third countries is motivated by doubts about judicial independence in some countries, and the perception that domestic courts may be biased against foreigners in corporate litigation, even in developed countries (Moore (2003), Bhattacharya et al. (2007)). In the context of the EU-US BIT, even major EU countries such as Italy, Spain and Poland achieve only medium scores (3.2-4.1 on a scale from 1-7) on rankings of judicial independence, such as the WEF Global competitiveness index 2014-15. Additional advantages of international arbitration (as opposed to purely domestic arbitration) include the length of proceedings, the amount of expertise and the clarity of potential awards. For a more detailed discussion, see Lavranos (2015) and Wolkewitz (2015).

³*Vattenfall vs. Germany*, ICSID ARB/12/12, is still ongoing as of today. A final verdict is not expected before 2017.

Table 1*Number of ratified bilateral investment treaties by country in 2014. Source: UNCTAD*

| | Country | # BITs |
|-----|----------------|--------|
| 1. | Germany | 132 |
| 2. | Switzerland | 115 |
| 3. | China | 106 |
| 4. | United Kingdom | 95 |
| 4. | Netherlands | 95 |
| 6. | France | 94 |
| 7. | Czech Republic | 84 |
| 8. | Italy | 83 |
| 8. | South Korea | 83 |
| 10. | Romania | 81 |

the energy company is claiming €4.7bn in lost profits due to the German phase-out of nuclear power in 2011.⁴

The economic literature has analyzed BITs largely from an empirical perspective, with a number of papers dealing with the question of whether BITs have managed to attract FDI. While the early literature has found conflicting evidence (Hallward-Dreimeier, 2003), more recent papers with improved identification have concluded that BITs are indeed helpful in raising the flow of inward FDI (Neumayer and Spess, 2005; Busse et al., 2010; Egger and Merlo, 2012; Colen et al., 2016).

Economic papers with formalized theoretical models on BITs in an international context are much sparser: Blume et al. (1984) and Miceli and Segerson (1994) started the older literature on efficient compensation rules after government interventions for public purpose, but restrict themselves to a purely domestic context. Aisbett (2007) and Tomz and Wright (2008) specifically look at BITs, and model expropriations as a tool for the state to deliberately obtain assets. In this setting, a BIT is seen as a commitment device to reduce inefficiencies stemming from time inconsistency problems. However, as we will discuss in section 1.2, this classical definition of expropriation fails to capture some of the more recent developments surrounding expropriations. Aisbett et al. (2010a) and Aisbett et al. (2010b) allow for a wider definition of expropriations, with the state expropriating for environmental reasons. Their solution to the

⁴Another criticism of BITs is directly targeted at the ISDS system. Problematic areas include the setup of arbitration courts, the transparency of proceedings and the lack of right of appeal. However, given that this is a paper on the economic effects of a BIT only, the aforementioned criticisms are beyond the scope of this paper. We will assume that the judicial system works properly for the purpose of this paper, and leave potential judicial reform to other disciplines. In fact, the EU has proposed a new Investment Court System to the US in November 2015, which is aimed at remedying the shortcomings of the current ISDS system.

investment-regulation tradeoff involves a ‘police powers carve-out’, which means that expropriations should not qualify for compensation when the public benefit of the regulatory measure is sufficiently high. However, this partial reversal of the scope of BITs may squander potential efficiency gains, and differs from our proposed solution of a profit fee. In addition, while their paper contains a detailed discussion on international arbitration, their model is actually framed in a purely domestic context.

Hence, there is still a gap in the literature on theoretical models in the international context of BITs that go beyond classical definitions of expropriation. The empirical literature has neglected the role of compensation costs, despite their prominence in the political debate. We fill these gaps by analyzing the welfare effects of a BIT from a theoretical perspective, while incorporating the expropriatory effects of regulatory measures in an international context. The model explicitly accounts for the tradeoff between attracting FDI with heterogeneous firms and the state’s scope for regulation. As a further contribution, we also add an empirical exercise to estimate the expected compensation payments that stem from a BIT. Our novel insights are as follows:

First, our base model shows that hitherto existing BITs improve upon overall efficiency by changing the state’s objective function, which reins in excessive regulation. However, this makes the state unambiguously worse off, with the gains accruing solely on the investor’s side. This asymmetry in benefits may cause the state to refrain from signing a BIT. We then propose a profit fee to redistribute part of the welfare gains from BITs back to the state. This causes a pareto-improvement compared to the no-BIT case, and provides all parties with incentives in favour of a BIT. A redistributive fee enables the state to provide the positive insurance effect of a BIT to firms, while at the same time sharing the cost of doing so.

Second, the model reveals that the aggregate welfare effects of a BIT depend strongly on industry characteristics. Our results show that BITs raise aggregate welfare for very productive industries, but lower it for less productive industries. The intuition is as follows: Less productive firms that enter due to a BIT generate only little economic profit. At the same time, these additional firms impose a cost on the government by limiting its scope for regulation, since the government needs to compensate these additional firms in case any new law conflicts with firm profits. For less productive industries, these costs then outweigh the benefits, implying negative social returns. In other words, over-entry renders the BIT inefficient for less productive firms. Closely connected, this implies that instead of the attraction of additional FDI, the protection of already existing FDI is the main unambiguous channel of welfare improvement from a BIT. This is an important finding given that attracting new FDI is often the main argument for host states to sign a BIT.

Third, several extensions are added to the base model. Extending the model to allow for the government benefiting directly from FDI through a tax creates multiple equilibria, with the possibility of the economy being stuck in a bad equilibrium. A BIT then causes the multiple equilibria to vanish, potentially leading the economy towards a more efficient equilibrium. Further extensions also show that under no BIT, an increase in the proportion of domestic firms reduces the government's incentive to regulate, but the effect is reversed as a BIT is introduced. Domestic firms can benefit from a BIT despite the fact that they are not eligible for compensation under expropriation. We also demonstrate that an increase in the likelihood of expropriation makes exporting more attractive relative to FDI in the no-BIT case, but that the effect is reversed when a BIT is in place.

Lastly, in the empirical part we take the model to the data in order to predict expected compensation payments. Using past data on compensations, we predict the expected annual cost for Germany from an EU-US BIT to be \$27mn, and the compensating fee on firm profits to be 0.5%. This rather moderate estimate may help to put numbers into perspective and ameliorate concerns about potential lawsuits that pose an extreme financial burden on state budgets.

The remainder of this paper is organized as follows: Section 1.2 establishes a definition of the type of expropriation that we are going to analyze in this paper. Section 2.1 to 2.5 outline the base version of our theoretical model on BITs. Extensions follow in sections 2.6 to 2.8. Section 3 is the empirical part, where compensation costs of a BIT are estimated. Section 4 then concludes.

1.2 Definition of expropriation

Table 2 defines different types of expropriation. What the first two definitions have in common is that the state is *deliberately* expropriating in order to gain some direct benefit. In the case of classical, cold and creeping expropriation, the state (or the domestic firms he wants to support) gains at the expense of those who get expropriated.

The third type of regulatory expropriation does not have expropriation as direct intention. Instead, the state exercises 'police powers' by regulating a certain business out of health or environmental concerns. As a form of collateral damage, this regulation then has the unintended consequence of expropriating an investor. Germany provides an illustrative example: After the Fukushima nuclear accident in 2011, the German government decided to shut down all nuclear plants for safety concerns. Given that energy companies based their business plan on being able to run their plants for decades to go, this intervention can be seen as some form of expropriation. As a consequence, Swedish energy company Vattenfall is suing Germany for compensation.

Table 2*Definition: Types of expropriation*

| | Defintion | Motivation | Example |
|---------------------------|--|--|---|
| Classical | Kobrin (1984): Involuntary forced divestment of FDI involving ownership transfer | Government gains assets | Nationalization of a factory or fully developed mine |
| Cold/ creeping | Involuntary forced reduction in asset value or profitability of FDI without de jure ownership transfer. | Government gains assets or supports domestic competitors | Retroactive tax increase, exchange rate controls, discriminatory regulation |
| Regulatory | Involuntary forced reduction in asset value or profitability of FDI through regulatory measures without ownership transfer | Government regulates out of health and safety concerns. Expropriation as colateral damage | German nuclear power phase-out. Australian cigarette plain packaging |

Crucially, it was not the government’s intention to expropriate the energy companies and gain control over the nuclear plants. Instead, the loss of firm profit happened as collateral damage of the original aim to protect the citizens.⁵

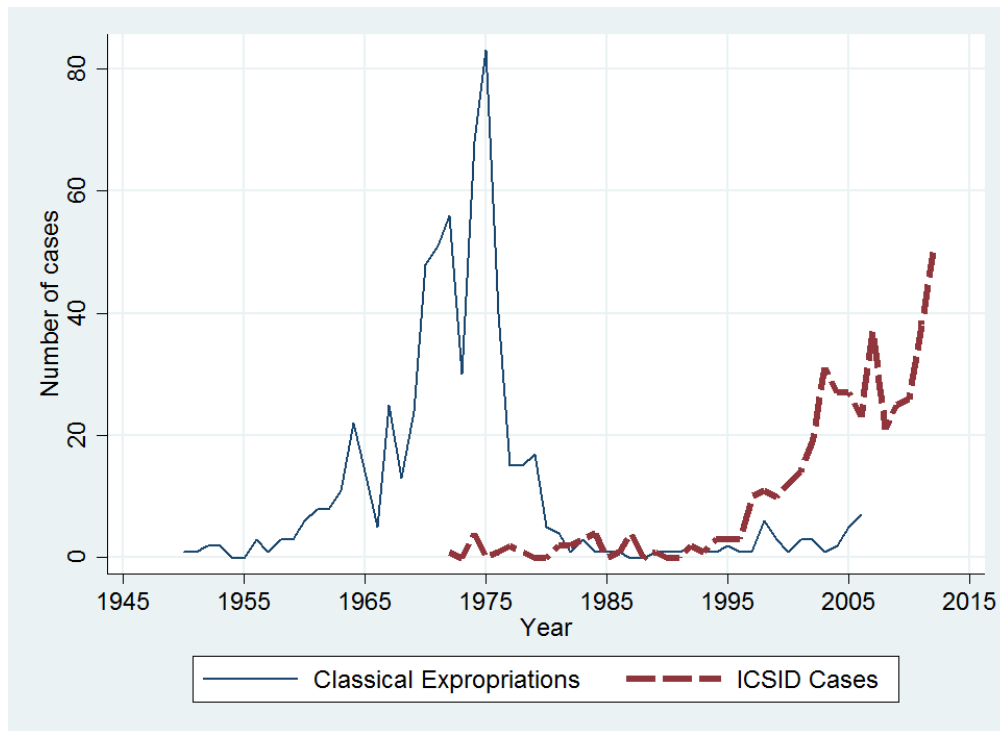
Classical expropriations have decreased in importance, as figure 1 shows. The solid line plots the development of classical expropriations of foreign direct investments around the world and is based on Hajzler (2012) and Minor (1994), who extend the seminal work by Kobrin (1984). Classical expropriations were extremely common in the 1960s and 1970s, but have receded since. In contrast, the dashed line plots the number of lawsuits dealt with at the ICSID arbitration court, which accounts for two-thirds of all investor-state arbitration cases. The figure shows that the number of cases has risen strongly in recent years, demonstrating that while classical expropriations have lost importance, some newer forms of expropriations are increasingly debated at arbitration courts. It underlines the need to move away from seeing expropriations as the ‘classical’ type and to pay more attention to alternative forms of expropriation.

⁵The legal literature has yet to converge on a common terminology for the third type of ‘regulatory expropriations’. While some papers agree with our wording (Newcombe (2005)), some others may employ alternative terms such as ‘regulatory takings’ (Miceli and Segerson (1994)). From an economic perspective, the investment-related effects of regulatory measures that impact on firm profits are tantamount to the effects from classical expropriations. Hence, the wording of ‘regulatory expropriations’ seems adequate in an economic context.

Figure 1

Development of expropriations and ICSID lawsuits over time.

Source: Hajzler (2012), Minor (1994) and ICSID.



In this paper, we will focus our analysis on the new type of regulatory expropriation. This is because there is a gap in the literature on this new type, as previous papers were almost exclusively restricted to classical expropriations in connection with BITs. However, we have seen that classical expropriations have decreased in importance. In addition, regulatory expropriations are the only type entering the debate surrounding BITs.⁶ It is fair to say that BITs would be less controversial if their scope only extended to the first two types of expropriation, since they conflict with the notion of private property and serve no other goal than enriching the state. It is the possibility of a BIT extending to the third type of regulatory expropriation and the willingness of arbitration courts to interpret a BIT in this way that proves controversial, since it conflicts with the state’s sovereignty to pass laws intended for public benefit.⁷

⁶For example, former Austrian chancellor Werner Faymann voiced his concerns in an interview to German newspaper *Süddeutsche* on 4th May 2015: ‘BITs can undermine the state’s power over the legislative process and can hence harm democracy. The threat of high compensation demands could have the state refrain from passing necessary laws in the area of environment, food standards and social security.’

⁷An example of regulatory expropriation with a subsequent successful trial on the investors behalf is provided by *Metalclad Corporation v. The United Mexican States*, ICSID Case No. ARB(AF)/97/1.

2 Theory

2.1 Model setup

This section lays out the base model which forms the main pillar of our analysis. In later subsections, we will provide some extensions to the base model.

We consider an arbitrary industry k in a home country H . Inside the home country, there are foreign firms F that conduct FDI, and one domestic government G that regulates.

2.1.1 Government

The industry of the home country is hit by random policy-relevant shocks ε drawn from a continuous probability density function $f(\varepsilon)$ where $\varepsilon \in (-\infty, +\infty)$. Examples for such sector-specific shocks include the Fukushima nuclear accident, or a new study revealing that a certain food additive is a health hazard. These shocks may prompt calls for policy actions, requiring regulation. The government's goal is to satisfy its voters, by responding to these regulation demands.

The shocks will impact on the government's payoff according to function $g(\varepsilon)$. We have $g(0) = 0$ and $g'(\varepsilon) > 0$, with figure 2 providing an example of function $g(\varepsilon)$. Negative shocks can be interpreted as adverse shocks that reveal potential dangers associated with a certain industry, with positive shocks revealing positive benefits of that industry. The more negative the shock, the stronger its potential negative effects.

When the shock hits, the government can choose to pass legislation to regulate the industry in question. This would then nullify the negative impact of the shock on the government's payoff, as potential dangers have been regulated to the satisfaction of the voters. The nullification of the shock's negative impact constitutes the positive effect of regulation. However, there is also a negative effect, in accordance with the concept of regulatory expropriation: In this model, regulating the industry by passing legislation entails regulatory expropriation as collateral damage. When the government decides to regulate, all firms in the industry will be expropriated. Hence, the term 'regulation' will be synonymous with 'regulatory expropriation' for the remainder of the paper.

The government does not directly benefit from FDI, we can think of all the benefits of FDI being internalized by the private investors. This is done to make the base model more tractable, and to demonstrate the potential welfare-improving effects of a BIT even in the absence of immediate

Figure 2
Government payoff function

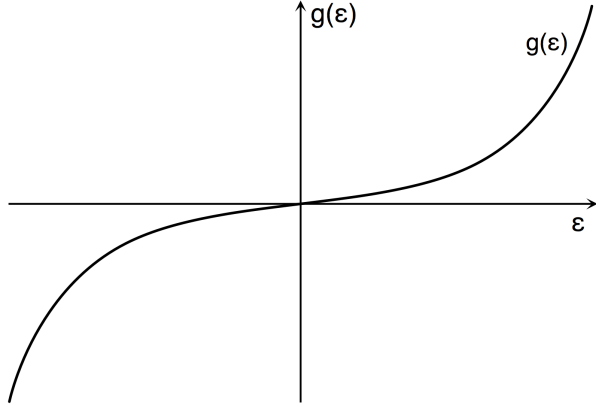
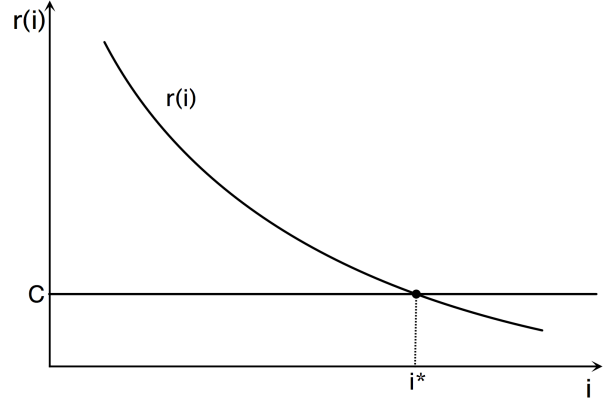


Figure 3
Firm revenue



benefits to the government. This assumption will be relaxed in the later extensions of the model.

The government's maximization problem is hence given by:

$$\max_{I_R} u_G = (1 - I_R) \cdot g(\varepsilon) + T \quad (1)$$

Here, T denotes any additional monetary transfer, and I_R denotes an indicator function:

$$I_R = \begin{cases} 1 & \text{if } G \text{ chooses to regulate} \\ 0 & \text{if } G \text{ chooses not to regulate} \end{cases} \quad (2)$$

2.1.2 Firms

There is a continuum of profit-maximizing, risk-neutral foreign firms acting according to the expected utility hypothesis. At the beginning of the game, firms choose whether or not to invest in the home country H . Firms are heterogeneous, i.e. each firm i can expect an idiosyncratic revenue r_i from its investment. More productive firms can expect higher revenue. Without loss of generality, we assume that subscript i ranks firms according to their productivity in descending order, i.e. $(r_{i-1} > r_i \forall i)$. Each firm faces the same cost c when investing, and the cost is sunk after an investment decision has been made. If there is no regulation by the government, firms can realize their revenue. However, if the government decides to regulate, firms are expropriated and cannot realize their revenue and are left with their sunk costs. If a

firm does not invest, its revenues and costs are 0. Hence, firm i 's maximization problem is as follows:

$$\max_{I_I} \pi_i = I_I \cdot [(1 - I_R) \cdot r_i - c - T] \quad (3)$$

Here, I_I stands for another indicator function:

$$I_I = \begin{cases} 1 & \text{if } F \text{ chooses to invest} \\ 0 & \text{if } F \text{ chooses not to invest} \end{cases} \quad (4)$$

The function $r(i)$ combines the r_i into a continuous revenue function for the whole industry, with $r(i_0) = r_{i_0}$ and $r'(i) < 0$. Figure 3 provides a graphic depiction. If there was no expropriation risk, the first-best solution would require the efficient cutoff for investment to be at i^* , with $r(i^*) = c$. Productive firms $i < i^*$ should invest, while less productive firms $i > i^*$ should refrain from doing so.

There is only one time period, and all information is common knowledge. The time structure of the game is as follows:

1. Foreign firms decide whether to invest
2. Policy-relevant shock ε hits
3. Government decides whether or not to regulate
4. Payoffs are realized

Hence, the government chooses, for a given ε , whether or not to regulate. The resulting equilibrium regulation threshold is called ε^{eq} . If $\varepsilon < \varepsilon^{eq}$, the government regulates. If $\varepsilon > \varepsilon^{eq}$, the government does not regulate. Firms choose their equilibrium investment level i^{eq} in response.

2.2 Base Model - No BIT

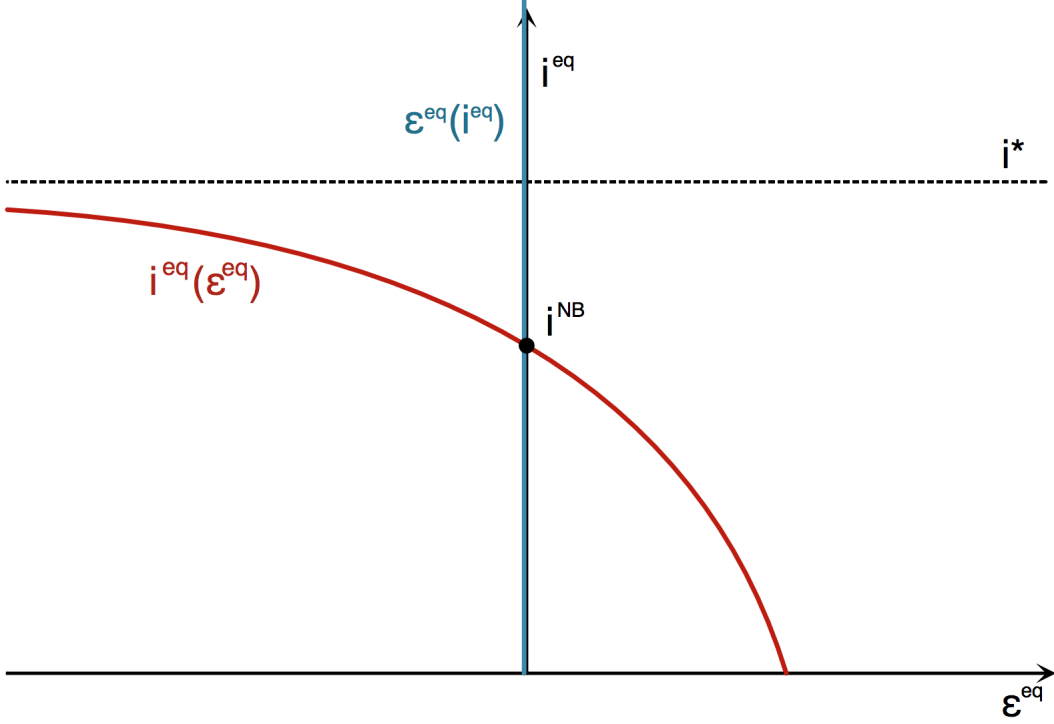
We can now solve for for subgame-perfect Nash equilibrium values of the game under no BIT (superscript NB). We have $T = 0$ in this case.

Proposition 2.2.1 (Base model - No BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq*} = \varepsilon^{NB} = 0$

Firm investment $i^{eq*} = i^{NB} = r^{-1}[\frac{c}{p(\varepsilon > 0)}]$

Figure 4
Base model - No BIT - Equilibrium



Proof $u_G = g(\varepsilon)$ if $I_R = 0$ and $u_G = 0$ if $I_R = 1$, with $g(\varepsilon) < 0$ if $\varepsilon < 0$. $i^{NB} = r^{-1}[\frac{c}{p(\varepsilon > 0)}]$ since $E(\pi_i) = p(\varepsilon > 0) \cdot r_i - c$, which must be greater than zero for investment to happen. ■

The regulation threshold is $\varepsilon^{NB} = 0$, so the government regulates whenever $\varepsilon < 0$.⁸ Only the most productive firms have positive expected profits, so only firms with $i < i^{NB}$ will invest. The less productive firms refrain from realizing their profitable projects due to the risk of expropriatory regulation, leading to potential under-investment.

Corollary 2.2.2 (Base model - No BIT - Slope of investment)

Investment depends negatively on regulation: $\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} < 0$

Proof See appendix section 5.1. ■

Figure 4 provides a graphical depiction of the equilibrium. The $i^{eq}(\varepsilon^{eq})$ curve has a negative slope, since a higher regulation threshold implies a higher likelihood of regulatory expropriation, which leads to less investment. The $\varepsilon^{eq}(i^{eq})$ curve shows how the regulation threshold in turn depends on investment. Since the amount of investment does not enter the government's objective function, the regulation threshold is independent of investment, and always chosen at $\varepsilon^{eq*} = \varepsilon^{NB} = 0$, so it is lying on top of the y-axis.

⁸The government cannot abuse its power by threatening regulation for $\varepsilon > 0$ in order to extract rents from firms. Due to the structure of the game, any threat by the government is not credible.

By regulating, the government imposes a negative externality on the firm. The government does not take into account that, when regulating, it is preventing firms from realizing their profits.⁹ For some range of negative shocks small in absolute value (ε negative but close to zero), this is inefficient, as the losses from firm profits outweigh the gains in the government's payoff. Hence, the following proposition applies:

Proposition 2.2.3 (Base model - No BIT - Efficiency)

In the no-BIT equilibrium, there is overregulation. Aggregate welfare is inefficiently low.

Proof See appendix section 5.2. ■

Proposition 2.2.1 leads to the following corollary giving us government's payoff U_G and total firm profits Π in equilibrium.

Corollary 2.2.4 (Base model - No BIT - Payoffs)

$$U_G = \int_0^\infty f(\varepsilon)g(\varepsilon)d\varepsilon \quad (5)$$

$$\Pi = \int_0^\infty f(\varepsilon)d\varepsilon \cdot \int_0^{i^{NB}} r(i)di - c \cdot i^{NB} \quad (6)$$

2.3 Base Model - With BIT

We will now introduce a BIT to internalize the negative externality that the government imposes by regulatory expropriation. With a BIT, the government will now have to fully compensate all firms in the industry for their forgone revenue r when regulating.¹⁰ We assume that regulatory expropriations and expected revenue can be verified by impartial courts at zero cost. The government's maximization problem then becomes:¹¹

$$\max_{I_R} u_G = (1 - I_R) \cdot g(\varepsilon) - I_R \int_0^{i^*} r(i)di \quad (7)$$

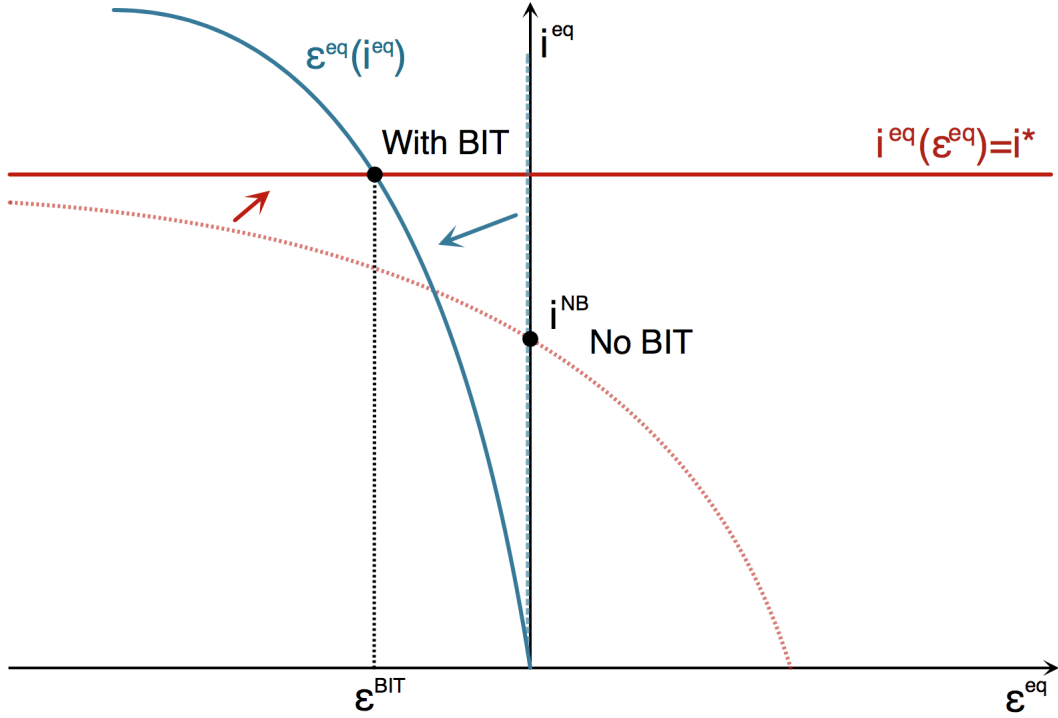
The government now chooses I_R by comparing the gains from regulation with the financial losses from doing so. It will decide that the financial loss from regulation is now sometimes not worth the gain in terms of nullifying the negative shock.

⁹This feature of the policymaker was coined 'fiscal illusion' by Blume et al. (1984)

¹⁰Note that for a BIT to maximize efficiency, compensation needs to be paid for the whole revenue r , and neither just a fraction of it, nor just forgone profits $r - c$. This is because at the point when G decides about regulation, what is at stake is the whole potential revenue r , given that the investment cost is already sunk. Hence, for a BIT to completely internalize the externality, the government must be required to compensate all the forgone revenue r .

¹¹We already use the result that firms will now invest up the level $i = i^*$.

Figure 5
Base model - With BIT - Equilibrium



Proposition 2.3.1 (Base model - With BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq*} = \varepsilon^{BIT} = g^{-1}[-\int_0^{i^*} r(i)di] < 0$

Firm investment: $i^{eq*} = i^* = r^{-1}(c)$

Proof $u_G = g(\varepsilon)$ if $I_R = 0$ and $u_G = -\int_0^{i^*} r(i)di$ if $I_R = 1$. Firms have guaranteed profits $E(\pi_i) = r_i - c$. ■

Since $\varepsilon^{BIT} < \varepsilon^{NB} = 0$, regulatory expropriations now happen less often than under the no-BIT case, and the inefficiency from excessive regulation is now avoided. Firms now have guaranteed profits after the introduction of a BIT: Either their investments realize revenue, or they receive compensation after suffering from regulatory expropriation. This causes less productive firms from $i^{NB} < i < i^*$ to enter as well.

Corollary 2.3.2 (Base model - With BIT - Slope of regulation)

Regulation depends negatively on investment: $\frac{\partial \varepsilon^{eq}}{\partial i^{eq}} < 0$

Proof See appendix 5.3. ■

Figure 5 shows graphically how we move from the no-BIT to the with-BIT equilibrium. The $\varepsilon^{eq}(i^{eq})$ curve pivots counterclockwise around the origin, with the negative slope reflecting the fact that the government now faces compensation charges from regulation. More investments

make regulation more costly, thereby lowering the optimal regulation threshold. The $i^{eq}(\varepsilon^{eq})$ curve becomes a flat line parallel to the x-axis at i^* . This reflects the fact that firms now invest i^* regardless of the regulation threshold, as they now have guaranteed profits due to BIT protection. The new equilibrium is to the north-west of the old one, implying less regulation and more investment.

Corollary 2.3.3 (Base model - With BIT - Payoffs)

$$U_G = \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)g(\varepsilon)d\varepsilon - \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon \int_0^{i^*} r(i)di \quad (8)$$

$$\Pi = \int_0^{i^*} r(i)di - c \cdot i^* \quad (9)$$

Regulatory expropriations by the government lead to lawsuits. In order to obtain the total number of lawsuits L , we need to aggregate across sectors. Recall that we have so far only looked at one specific sector k . The number L depends on the total number of firms affected by regulatory expropriation and is given by $L = \sum_{k=1}^K p_k [\varepsilon < g^{-1}(-\int_0^{i_k^*} r_k(i)di)] \cdot i_k^*$. Hence, our model makes the following predictions:

Proposition 2.3.4 (Base model - With BIT - Lawsuits)

1. L depends positively on $-g(\cdot)$, the government's gain from regulating.
2. L depends negatively on firm productivity $r(i)$.
3. The effect of the amount of FDI i^* on L is ambiguous.

Proof See appendix section 5.4. ■

We will test these predictions in the empirical section later.

2.4 Comparison

We can now compare how payoffs change for each party under the no-BIT and with-BIT scenario.

Proposition 2.4.1 (Base model - With BIT - Government payoff difference)

$$\Delta U_G = - \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon \int_0^{i^*} r(i)di + \int_{\varepsilon^{BIT}}^0 f(\varepsilon)g(\varepsilon)d\varepsilon < 0 \quad (10)$$

Proof Calculate (8)-(5). $f(\varepsilon) > 0 \forall \varepsilon$ and $r(i) > 0 \forall i$ and $g(\varepsilon) < 0$ for $\varepsilon < 0$. Hence, $\Delta U_G < 0$. ■

The government unambiguously loses from a BIT. The first term in ΔU_G denotes the loss from financial compensation that must be paid. The second term denotes the loss of abstaining from passing legislation for a range of small shocks. As the government regulates less due to the fear of compensation charges, it has to bear the negative impact of shocks more often. The cost of passing less legislation under a BIT is also called ‘regulatory chill’.¹²

Proposition 2.4.2 (Base model - With BIT - Firm profits difference)

$$\Delta \Pi = \int_{i^{NB}}^{i^*} [r(i) - c] di + \left[\int_{\varepsilon^{BIT}}^0 f(\varepsilon) d\varepsilon + \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon) d\varepsilon \right] \int_0^{i^{NB}} r(i) di > 0 \quad (11)$$

Proof Calculate (9)-(6). $f(\varepsilon) > 0 \forall \varepsilon$ and $r(i) > 0 \forall i$ and $r(i) - c > 0$ for $i < i^*$. Hence, $\Delta \Pi > 0$. ■

Firms unambiguously gain from a BIT. The first term in $\Delta \Pi$ denotes the gain for firms from realizing additional FDI. The second term contains the gain from having less regulatory expropriation and financial compensation for already existing FDI.¹³

With firms definitely better off and the government definitely worse off under a ‘standard’ BIT, it is worth looking at what happens to aggregate welfare W , computed as the sum of total firm profits and the government’s payoff. The change in aggregate welfare ΔW is given below:

Proposition 2.4.3 (Base model - Aggregate welfare difference)

$$\Delta W = \int_{\varepsilon^{BIT}}^0 f(\varepsilon) d\varepsilon \cdot \int_0^{i^{NB}} r(i) di + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \cdot \int_{i^{NB}}^{i^*} r(i) di + \int_{\varepsilon^{BIT}}^0 f(\varepsilon) g(\varepsilon) d\varepsilon - c(i^* - i^{NB}) \quad (12)$$

Proof Calculate (10) + (11). ■

The first two terms present the true economic gains from a BIT. They consist of gains from existing FDI suffering less regulatory expropriation, as well as the gains from new FDI taking place. The latter two terms present true economic losses from a BIT. These include the cost of regulatory chill, as well as the cost of additional investments. It is worth noting that the compensation payments made by the state to the firms do not enter the equation, since they are just a transfer from one party to another, and hence cancel out.

Corollary 2.4.4 (Base model - Sign of aggregate welfare difference)

The sign of (12) is ambiguous.

Proof See appendix section 5.5. ■

¹²Anecdotal evidence for regulatory chill can be found in New Zealand: As Philip Morris challenged the Australian decision to introduce cigarette plain packaging in 2011 invoking a BIT as legal instrument, New Zealand announced that it would put similar planned measures on hold.

¹³Already existing FDI denotes FDI that would have taken place even in the absence of a BIT.

The overall effect of a BIT on welfare is ambiguous. If ΔW is positive, then the with-BIT scenario implies higher welfare.

Corollary 2.4.5 (Base model - Aggregate welfare difference derivatives)

$$\frac{\partial \Delta W}{\partial r(i)} > 0, \quad \frac{\partial \Delta W}{\partial c} < 0$$

Proof See appendix section 5.6. ■

Corollary 2.4.6 (Base model - Efficiency of a BIT)

A BIT raises aggregate welfare for highly productive industries (r high, c low), but lowers it for less productive industries (r low, c high).

Proof Follows from corollary 2.4.5. ■

Corollary 2.4.6 may be surprising, since one might have initially expected that it should be precisely the less productive, marginally profitable industries that should receive protection by a BIT, in order to encourage more firms to invest. However, the exact opposite is true. The intuition is as follows: Under the no-BIT scenario, only the most productive firms profitable enough to withstand the risk of regulatory expropriation run their business. As a BIT is introduced, less productive firms with only little economic profit ($r - c$ is small) will enter. At the same time, these additional firms ramp up the regulation cost for the government, as there are now more firms around to be compensated. The higher cost of compensation causes the government to refrain from regulation, imposing an economic cost in the form of regulatory chill. For the less productive industries, it may be the case that the small profits they generate do not outweigh the costs of regulatory chill, thereby implying negative social returns. Hence, we see over-entry for less productive industries if a BIT is introduced. In contrast, highly productive industries deserve protection: A BIT makes the government internalize the high cost of regulating a very productive industry through the threat of substantial compensation payments.

While in general, there is ambiguity about the aggregate welfare effects of a BIT, we can show that if we shut off the channel of additional FDI entering, the welfare effects of a BIT are unambiguously positive:

Proposition 2.4.7 (Base model - No new FDI)

Assume that no new FDI enters. Then ΔW is always positive.

Proof See appendix section 5.7. ■

Corollary 2.4.8 (Base model - No new FDI)

Protection of existing FDI is the only channel of unambiguous welfare gain of a BIT.

Proof Follows from proposition 2.4.7. ■

Intuitively, when a BIT for some exogenous reason does not cause additional FDI to enter, the BIT still provides protection for already existing FDI. For this existing FDI, the BIT simply internalizes a negative externality, and this is definitely welfare-enhancing. This is an important result since the attraction of new FDI is often cited as the main advantage of a BIT. But instead of the attraction of new FDI, the protection of existing FDI is the actual channel of unambiguous welfare gain from a BIT.

2.5 Base Model - With BIT and Insurance Fee

We will now focus on the case where ΔW is positive, implying that firms gain more than the state loses. This means that the BIT creates an efficiency gain by avoiding excessive regulation. In that case, we can devise a fee h that redistributes the efficiency gains, so that all parties are better off. The fee will be paid immediately after the firm decided to invest, and will be based on expected profits.¹⁴ This implies that the fee each firms needs to pay would be $h(r_i - c)$. A fee on profits ensures that firms' ex ante incentives are unchanged. In aggregate, the fee needs to be chosen such all parties are better off, implying that the fee intake needs to be greater than the government loss from a BIT, but smaller than the firms' gain. Hence, the optimal fee h is pinned down as follows:

Corollary 2.5.1 (Base model - Redistributive fee)

$$\begin{aligned} \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon \int_0^{i^*} r(i)di + \int_{\varepsilon^{BIT}}^0 f(\varepsilon)g(\varepsilon)d\varepsilon \\ < \int_0^{i^*} h[r(i) - c]di < \\ \int_{i^{NB}}^{i^*} [r(i) - c]di + \int_{-\infty}^0 f(\varepsilon)d\varepsilon \int_0^{i^{NB}} r(i)di \end{aligned} \quad (13)$$

The fee redistributes the gain from avoiding inefficient regulation under small shocks, so that both firms and the government are better off. With such a redesigned BIT, both firms and the government will have an incentive to sign an agreement.

¹⁴Expected profits are assumed to be known since all information is common knowledge. It is important that the fee is paid by firms based on expected profits ex ante before the shock hits. This ensures that the government does not need to take a possible loss of fee income into account when deciding upon regulation. In reality, expected profits may not be known but can instead be based on past performance.

2.5.1 Discussion

We can interpret the fee as some form of compulsory state insurance: The government acts as an insurance company by offering a BIT (the insurance), collecting the insurance fee, and then creating a fund which is used for compensation payments.¹⁵ While previous standard BITs offered benefits to firms free of charge, this redesigned BIT forces the firms as beneficiaries to make a financial contribution as well. While the government does not directly benefit from FDI, it now does so indirectly since it can monetize on the firms' gains from a BIT. With such a state insurance, the insurance fee will also be lower than under private insurance: This is because state insurance with a BIT changes the government's incentives to regulate, whereas a purely private insurance provider would only pool risks between the firms but not affect government incentives.

The insurance interpretation illustrates the advantage of letting the damage causing party offer insurance. In a standard insurance setup, we have the insurance seller, the insurance buyer, and nature as the damage causing party (e.g. natural disaster insurance). In many insurance contexts, the damage-causing party is identical with the insurance *buyer*, causing moral hazard problems (e.g. car insurance, health insurance). However, in our BIT setting, we are arguing in favour of letting the damage causing party (the government) become the insurance *seller*. The advantage is that this can align the government's incentives, remove moral hazard and cause a more efficient level of regulation.

Interpreting the BIT in such an insurance context turns the question of whether to have a BIT into one that asks which party should bear the cost associated with the risk of policy-relevant shocks. The risk of shocks is given by nature. Without a BIT, the government can act as it pleases, with the cost of reacting to the shock falling entirely on the firms, whose profits are slashed. The introduction of a BIT then moves the cost entirely to the government, since any reaction to the shocks requires the government to fully compensate the firms.

2.6 Extension: FDI tax

2.6.1 General setup

In the following subsections, we add several extensions to the base model for a more realistic setup. Only one extension at a time is added to the base model for tractability. For each

¹⁵We will be using the term 'insurance' despite the fact that with risk-neutral agents, there is no efficiency gain per se from reducing risk. Introducing risk aversion in both parties is a possible extension of the paper.

extension, we will only present the main results, and leave the mathematical details to the appendix.

In the base version of the model, the government did not benefit directly from FDI, and firms' revenues and profits were absent from the government's payoff function. We now add the feature that the government can benefit directly from FDI, by allowing it to tax firm profits with tax t . This creates a direct incentive for the government to attract FDI, as it now internalizes some of the firms' profits.¹⁶

2.6.2 No BIT

The government's maximization problem is given by:

$$\max_{I_R} u_G = (1 - I_R) \left\{ g(\varepsilon) + \int_0^{i^{NB}} t[r(i) - c] di \right\} \quad (14)$$

When deciding whether to regulate, the government now takes the possible loss in tax intake into account.

Proposition 2.6.1 (FDI Tax - No BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq*} = \varepsilon^{NB} = g^{-1} \left[- \int_0^{i^{NB}} t[r(i) - c] di \right] < 0$

Firm investment: $i^{eq*} = i^{NB} = r^{-1} \left[\frac{1 - p(\varepsilon > \varepsilon^{NB})t}{(1-t)p(\varepsilon > \varepsilon^{NB})} c \right]$

Proof See appendix section 5.8. ■

Including an FDI tax lowers the regulation threshold in the no-BIT case compared to the base model, making regulatory expropriation less likely. This is intuitive, as the possibility of forgone tax revenues deters regulation.

Corollary 2.6.2 (FDI Tax - No BIT - Slope of regulation)

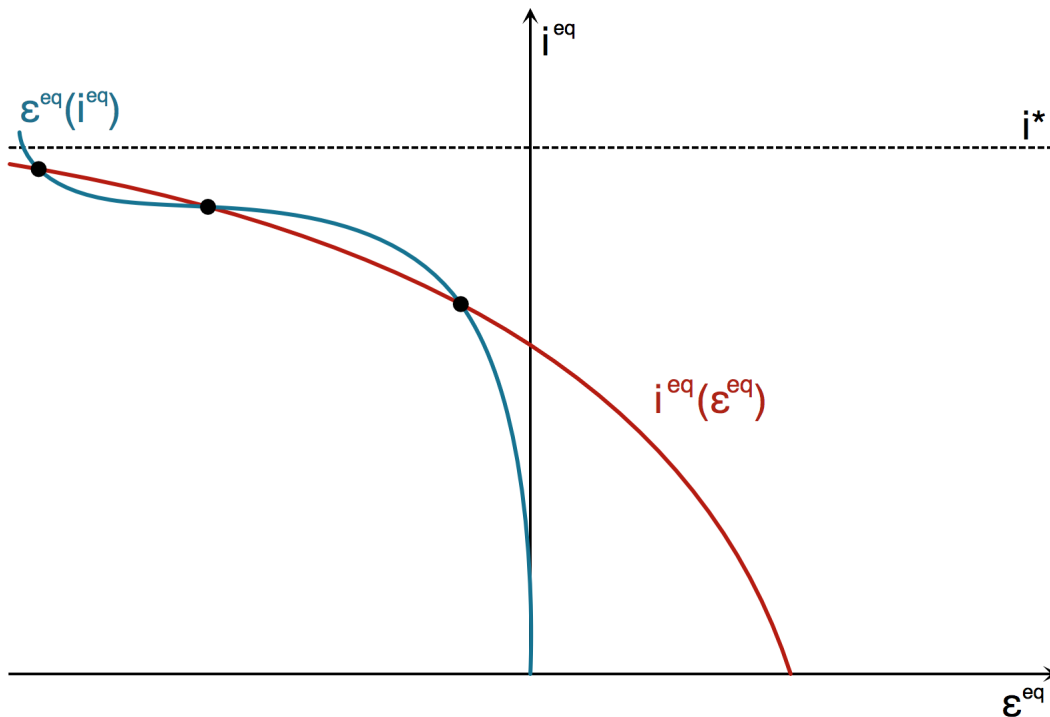
Regulation depends negatively on investment: $\frac{\partial \varepsilon^{eq}}{\partial i^{eq}} < 0$

Proof See appendix section 5.9. ■

Corollary 2.6.2 states that ε^{eq} depends negatively on i^{eq} . The intuition is that more investments can potentially generate more tax revenue, implying a higher opportunity cost of regulation. In addition, i^{eq} depends negatively on ε^{eq} , just as in the base model, since more regulation deters investment. This implies the following proposition:

¹⁶The difference compared to the insurance fee in section 2.5 is as follows: In the current section, the tax is collected *after* the realization of profits. This implies that by regulating, the government is bereaving itself of the chance to collect taxes from profitable investments.

Figure 6
FDI tax - No BIT - Multiple equilibria



Proposition 2.6.3 (FDI tax - No BIT - Multiple equilibria)

In the no-BIT case with an FDI tax, multiple equilibria can arise.

Proof See appendix section 5.10. ■

Figure 6 shows a graphical example of multiple equilibria.¹⁷ The country may find itself in a ‘high investment, low regulation’ equilibrium, or a ‘low investment, high regulation’ equilibrium. Half of the equilibria are stable.

2.6.3 With BIT

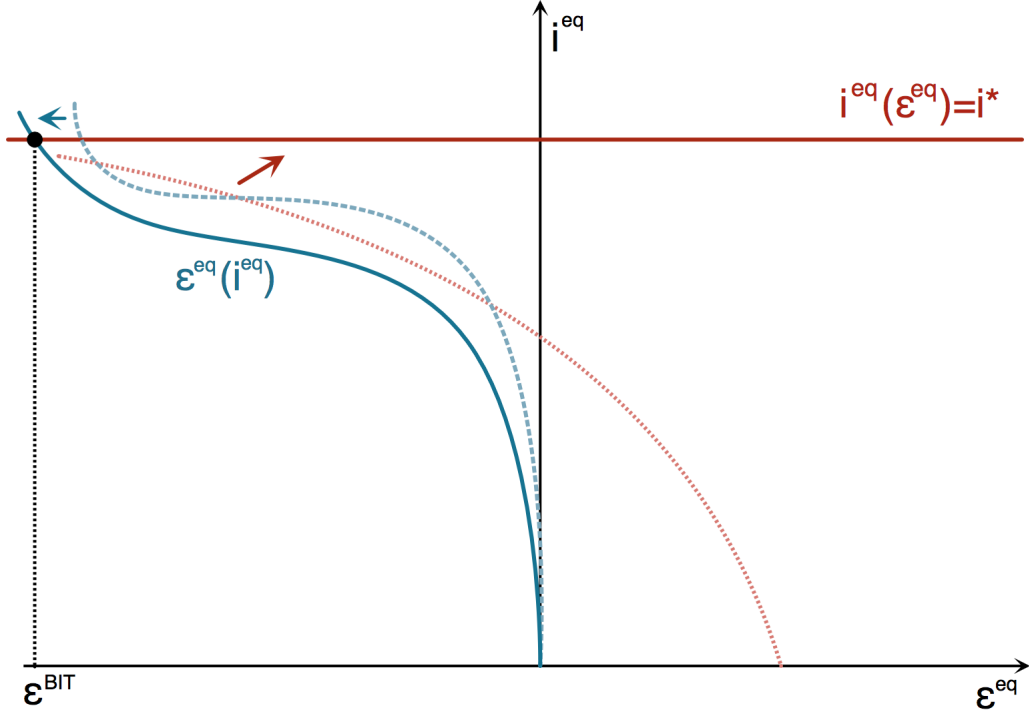
Introducing a BIT means that the government now needs to compensate firms for the after-tax revenue that they would have received in the absence of regulatory expropriation. The government’s maximization problem is as follows:¹⁸

$$\max_{I_R} u_G = (1 - I_R) \cdot g(\varepsilon) - I_R \int_0^{i^*} r(i)di + \int_0^{i^*} t[r(i) - c]di \quad (15)$$

¹⁷The problem of multiple equilibria did not exist in the base version under the no-BIT case. The reason is that the optimal level of regulation was unaffected by the amount of investment in the base model.

¹⁸Again, we use the fact that now firms have guaranteed profit and hence invest up to i^* .

Figure 7
FDI tax - With BIT - Equilibrium



Proposition 2.6.4 (FDI Tax - With BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq} = \varepsilon^{BIT} = g^{-1}[-\int_0^{i^*} r(i)di] < 0$*

Firm investment $i^{eq} = i^* = r^{-1}(c)$*

Proof See appendix section 5.11. ■

The presence of compensation costs will now lower the likelihood of regulation. Graphically (as in figure 7), introducing a BIT shifts the $\varepsilon^{eq}(i^{eq})$ curve to the left, since for every level of investments, regulation become less likely. At the same time, firms now have guaranteed profit, causing the $i^{eq}(\varepsilon^{eq})$ curve to become a flat line parallel to the x-axis at $i^{eq} = i^*$.

Proposition 2.6.5 (FDI tax - With BIT - Unique equilibrium)

In the with-BIT case with an FDI tax, the resulting equilibrium is unique.

Proof Follows from proposition 2.6.4. ■

The resulting unique equilibrium will always entail more investment and less regulatory expropriation than any of the no-BIT equilibria, as can be seen from proposition 2.6.4. Hence, the size of the change from introducing a BIT depends on which equilibrium the economy found itself in before. A BIT can help an economy to break out of a bad equilibrium, moving towards a more efficient direction.

Proposition 2.6.6 (FDI tax - With BIT - Government payoff difference)

With the FDI tax, the effect of a BIT on the government's payoff is ambiguous.

Proof See appendix section 5.12. ■

With the FDI tax intake, it is now possible that the government is better off with a BIT even without an additional redistributive fee. This stands in contrast to the base model, where the government was unambiguously worse off due to a BIT. The possible gain in government welfare from a BIT stems from overcoming the time inconsistency problem: Without a BIT, the government would like to commit to a lower regulation level in order to attract FDI. However, once firms have made their investment decision, the government has an incentive to renege on that commitment by engaging in excessive regulation. Rational firms can foresee this behaviour. As a result, the government suffers from an inefficiently low level of investment and hence a low tax intake. A BIT can help the government commit to a low regulation level, thereby achieving higher total welfare. This additional efficiency-enhancing channel of time-inconsistency was not present in the base model, since the government did not directly benefit from FDI then.

The other qualitative conclusions from the base model remain unchanged, even with the FDI tax. The overall efficiency gain from a BIT is still ambiguous and depends on industry characteristics. If a BIT improves overall efficiency, then it is still possible to redistribute the gain through a fee in order to achieve a pareto-improvement compared to the no-BIT case. Details of these results can be found in appendix section 6.1.

2.7 Extension: Domestic and Foreign Firms

2.7.1 General setup

This subsection extends the base model by adding a distinction between domestic and foreign firms in the industry. Like in the base model, we consider an arbitrary industry in the home country. Within the industry, a proportion μ of firms is of domestic origin, whereas a proportion $1 - \mu$ is foreign.

There are two differences between domestic and foreign firms: First, we assume that the government 'cares' about domestic firms more than about foreign firms, since the stakeholders and shareholders of domestic firms are more likely to be part of the electorate due to the equity home bias (French and Poterba (1991)). In our model, this is reflected by the government completely internalizing the domestic firms' profits and losses in its own objective function. For foreign firms however, the government internalizes only the taxable part of the profit. A second difference concerns the legal scope: Under current BIT legislation, the rights conferred

under a BIT only extend to foreign investors. Domestic investors do not have the right to apply to international arbitration courts, and will have to resort to domestic legal means, if available. For our model, this implies that under a BIT, foreign firms receive compensation after regulatory expropriation, whereas domestic firms do not. If the government decides to regulate the industry, this will amount to expropriation of all firms (domestic and foreign) in the industry.

2.7.2 No BIT

The government's maximization problem is given by:

$$\max_{I_R} u_G = (1 - I_R) \cdot \{g(\varepsilon) + \mu \int_0^{i^{NB}} r(i)di + (1 - \mu) \int_0^{i^{NB}} t[r(i) - c]di\} + \mu \int_0^{i^{NB}} (-c)di \quad (16)$$

We can now see that the base model is a special case of the extension discussed in this section, for $\mu = 0$ (all firms are foreign) and $t = 0$ (no taxes).

Proposition 2.7.1 (Domestic and foreign firms - No BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq*} = \varepsilon^{NB} = g^{-1}[-\mu \int_0^{i^{NB}} r(i)di - (1 - \mu) \int_0^{i^{NB}} t[r(i) - c]di]$

Firm investment: $i^{eq*} = i^{NB} = r^{-1}[\frac{1-p(\varepsilon > \varepsilon^{NB})t}{(1-t)p(\varepsilon > \varepsilon^{NB})}c]$

Proof See appendix section 5.13. ■

The regulation threshold is lower than in the no-BIT case of the base model, due to the explicit modelling for domestic firms. As the government taxes FDI, the possibility of multiple equilibria arises, just as in the extension in the previous subsection.

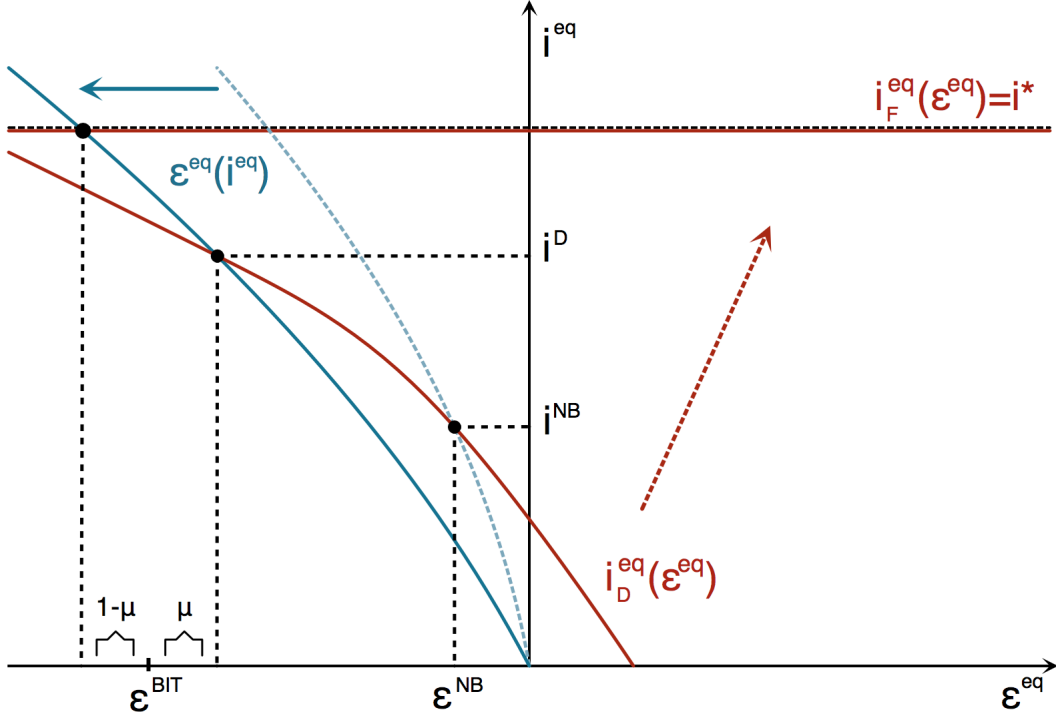
Corollary 2.7.2 (Domestic and foreign firms - No BIT - Slope of regulation)

Regulation depends negatively on μ : $\frac{\partial \varepsilon^{eq}}{\partial \mu} < 0$

Proof See appendix section 5.14. ■

The higher the proportion of domestic firms, the *less* likely is regulatory expropriation, as a larger proportion of domestic firms implies that the government has more to lose from excessive regulation. This explains why a BIT is more needed in an international context, as opposed to a purely domestic context. Conversely, sectors with a higher share of foreign firms are more likely to become victims of regulatory expropriation, as the stakeholders and shareholders are more likely to be abroad, and the government is not directly accountable to them.

Figure 8
Domestic and Foreign Firms: Equilibrium



2.7.3 With BIT

With the introduction of a BIT, foreign firms now have the right to receive compensation upon regulatory expropriation. This changes the government maximization problem to the following:

$$\max_{I_R} u_G = (1-I_R) \cdot [g(\varepsilon) + \mu \int_0^{i^D} r(i) di] - I_R \cdot (1-\mu) \int_0^{i^*} r(i) di + \mu \int_0^{i^D} (-c) di + (1-\mu) \int_0^{i^*} t[r(i)-c] di \quad (17)$$

Proposition 2.7.3 (Domestic and foreign firms - With BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq*} = \varepsilon^{BIT} = g^{-1}[-\mu \int_0^{i^D} r(i) di - (1-\mu) \int_0^{i^*} r(i) di]$

Domestic firm investment: $i^{eq*} = i^D = r^{-1}[\frac{1-p(\varepsilon > \varepsilon^{BIT})t}{1-t}c]$

Foreign firm investment: $i^{eq*} = i^F = i^* = r^{-1}(c)$

Proof See appendix section 5.15. ■

The new regulation threshold is lower than in the no-BIT case. Foreign firms have guaranteed profit, and invest i^* . Domestic firms raise their investment to i^D due to the reduced probability of regulatory expropriations. Figure 8 shows the graphical development. Without a BIT, the

equilibrium delivers the regulation threshold of ε^{NB} and the investment level i^{NB} for both types of firms. The introduction of a BIT causes the $i^{eq}(\varepsilon^{eq})$ curve for foreign firms to shift upwards and become a flat line parallel to the x-axis, since they have guaranteed profits. The $i^{eq}(\varepsilon^{eq})$ curve for domestic firms is unchanged since they do not receive compensation. As regulatory expropriations now have become more expensive for the government for each level of investment, the $\varepsilon^{eq}(i^{eq})$ curve pivots to the left. This delivers the new regulation threshold of ε^{BIT} and investment levels i^D for domestic firms and i^* for foreign firms.

Corollary 2.7.4 (Domestic and foreign firms - With BIT - Slope of regulation)

Regulation depends positively on μ : $\frac{\partial \varepsilon^{eq}}{\partial \mu} > 0$

Proof See appendix section 5.16. ■

The BIT has reversed the relationship between the amount of regulation and the proportion of domestic firms: The higher the proportion of domestic firms, the *more* likely is regulatory expropriation. This is because domestic firms have lower amounts of investment than foreign firms, so any relative increase in domestic firms' presence lowers the cost of regulation for the government. Despite the fact that domestic firms do not obtain direct compensation from the government in the case of regulatory expropriation, they still benefit from the introduction of a BIT. This is because the presence of foreign firms in the same industry drives up the price of regulation for the government, and hence reduces regulatory expropriation overall. Foreign firms act like a protective shield for domestic firms in the same industry.

The overall welfare effect is calculated as the sum of the government's payoff from regulation, as well as domestic and foreign firm's profit. The result from the base model that the overall welfare effect of a BIT is ambiguous and depends on industry characteristics still holds. If a BIT improves overall efficiency, then it is possible to redistribute the gain through a fee in order to achieve a pareto-improvement compared to the no-BIT case. Details can be found in appendix section 6.2.

2.8 Extension: Exports and FDI

2.8.1 General setup

In this extension, we account for the fact that when deciding how to serve foreign markets, firms do not only have the option of FDI, but can also choose to export. The classical choice between these two options is one of a proximity-concentration trade-off: FDI entails no tariffs and transport costs, but has the fixed cost c of setting up a new plant in the foreign country. In contrast, exporters can use existing production facilities at home (so there are no fixed

costs), but incur iceberg costs τ in serving the foreign market.¹⁹ In our BIT context, there is an additional difference in compensation policies between the two: Firms with FDI in the host country qualify for compensation upon regulatory expropriation under a BIT, whereas exporters simply lose access to their business but receive no compensation.

2.8.2 No BIT

The government's payoff function is identical to the no-BIT case in the base version. For a single firm, profits depend on its choice of serving the market, so it faces the following maximization problem:

$$\max_{I_F} \pi_i = p(\varepsilon > \varepsilon^{eq}) r_i \cdot (I_F + \frac{1 - I_F}{\tau}) - I_F \cdot c \quad (18)$$

Here, I_F stands for an indicator function:

$$I_F = \begin{cases} 1 & \text{if } F \text{ chooses FDI} \\ 0 & \text{if } F \text{ chooses export} \end{cases} \quad (19)$$

Proposition 2.8.1 (Exports and FDI - No BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq*} = \varepsilon^{NB} = 0$

Firm investment: $i^{eq*} = i^{NB} = r^{-1}[\frac{\tau}{(\tau-1)p(\varepsilon>0)}c]$

Proof See appendix section 5.17. ■

The most productive firms with $i < i^{NB}$ will opt for FDI, whereas less productive firms choose to export. This result of firm sorting for most demand functions has been documented in the literature.²⁰ However, the value of i^{NB} is lower than in the base model, because some less productive firms will choose export instead of FDI, an option that was not available in the base model.

Corollary 2.8.2 (Exports and FDI - No BIT - Slope of regulation)

Investment depends negatively on regulation: $\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} < 0$

Proof See appendix section 5.18. ■

An exogenous increase in the probability of regulatory expropriations causes FDI to become *less* attractive relative to exports. The reason is that firms will want to avoid losing the fixed cost

¹⁹ τ units need to be shipped for one unit to arrive.

²⁰See Helpman et al. (2004) and Mrázová and Neary (2013) for further discussion.

c due to regulatory expropriation by choosing exports instead, where no c is lost if regulation happens.

2.8.3 With BIT

The introduction of a BIT changes the government's maximization problem to the following:

$$\max_{I_R} u_G = (1 - I_R) \cdot g(\varepsilon) - I_R \int_0^{i^{BIT}} r(i) di \quad (20)$$

Proposition 2.8.3 (Exports and FDI - With BIT - Regulation and investment)

Regulation threshold: $\varepsilon^{eq*} = \varepsilon^{BIT} = g^{-1}[\int_0^{i^{BIT}} r(i) di]$

Firm investment: $i^{eq*} = i^{BIT} = r^{-1}[\frac{\tau}{\tau - p(\varepsilon > \varepsilon^{BIT})} c]$

Proof See appendix section 5.19. ■

The government will regulate if $\varepsilon < \varepsilon^{BIT}$, which is a lower regulation level than under no BIT. Concerning investment, there are two opposite effects: On the one hand, the prospect of compensation makes FDI more attractive relative to exports. On the other hand, the reduced probability of regulatory expropriation after the introduction of the BIT makes exporting safer relative to FDI, thereby reducing the incentive to engage in FDI. However, the FDI-increasing effect dominates:

Corollary 2.8.4 (Exports and FDI - With BIT - Change in investment)

With-BIT investment is larger than no-BIT investment: $i^{BIT} > i^{NB}$

Proof See appendix section 5.20. ■

The with-BIT investment level i^{BIT} is definitely higher than the no-BIT investment level i^{NB} . A BIT will induce firms to switch from exporting to FDI.

Corollary 2.8.5 (Exports and FDI - With BIT - Slope of regulation)

Investment depends positively on regulation: $\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} > 0$

Proof See appendix section 5.21. ■

The introduction of a BIT reverses comparative statics: An exogenous increase in the probability of regulation now causes FDI to become *more* attractive relative to exports. Firms rush to make themselves eligible for compensation by engaging in FDI, and this option becomes more attractive the more likely regulatory expropriations are.

Figure 9
Exports and FDI: Equilibrium

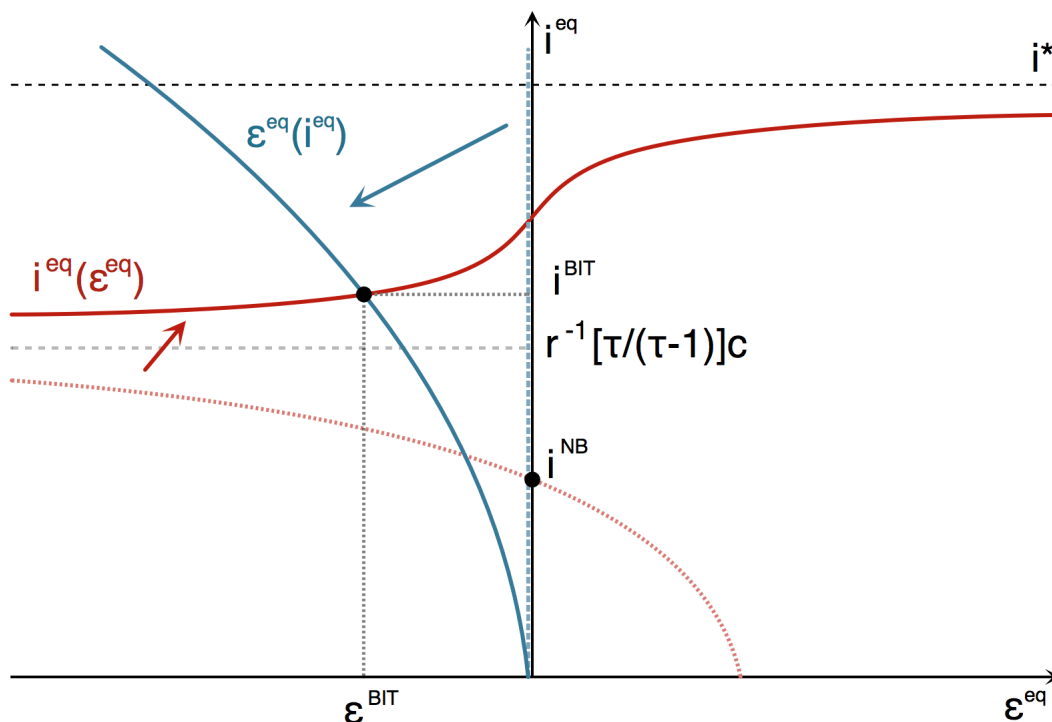


Figure 9 provides a graphical depiction of the change in equilibrium after the introduction of a BIT. The change in the slope sign of the $i^{eq}(\varepsilon^{eq})$ curve represents the reversal in comparative statics discussed above. The new equilibrium implies less regulatory expropriations and more investment.

The results from this extension demonstrate that a BIT can also be seen as a device to make firms switch from serving a market by exports to engaging in FDI. Governments may hence sign BITs in order to attract value-adding economic activity that would otherwise take place abroad. The other qualitative results of the base model remain. The overall efficiency effect from a BIT is still ambiguous and depends on industry characteristics. If a BIT improves overall efficiency, the gains can still be redistributed between firms and the government, so that both sides are better off. More details can be found in the appendix section 6.3.

3 Empirics

3.1 Data and specification

In this empirical section, we are going to use the base model from section 2 to estimate the expected compensation cost for Germany that would follow from an EU-US BIT. Based on the estimated cost, we will provide an estimate for the insurance fee h proposed in section 2.5 necessary to cover the compensation cost.²¹ In a first step, we will estimate the likelihood of a lawsuit based on country-specific variables. In a second step, we will then use data on expected payments from Hodgson (2014) to compute the expected cost of signing a BIT. It is important to note that we do not strive to identify the true causal effects of various variables on the likelihood of a lawsuit. Instead, this empirical exercise aims for forecasting, so the weaker criterion of coefficient stability (instead of coefficient consistency) is satisfactory.²²

We use data from the investment policy hub of UNCTAD on all past ratified BITs, as well as all lawsuits that invoke a BIT as legal instrument. Our sample consists of all countrypair-years that contain a ratified BIT from 1980 - 2014, with each countrypair generating two cross-sectional units in each direction.²³ The sample of all ratified BITs represents the population that could potentially generate lawsuits. We adjust for terminated BITs, and we do not include BITs that have only been signed but not ratified, since only ratified BITs can be invoked in order to file a lawsuits. In terms of lawsuits, there were 542 lawsuits invoking a BIT as a legal instrument as of 2014.²⁴ This implies that in our dataset, lawsuits are an extremely rare event ($542/65,527 = 0.83\%$)

We recall from proposition 2.3.4 that our model predicts lawsuits to depend on three parameters: The government payoff function $g(\cdot)$, firm productivity $r(i)$ and the interaction of the amount of FDI i^* and $g(\cdot)$.

The function $g(\cdot)$ denotes the government's gain from regulating in response to voter demands. The government gains more from regulating, the more accountable it is to its voters, which is more likely for more democratic countries. Hence, a democratization index can be used as empirical counterpart for $g(\cdot)$. As democratic countries often also have strong property protection, which reduces the likelihood of expropriation, a control variable for property protection

²¹This estimate of h will only provide a lower bound of the insurance fee necessary to achieve a pareto-improvement from a BIT, for two reasons: First, we cannot quantify the cost of regulatory chill, which needs to be determined politically. Secondly, our dataset only includes listed arbitration cases. To the extent that firms and governments have out-of-court settlements that involve payments on the governments side, we would underestimate the true cost of a BIT.

²²See Greene, *Econometric Analysis*, 5th International Edition, Chapter 20.

²³For example, Germany-Pakistan 2014 and Pakistan-Germany 2014 would be one observation each.

²⁴This includes lawsuits that use trilateral NAFTA as legal instrument.

is also included to identify the pure effect of democratization. We would then expect more democratic countries, *ceteris paribus*, to have more regulatory expropriations and hence face more lawsuits. Better property protection, however, should have a mitigating effect. We use the WGI World Bank voice and accountability index and the property rights index by the WEF Global Competitiveness Index.

Firm productivity is represented by $r(i)$. The more productive the foreign firms in the home country, the more profitable they are. More profitable firms are entitled to more compensation, so we would expect higher productivity of foreign affiliates leading to less regulatory expropriation. For productivity data, we will use the paper by Arndt and Spies (2012), who estimated total factor productivity of foreign affiliates in Germany for various country groups.²⁵ We expect higher productivity of the foreign affiliates in the home country to lead to less regulatory expropriation and hence less lawsuits.

Lastly, we have the interaction between FDI i^* in the home country and $g(\cdot)$. Higher amounts of FDI in a particular sector imply that it is more costly for the government to regulate. But at the *aggregate* level, more FDI implies more sectors which could be hit by shocks, resulting in more scope for the government to potentially take action. The overall effect of more FDI on lawsuits is hence ambiguous. Intuitively, we expect the latter effect to be larger, hence more aggregate FDI should imply more regulatory expropriations and lawsuits. An ideal empirical counterpart would use worldwide bilateral FDI data. However, bilateral FDI data is extremely patchy,²⁶ so aggregate inward FDI (of the host country) and aggregate outward FDI (of the source country) from UNCTAD were used as proxies.

The model specification assumes that each BIT-year could have potentially generated a lawsuit, and the dependent variable of interest is the number of lawsuits from country j to country i in year t . This is a count variable, allowing for the arrival rate of lawsuits to be modeled as a poisson process. However, the likelihood test of the dispersion parameter alpha indicates overdispersion, in that the conditional variance exceeds the conditional mean.²⁷ Hence, instead of a poisson regression, the following negative binomial regression is applied:

$$\begin{aligned} lawsuit_{ijt} = & \beta_0 + \beta_1 fdi_in_{it} + \beta_2 fdi_out_{jt} + \beta_3 property_{it} \\ & + \beta_4 democracy_{it} + \beta_5 productivity_j + \delta_t + \varepsilon_{ijt} \end{aligned} \tag{21}$$

²⁵One could argue that productivity data on foreign affiliates in Germany is not representative for the whole sample. However, the later analysis will mainly be based on within OECD pairs only, where Germany is a more representative country.

²⁶This is true for the UNCTAD and OECD bilateral FDI datasets.

²⁷Test statistics are available upon request.

- $lawsuit_{ijt}$: Number of lawsuits from j -country firms to country i in year t (UNCTAD).
- fdi_in_{it} : Log total inward FDI (\$mn) into country i in year t (UNCTAD).
- fdi_out_{jt} : Log total outward FDI (\$mn) by country j in year t (UNCTAD).
- $property_{it}$: Property rights index by WEF in country i in year t . Higher values imply better property protection.
- $democracy_{it}$: WGI voice and accountability index by World Bank. Higher values imply better democratization.
- $productivity_j$: TFP of foreign affiliates in Germany, as estimated in Arndt and Spies (2012).

Details about the variables can be found in the data appendix. Table 3 presents summary statistics.

Table 3
Summary Statistics

| | N | Mean | StDev. | Min | Max |
|---------------------|--------|--------|--------|---------|--------|
| Lawsuits | 81,823 | 0.007 | 0.098 | 0 | 6 |
| Log Inward FDI | 78,074 | 10.245 | 2.368 | -11.512 | 15.412 |
| Log Outward FDI | 72,611 | 8.893 | 3.804 | -11.513 | 15.664 |
| Property Protection | 77,514 | 4.605 | 1.173 | 1.558 | 6.606 |
| Democracy | 81,610 | 0.258 | 1.036 | -2.284 | 1.826 |
| Productivity | 78,967 | 6.482 | 0.518 | 5.98 | 7.983 |

3.2 Results

Results are presented in table 4. We estimate the same regression using four different samples: Column (1) uses the full sample, with all 65,527 BIT-years. All coefficients have the expected signs. Countries with better property protection and higher productivity of their foreign affiliates see less lawsuits. On the other hand, being a more democratic country has, *ceteris paribus*, a positive effect on the number of lawsuits. In column (2), we look at a sample of post-2000 years only, to see whether a structural break took place. However, coefficients are stable over time, with no marked increase in the propensity for lawsuits in recent years, if we control for sufficient variables. Any increase in the absolute number of lawsuits in recent years can hence be explained by the rising absolute number of BITs and the rise in FDI.

Since our goal is to predict the number of lawsuits for Germany originating in the US that can be expected from a EU-US BIT, restricting ourselves to a sample containing only within-OECD

Table 4
Regression results

| | (1) Full sample | (2) Post-2000 | (3) OECD | (4) OECD post-2000 |
|------------------|-----------------------|-----------------------|----------------------|-----------------------|
| FDI In | 0.353*** (0.0351) | 0.337*** (0.0365) | 0.738*** (0.0999) | 0.729*** (0.112) |
| FDI Out | 0.502*** (0.0466) | 0.486*** (0.0473) | 1.001*** (0.0902) | 1.007*** (0.0966) |
| Property Rights | -0.841*** (0.0669) | -0.865*** (0.0709) | -0.448** (0.225) | -0.427* (0.246) |
| Democracy | 0.401*** (0.0795) | 0.379*** (0.0834) | 0.810*** (0.292) | 0.860** (0.339) |
| Productivity | -0.625** (0.272) | -0.584** (0.273) | -0.708 (0.654) | -0.950 (0.744) |
| Constant | -7.549*** (2.072) | -7.331*** (2.084) | -20.56*** (4.827) | -19.17*** (5.536) |
| Observations | 65,527 | 50,434 | 8,152 | 5,839 |
| Year FE | Yes | Yes | Yes | Yes |
| Pseudo R-Squared | 0.178 | 0.160 | 0.291 | 0.263 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

pairings might be more informative. In this OECD-only sample in column (3), all coefficients retain their sign, with the productivity of foreign affiliates losing significance. A last sample in column (4) uses within-OECD pairings after 2000. Results from this last column will be used for our prediction, since it has the highest external validity for our prediction purposes.

Entering the corresponding values of 2014 (the most recent year) for all explanatory variables of a German-US pairing, we obtain a point estimate of 0.745 for the dependent variable. This means that if Germany were to sign a BIT with the USA, Germany could expect 0.745 lawsuits by US investors per year. This is about in line with the Canadian experience in NAFTA, as Canada has faced 23 lawsuits by 2014 from US investors since the ratification of NAFTA in 1994. According to Hodgson (2014), who examined all ICSID cases up to 2012 for which public information was available, the investor prevails in 41% of all cases. Conditional on winning, the average payment made to the investor is \$76.33mn, together with \$4.93mn in legal and tribunal

costs. Therefore, the expected annual total cost from compensation payments for Germany from a German-US BIT would be $0.745 \times (0.41 \times \$76.33\text{mn} + \$4.93\text{mn}) = \27mn .²⁸

Hence, the expected annual cost that needs to be recovered by the insurance fee is \$27mn. Given that total revenue by US affiliates in Germany from 2010-13 was €568.5bn,²⁹ their profit margin in 2010-13 was 3.5%,³⁰ and assuming an exchange rate of 0.9 dollars per euro, we find that we would need an insurance fee on profits of $h = (4 \cdot 0.027\text{bn} \cdot 0.9) / (0.035 \cdot 568.5\text{bn}) = 0.49\%$ to cover the compensation costs. As pointed out at the beginning of this section, this estimate constitutes a lower bound of what is needed to achieve a Pareto improvement from a BIT. Due to possible out-of-court settlements and the unaccounted cost of regulatory chill, any true h would need to be higher, and its value would need to be determined politically.

This back-of-the-envelope calculation helps us to put a ballpark figure on expected costs, alleviating potential concerns about the severity of financial liabilities resulting from a BIT. The insurance fee is not simply an additional burden on firms with no benefits in return. Instead, the fee is part of a package that contains a BIT, with firms benefiting from the removal of uncertainty through a BIT.

4 Concluding Remarks

We have developed a theoretical model on bilateral investment treaties, explicitly modelling the trade-off between FDI and the state's ability to regulate in an international context. This helps to fill a gap in the theoretical literature on BITs. In the model, firms can decide whether to invest, with the government deciding whether to regulate in response to shocks. A BIT forces the government to pay monetary compensation to firms in the case of regulatory expropriation. Our model has provided important new insights on the welfare effects of a BIT: The model shows that a BIT can raise overall efficiency by internalizing the negative externality that the government imposes on firms when regulating. The improvement in overall efficiency is more likely to hold for highly productive industries, and less likely for less productive industries. In addition, the model shows that attracting new FDI through a BIT may actually decrease overall welfare, with the BIT's protection of existing FDI constituting the only channel of unambiguous welfare gain. Several extensions of the base model, allowing for the distinction of domestic vs. foreign firms, and the choice between exporting and FDI, are also included.

²⁸Current legal practice on the apportionment of legal cost at arbitration tribunals still varies. For our calculations, we assume the 'pay your own way' principle, as is adopted in the majority of cases.

²⁹Source: German Central Bank

³⁰Source: Amadeus database

In hitherto existing BITs, the increase in aggregate efficiency happens with firms gaining at the state's expense. We propose to redesign BITs by including a fee on firm profits in order to redistribute the welfare gain from BITs among firms and the government, so that a Pareto improvement compared to the no-BIT case results. This fee-enhanced BIT can be interpreted as the government offering state insurance in the form of a BIT, and making firms contribute financially to it. This approach combines the advantage of a BIT in efficiency gains, while at the same time removing the financial burden of compensation payments as one of the main obstacles in justifying BITs. In an empirical exercise, we estimate the annual German compensation cost from an EU-US BIT to be \$27mn, and the compensating fee on firm profits to be 0.5%.

Further research could extend the current theoretical setup to allow for a dynamic setting involving multiple time periods, in order to capture reputation and learning effects over time. The model could also be extended to a general equilibrium setting involving two countries, with two governments and firms originating from and investing in both countries. Firm profits would then be paid out as dividends to shareholders in the other country, and taxes would be invested in public goods. However, the qualitative results of the paper would remain largely unchanged in both cases. As long as governments do not fully internalize the effects of regulating foreign firms, the problem of negative externalities and excessive regulation remain, even in a dynamic setting with reputational effects or in general equilibrium. In that case, a BIT could still help to achieve pareto-improvement. Another possible extension would allow for risk aversion on either the firms' or the governments' side, with the BIT then providing further efficiency gains by shifting the cost of bearing the risk of political shocks to the less risk averse party. For the empirical part, better data in terms of bilateral FDI and the productivity of foreign affiliates would be desirable and could potentially improve upon forecasting precision.

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5 Appendix A: Proofs

5.1 Base model - No BIT - Slope of investment

Proof of corollary 2.2.2:

$$\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} = \frac{\partial r^{-1}\left[\frac{c}{p(\varepsilon > \varepsilon^{eq})}\right]}{\partial \varepsilon^{eq}} = [r^{-1}]' \cdot \left[-\frac{c}{(1 - F(\varepsilon^{eq}))^2}\right] \cdot [-f(\varepsilon^{eq})]$$

and since $r'(\cdot) < 0$, we have $[r^{-1}]'(\cdot) < 0$ by the formula for the derivative of the inverse, and hence the whole expression is negative. ■

5.2 Base model - No BIT - Efficiency

Proof of proposition 2.2.3:

For a fixed given level of i^{NB} , the government regulates too often in the absence of a BIT. The level of investment i^{NB} can be seen as fixed because investment decisions have already been made at the point when G decides about regulation. Aggregate welfare is calculated as the sum of government payoff and firm profits. With an arbitrary regulation threshold $\bar{\varepsilon}$, aggregate welfare is given by:

$$\int_{\bar{\varepsilon}}^{\infty} f(\varepsilon)[g(\varepsilon) + \int_0^{i^{NB}} r(i)di]d\varepsilon - c \cdot i^{NB} \quad (22)$$

Now define $\varepsilon^{NB} = g^{-1}\left[-\int_0^{i^{NB}} r(i)di\right] < 0$. For $\varepsilon^{NB} < \bar{\varepsilon} < 0$, the expression in brackets $[g(\varepsilon) + \int_0^{i^{NB}} r(i)di]$ from equation (22) is then positive. Since in the no BIT equilibrium, we have $\bar{\varepsilon} = 0$, aggregate welfare can be raised by lowering $\bar{\varepsilon}$, which implies regulating less often. ■

5.3 Base model - With BIT - Slope of regulation

Proof of corollary 2.3.2:

$$\frac{\partial \varepsilon^{eq}}{\partial i^{eq}} = \frac{\partial g^{-1}\left[-\int_0^{i^{eq}} r(i)di\right]}{\partial i^{eq}} = [g^{-1}]' \cdot [-r(i^{eq})] < 0$$

Since $g'(\cdot) > 0$, we have $[g^{-1}]'(\cdot) > 0$ by the formula for the derivative of the inverse, and hence $\frac{\partial \varepsilon^{eq}}{\partial i^{eq}} < 0$. ■

5.4 Base model - With BIT - Lawsuits

Proof of proposition 2.3.4. Recall that L , the number of lawsuits is given by:

$$L = \sum_{k=1}^K p_k [\varepsilon < g^{-1}(-\int_0^{i_k^*} r_k(i) di)] \cdot i_k^* = \sum_{k=1}^K \{F_k[g^{-1}(-\int_0^{i_k^*} r_k(i) di)]\} \cdot i_k^* \quad (23)$$

where $F(\cdot)$ is the cdf of $f(\cdot)$.

1. L depends positively on $-g(\cdot)$, the government's gain from regulating.

Proof We have

$$\frac{\partial L}{\partial g^{-1}(\cdot)} = \sum_{k=1}^K \{f_k[g^{-1}(-\int_0^{i_k^*} r(i) di)]\} \cdot i_k^* > 0$$

And since $\frac{\partial L}{\partial g^{-1}(\cdot)} > 0$, we have $\frac{\partial L}{\partial g(\cdot)} < 0$, and hence $\frac{\partial L}{\partial [-g(\cdot)]} > 0$. ■

2. L depends negatively on firm productivity $r(i)$.

Proof Let $z = -\int_0^{i^*} r(i) di$. We have:

$$\frac{\partial L}{\partial r} = \frac{\partial L}{\partial g^{-1}} \cdot \frac{\partial g^{-1}(z)}{\partial z} \cdot \frac{\partial z(r)}{\partial r}$$

We further have $\frac{\partial L}{\partial g^{-1}} > 0$ from above, $\frac{\partial g^{-1}(z)}{\partial z} > 0$ since $g'(\cdot) > 0$ and by the formula for the derivative of the inverse, and $\frac{\partial z(r)}{\partial r} < 0$ since $z(r) = -\int_0^{i^*} r(i) di$. Hence, the sign of $\frac{\partial L}{\partial r}$ is negative. ■

3. The effect of the amount of FDI i^* on L is ambiguous.

Proof Let $z = -\int_0^{i^*} r(i) di$ and Let $y = F_k[g^{-1}(-\int_0^{i^*} r(i) di)]$. We have:

$$\frac{\partial L}{\partial i^*} = \sum_{k=1}^K [\frac{\partial y}{\partial i^*} \cdot i^* + y] = \sum_{k=1}^K [\frac{\partial y}{\partial g^{-1}} \cdot \frac{\partial g^{-1}}{\partial z} \cdot \frac{\partial z}{\partial i^*} \cdot i^* + y]$$

We further have $\frac{\partial y}{\partial g^{-1}} > 0$ and $\frac{\partial g^{-1}(z)}{\partial z} > 0$, and $\frac{\partial z}{\partial i^*} = -r(i^*) < 0$. Hence, the first term in the summation, $\frac{\partial y}{\partial i^*} \cdot i^*$ is negative, while the second term y is positive. Hence, the overall sign is ambiguous. ■

Example

We further demonstrate the result by showing ambiguity for a specific example. Let

$$\varepsilon \sim f(\varepsilon) = \frac{1}{1000}, \quad \varepsilon \in [-1000, 0], \quad g(\varepsilon) = \varepsilon, \quad g^{-1}(\varepsilon) = \varepsilon$$

$$r(i) = ae^{-i}, \quad r^{-1}(i) = \ln\left(\frac{a}{i}\right), \quad a > 1, \quad c = 1$$

Then we have

$$L = F\left(-\int_0^{i^*} ae^{-i} di\right) \cdot i^* = \left[\frac{1}{1000}a(e^{-i^*} - 1) + 1\right] \cdot i^* \quad (24)$$

Taking the derivative of L with respect to i^* :

$$\frac{\partial L}{\partial i^*} = \frac{1}{1000}ae^{-i^*}(1 - i^*) - \frac{1}{1000}a + 1 \quad (25)$$

The sign of $\frac{\partial L}{\partial i^*}$ in (25) is ambiguous and depends on i^* and parameter a . If $a = 1000$, then $\frac{\partial L}{\partial i^*} > 0$ if $i^* < 1$ and $\frac{\partial L}{\partial i^*} < 0$ if $i^* > 1$. ■

5.5 Base model - Sign of aggregate welfare change

Proof of corollary 2.4.4. Ambiguity can be seen from the parameter definitions. Alternatively, we prove the statement by demonstrating ambiguity for a specific example. Let

$$\varepsilon \sim f(\varepsilon) = \frac{1}{1000}, \quad \varepsilon \in [-500, +500], \quad g(\varepsilon) = \varepsilon, \quad g^{-1}(\varepsilon) = \varepsilon$$

$$r(i) = ae^{-i}, \quad r^{-1}(i) = \ln\left(\frac{a}{i}\right), \quad a > 1, \quad K = 1, \quad c = 1$$

Then we have:

$$i^{NB} = r^{-1}\left[\frac{c}{p(\varepsilon > 0)}\right] = r^{-1}(2) = \ln\left(\frac{a}{2}\right), \quad i^* = r^{-1}(c) = \ln(a)$$

$$\varepsilon^{BIT} = g^{-1}\left[-\int_0^{i^*} r(i) di\right] = -\int_0^{\ln(a)} ae^{-i} di = -[(-ae^{-\ln(a)}) - (-ae^0)] = 1 - a$$

This gives us for aggregate welfare change ΔW :

$$\begin{aligned} \Delta W &= \int_{1-a}^0 \frac{1}{1000} d\varepsilon \cdot \int_0^{\ln \frac{a}{2}} ae^{-i} di + \int_{1-a}^{500} \frac{1}{1000} d\varepsilon \cdot \int_{\ln \frac{a}{2}}^{\ln(a)} ae^{-i} di + \int_{1-a}^0 \frac{1}{1000} \varepsilon d\varepsilon - [\ln(a) - \ln \frac{a}{2}] \\ &= \frac{1}{1000}(a-2)(a-1) + \left[\frac{1}{2} + \frac{1}{1000}(a-1)\right] - \frac{1}{2000}(1-a)^2 - \ln 2 \\ &= (a-1)^2 + 1000 - 2000 \cdot \ln 2 \end{aligned} \quad (26)$$

If $a > 20.654$, then ΔW is positive. Otherwise, ΔW is negative. Hence, the overall welfare effect is ambiguous and depends on the parameters. ■

5.6 Base model - Aggregate welfare change derivatives

Proof of corollary 2.4.5:

$$\frac{\partial \Delta W}{\partial r(i)} = \int_{\varepsilon^{BIT}}^0 f(\varepsilon) d\varepsilon \cdot i^{NB} + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \cdot (i^* - i^{NB}) > 0$$

$$\frac{\partial \Delta W}{\partial c} = -(i^* - i^{NB}) < 0$$

■

5.7 Base model - No new FDI

Proof of proposition 2.4.7.

Assume that, for some exogenous reason, no additional FDI can enter after a BIT is introduced. Firm investment stays at i^{NB} . Then, the government regulates if $\varepsilon < \varepsilon^{BIT} = g^{-1}[\int_0^{i^{NB}} r(i) di] < 0$. Total firm profits are given by:

$$\int_0^{i^{NB}} r(i) di - c \cdot i^{NB} \quad (27)$$

The government's payoff is given by:

$$\int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) g(\varepsilon) d\varepsilon - \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon) d\varepsilon \int_0^{i^{NB}} r(i) di \quad (28)$$

And aggregate welfare under a BIT is better if the following inequality holds:

$$\int_{\varepsilon^{BIT}}^0 f(\varepsilon) [g(\varepsilon) + \int_0^{i^{NB}} r(i) di] d\varepsilon > 0 \quad (29)$$

Since we integrate from ε^{BIT} to 0, we have that ε lies between the two integration limits. For $\varepsilon^{BIT} < \varepsilon < 0$, the LHS is positive by the definition of ε^{BIT} and hence the inequality holds. With no new FDI, aggregate welfare is always increased with the introduction of a BIT. ■

5.8 FDI tax - No BIT - Regulation and investment

Proof of proposition 2.6.1:

$u_G = 0$ if $I_R = 1$ and $u_G = g(\varepsilon) + \int_0^{i^{NB}} t[r(i) - c]di$ if $I_R = 0$. Firms have $E(\pi_i) = p(\varepsilon > \varepsilon^{NB})[r_i - t(r_i - c)] - c = (1 - t)pr_i - (1 - pt)c$, which must be greater than zero for investment to happen. ■

5.9 FDI tax - No BIT - Slope of regulation

Proof of corollary 2.6.2:

$$\frac{\partial \varepsilon^{eq}}{\partial i^{eq}} = \frac{\partial g^{-1}[-\int_0^{i^{eq}} t[r(i) - c]di]}{\partial i^{eq}} = [g^{-1}]' \cdot [-t(r(i^{eq}) - c)]$$

Since $g'(\cdot) > 0$, we have $[g^{-1}]'(\cdot) > 0$ by the formula for the derivative of the inverse, and hence $\frac{\partial \varepsilon^{eq}}{\partial i^{eq}} < 0$ ■.

5.10 FDI tax - No BIT - Multiple equilibria

Proof of proposition 2.6.3

We prove the statement by showing that a specific example has multiple solutions. Let

$$\varepsilon \sim f(\varepsilon) = \frac{1}{1000}, \varepsilon \in [-1000, 0], g(\varepsilon) = \varepsilon, g^{-1}(\varepsilon) = \varepsilon$$

$$r(i) = ae^{-i}, r^{-1}(i) = \ln\left(\frac{a}{i}\right), a > 1, c = 1$$

Then we have in the FDI tax, no BIT case:

$$i^{NB}(\varepsilon^{NB}) = r^{-1}\left[\frac{1 - p(\varepsilon > \varepsilon^{NB})t}{(1 - t)p(\varepsilon > \varepsilon^{NB})}c\right] = \ln\left[\frac{a}{\frac{1 - (-\frac{1}{1000}\varepsilon^{NB})t}{(1-t)(-\frac{1}{1000}\varepsilon^{NB})}}\right] = \ln\left[-\frac{a(1 - t)(\varepsilon^{NB})}{1000 + \varepsilon^{NB}t}\right] \quad (30)$$

$$\varepsilon^{NB}(i^{NB}) = g^{-1}\left[-\int_0^{i^{NB}} t[r(i) - c]di\right] = -t \int_0^{i^{NB}} (ae^{-i} - 1)di = -t(-ae^{-i^{NB}} - i^{NB} + a) \quad (31)$$

Substituting (31) into (30):

$$i^{NB} = \ln[at(1 - t)(-ae^{-i^{NB}} - i^{NB} + a)] - \ln[1000 - t^2(-ae^{-i^{NB}} - i^{NB} + a)] \quad (32)$$

Choosing $a = 200$ and $t = 0.125$ turns (32) into:

$$i^{NB} = \ln(-4375e^{-i^{NB}} - 21.875i^{NB} + 4375) - \ln(3.125e^{i^{NB}} + 0.015625i^{NB} + 996.875) \quad (33)$$

There are two solutions for (33): $i_1^{NB} = 0.443$ and $i_2^{NB} = 1.026$. Substituting back into (31) gives $\varepsilon_1^{NB} = -8.886$ and $\varepsilon_2^{NB} = -16.027$. Hence, we have shown that multiple equilibria exist for the FDI tax, no BIT case. ■

5.11 FDI tax - With BIT - Regulation and Investment

Proof of proposition 2.6.4:

$u_G = -\int_0^{i^*} [r(i) - t(r(i) - c)]di$ if $I_R = 1$ and $u_G = g(\varepsilon) + \int_0^{i^{NB}} t[r(i) - c]di$ if $I_R = 0$. Firms have guaranteed profits $E(\pi_i) = (1 - t)(r_i - c)$. ■

5.12 FDI tax - With BIT - Government payoff difference

Proof of proposition 2.6.6.

The difference in government payoff is given by:

$$\begin{aligned} & - \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon \int_0^{i^*} [r(i) - t(r(i) - c)]di \\ & + \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon)[g(\varepsilon) + \int_0^{i^{NB}} t(r(i) - c)]d\varepsilon \\ & + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)d\varepsilon \int_{i^{NB}}^{i^*} t[r(i) - c]di \end{aligned} \quad (34)$$

The first term represents the loss from compensation payments and is negative, as we have $f(\cdot) > 0$, $[r(i) - t(r(i) - c)] > 0 \forall i$. The second term represents regulatory chill plus tax income for shocks $\varepsilon^{BIT} < \varepsilon < \varepsilon^{NB}$, and is negative by revealed preference. The third term represents the additional tax income and is positive. Hence, the overall sign is ambiguous. ■

5.13 Domestic and foreign firms - No BIT - Regulation and investment

Proof of proposition 2.7.1:

$u_G = g(\varepsilon) + \mu \int_0^{i^{NB}} [r(i) - c]di + (1 - \mu) \int_0^{i^{NB}} t[r(i) - c]$ if $I_R = 0$ and $u_G = \mu \int_0^{i^{NB}} (-c)di$ if $I_R = 1$. $E(\pi_i) = p(\varepsilon > \varepsilon^{NB})[r_i - t(r_i - c)] - c = (1 - t)pr_i - (1 - pt)c$, which must be greater than zero for investment to happen. ■

5.14 Domestic and foreign firms - No BIT - Slope of regulation

Proof of corollary 2.7.2:

$$\frac{\partial \varepsilon^{eq}}{\partial \mu} = [g^{-1}]' \cdot \left[- \int_0^{i^{NB}} r(i) di + \int_0^{i^{NB}} t(r(i) - c) di \right] = [g^{-1}]' \cdot \left[- \int_0^{i^{NB}} [r(i) - t(r(i) - c)] di \right]$$

Since $g'(\cdot) > 0$, we have $[g^{-1}]'(\cdot) > 0$ by the formula for the derivative of the inverse, and hence $\frac{\partial \varepsilon^{eq}}{\partial \mu} < 0$. ■

5.15 Domestic and foreign firms - With BIT - Regulation and Investment

Proof of proposition 2.7.3:

$u_G = g(\varepsilon) + \mu \int_0^{i^D} [r(i) - c] di + (1 - \mu) \int_0^{i^*} t[r(i) - c] di$ if $I_R = 0$ and $u_G = \mu \int_0^{i^D} (-c) di - (1 - \mu) \int_0^{i^*} [r(i) - t(r(i) - c)] di$ if $I_R = 1$. We further have $E(\pi_i^D) = p(\varepsilon > \varepsilon^{BIT})[r_i - t(r_i - c)] - c = (1 - t)pr_i - (1 - pt)c$ for domestic firms, and $E(\pi_i^F) = (1 - t)[r_i - c]$ for foreign firms, which must be greater than zero for investment to happen. ■

5.16 Domestic and foreign firms - With BIT - Slope of regulation

Proof of corollary 2.7.4:

$$\frac{\partial \varepsilon^{eq}}{\partial \mu} = [g^{-1}]' \cdot \left[- \int_0^{i^D} r(i) di + \int_0^{i^*} r(i) di \right]$$

Since $g'(\cdot) > 0$, we have $[g^{-1}]'(\cdot) > 0$ by the formula for the derivative of the inverse, and since $i^* > i^D$, we have $\frac{\partial \varepsilon^{eq}}{\partial \mu} > 0$. ■

5.17 Exports and FDI - No BIT - Regulation and investment

Proof of proposition 2.8.1:

$u_G = g(\varepsilon)$ if $I_R = 0$ and $u_G = 0$ if $I_R = 1$. $E(\pi_i) = p(\varepsilon > 0)r_i - c$ if $I_F = 1$ and $E(\pi_i) = p(\varepsilon > 0)\frac{r_i}{\tau}$ if $I_F = 0$. ■

5.18 Exports and FDI - No BIT - Slope of regulation

Proof of corollary 2.8.2:

$$\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} = [r^{-1}]' \cdot \left[-\frac{\tau c}{((\tau - 1)p(\varepsilon > \varepsilon^{eq}))^2} \right] \cdot (\tau - 1) \cdot [-f(\varepsilon^{eq})]$$

Since $r'(\cdot) < 0$, we have $[r^{-1}]' < 0$ by the formula for the derivative of the inverse, so $\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} < 0$. ■

5.19 Exports and FDI - With BIT - Regulation and investment

Proof of proposition 2.8.3:

$u_G = g(\varepsilon)$ if $I_R = 0$ and $u_G = -\int_0^{i^{BIT}} r(i)di$ if $I_R = 1$. $E(\pi_i) = r_i - c$ if $I_F = 1$ and $E(\pi_i) = p(\varepsilon > \varepsilon^{BIT})\frac{r_i}{\tau}$ if $I_F = 0$. ■

5.20 Exports and FDI - With BIT - Change in investment

Proof of corollary 2.8.4:

$$\begin{aligned} i^{NB} &= r^{-1}\left[\frac{\tau}{(\tau - 1)p(\varepsilon > 0)}c\right] < r^{-1}\left[\frac{\tau}{\tau - p(\varepsilon > \varepsilon^{BIT})}c\right] = i^{BIT} \\ \frac{1}{(\tau - 1)p(\varepsilon > 0)} &> \frac{1}{\tau - p(\varepsilon > \varepsilon^{BIT})} \\ (\tau - 1)p(\varepsilon > 0) &< \tau - p(\varepsilon > 0) - p(\varepsilon^{BIT} < \varepsilon < 0) \\ \tau p(\varepsilon > 0) &< \tau - p(\varepsilon^{BIT} < \varepsilon < 0) \\ p(\varepsilon^{BIT} < \varepsilon < 0) + \tau p(\varepsilon > 0) &< \tau \end{aligned} \tag{35}$$

Given that $p(\varepsilon > 0) + p(\varepsilon^{BIT} < \varepsilon < 0) \leq 1$ and $\tau > 1$ inequality (35) must hold and hence $i^{BIT} > i^{NB}$. ■

5.21 Exports and FDI - With BIT - Slope of regulation

Proof of corollary 2.8.5

$$\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} = [r^{-1}]' \cdot \left[-\frac{\tau c}{(\tau - p(\varepsilon > \varepsilon^{eq}))^2} \right] \cdot f(\varepsilon^{eq})$$

Since $r'(\cdot) < 0$, we have $[r^{-1}]' < 0$ by the formula for the derivative of the inverse, so $\frac{\partial i^{eq}}{\partial \varepsilon^{eq}} > 0$.

■

6 Appendix B: Model extensions

6.1 Extension: FDI Tax

6.1.1 No BIT

Government payoff function:

$$\text{No regulation: } u_G = g(\varepsilon) + \int_0^{i^{NB}} t[r(i) - c]di$$

$$\text{Regulation: } u_G = 0$$

Regulation threshold is $\varepsilon^{NB} = g^{-1}[-\int_0^{i^{NB}} t[r(i) - c]di]$. If the shock is below ε^{NB} , the government will regulate.

Expected profit for a single firm:

$$1. \pi_i = p(\varepsilon > \varepsilon^{NB})[r_i - t(r_i - c)] - c = (1 - t)pr_i - (1 - pt)c$$

Firm investment is $i^{NB} = r^{-1}[\frac{1-p(\varepsilon > \varepsilon^{NB})t}{(1-t)p(\varepsilon > \varepsilon^{NB})}c]$. The most productive firms $i < i^{NB}$ will invest, others refrain from doing so.

Government welfare under no BIT:

$$\int_{\varepsilon^{NB}}^{\infty} f(\varepsilon)g(\varepsilon)d\varepsilon + \int_{\varepsilon^{NB}}^{\infty} f(\varepsilon)d\varepsilon \int_0^{i^{NB}} t[r(i) - c]di \quad (36)$$

Firm profits under no BIT:

$$\int_{\varepsilon^{NB}}^{\infty} f(\varepsilon)d\varepsilon \int_0^{i^{NB}} [r(i) - t(r(i) - c)]di - ci^{NB} \quad (37)$$

6.1.2 With BIT

Government payoff function:

No regulation: $u_G = g(\varepsilon) + \int_0^{i^*} t[r(i) - c]di$

Regulation: $u_G = - \int_0^{i^*} [r(i) - t(r(i) - c)]di$

Regulation threshold is $\varepsilon^{BIT} = g^{-1}[- \int_0^{i^*} r(i)di]$.

Expected profit for a single firm:

1. $\pi_i = (1 - t)[r_i - c]$

Firm investment is $i^* = r^{-1}(c)$.

Government welfare with BIT:

$$\int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)g(\varepsilon)d\varepsilon + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)d\varepsilon \int_0^{i^*} t[r(i) - c]di - \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon \int_0^{i^*} [r(i) - t(r(i) - c)]di \quad (38)$$

Firm profits with BIT:

$$\int_0^{i^*} [r(i) - t(r(i) - c)]di - ci^* \quad (39)$$

6.1.3 Comparison

No-BIT of the extended model vs. base model:

$$\varepsilon_{Ext}^{NB} < \varepsilon_{Base}^{NB} = 0 \text{ and } i_{Ext}^{NB} > i_{Base}^{NB}$$

With-BIT vs. No-BIT of the extended model:

$$\varepsilon^{BIT} < \varepsilon^{NB} \text{ and } i^{NB} < i^{BIT} = i^*$$

With-BIT of the extended model vs. base model:

$$\varepsilon_{Ext}^{BIT} = \varepsilon_{Base}^{BIT} \text{ and } i_{Ext}^{BIT} = i_{Base}^{BIT} = i^*$$

Difference in total firm profit from introducing a BIT in the extended model (sign positive):

$$\begin{aligned} & \left[\int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon + \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon)d\varepsilon \right] \cdot \int_0^{i^{NB}} [r(i) - t(r(i) - c)]di \\ & + \int_{i^{NB}}^{i^*} (1 - \tau)(r(i) - c)di \end{aligned} \quad (40)$$

Firms gain from compensation payments, less regulatory expropriation on existing investments, and profits from new investments.

Difference in government welfare from introducing a BIT in the extended model (sign ambiguous):

$$\begin{aligned}
& - \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon) d\varepsilon \int_0^{i^*} [r(i) - t(r(i) - c)] di \\
& + \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) [g(\varepsilon) + \int_0^{i^{NB}} t(r(i) - c)] d\varepsilon \\
& + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \int_{i^{NB}}^{i^*} t[r(i) - c] di
\end{aligned} \tag{41}$$

The government loses from from compensation payments and regulatory chill. It gains from new tax intakes due to additional investments.³¹

In the aggregate welfare comparison, the with-BIT scenario is better than no-BIT if the following inequality holds:

$$\begin{aligned}
& \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) d\varepsilon \int_0^{i^{NB}} r(i) di + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \int_{i^{NB}}^{i^*} r(i) di \\
& > - \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) g(\varepsilon) d\varepsilon + c(i^* - i^{NB})
\end{aligned} \tag{42}$$

This is almost identical to the welfare change in the base model.

6.2 Extension: Domestic vs. Foreign Firms

6.2.1 No BIT

Government payoff function:

$$\text{No regulation: } u_G = g(\varepsilon) + \mu \int_0^{i^{NB}} [r(i) - c] di + (1 - \mu) \int_0^{i^{NB}} t[r(i) - c]$$

$$\text{Regulation: } u_G = \mu \int_0^{i^{NB}} (-c) di$$

Regulation threshold is $\varepsilon^{NB} = g^{-1}[-\mu \int_0^{i^{NB}} r(i) di - (1 - \mu) \int_0^{i^{NB}} t[r(i) - c] di]$. If the shock is below ε^{NB} , the government will regulate.

Expected profit for a single firm:

$$1. \pi_i = p(\varepsilon > \varepsilon^{NB})[r_i - t(r_i - c)] - c = (1 - t)pr_i - (1 - pt)c$$

³¹The gain in tax from investments that now do not suffer from regulatory expropriation any more is outweighed by the loss from regulatory chill. This can be seen by revealed preference.

Firm investment is $i^{NB} = r^{-1}[\frac{1-p(\varepsilon > \varepsilon^{NB})t}{(1-t)p(\varepsilon > \varepsilon^{NB})}c]$. The most productive firms $i < i^{NB}$ will invest, others refrain from doing so.

Government welfare under no BIT:

$$\begin{aligned} \int_{\varepsilon^{NB}}^{\infty} f(\varepsilon)g(\varepsilon)d\varepsilon + \int_{\varepsilon^{NB}}^{\infty} f(\varepsilon)d\varepsilon[\mu \int_0^{i^{NB}} (r(i)-c)di + (1-\mu) \int_0^{i^{NB}} t(r(i)-c)di] \\ + \int_{-\infty}^{\varepsilon^{NB}} f(\varepsilon)d\varepsilon\mu \int_0^{i^{NB}} (-c)di \end{aligned} \quad (43)$$

Firm profits under no BIT:

$$\int_{\varepsilon^{NB}}^{\infty} f(\varepsilon)d\varepsilon \int_0^{i^{NB}} [r(i) - t(r(i) - c)]di - ci^{NB} \quad (44)$$

6.2.2 With BIT

Government payoff function:

$$\text{No regulation: } u_G = g(\varepsilon) + \mu \int_0^{i^D} [r(i) - c]di + (1-\mu) \int_0^{i^*} t[r(i) - c]di$$

$$\text{Regulation: } u_G = \mu \int_0^{i^D} (-c)di - (1-\mu) \int_0^{i^*} [r(i) - t(r(i) - c)]di$$

Regulation threshold is $\varepsilon^{BIT} = g^{-1}[-\mu \int_0^{i^D} r(i)di - (1-\mu) \int_0^{i^*} r(i)di]$.

Expected profit for a single domestic firm:

$$1. \pi_i^D = p(\varepsilon > \varepsilon^{BIT})[r_i - t(r_i - c)] - c = (1-t)pr_i - (1-pt)c$$

Domestic firm investment is $i^D = r^{-1}[\frac{1-p(\varepsilon > \varepsilon^{BIT})t}{1-t}c]$.

Expected profit for a single foreign firm:

$$1. \pi_i^F = (1-t)[r_i - c]$$

Foreign firm investment is $i^F = i^* = r^{-1}(c)$.

Government welfare with BIT:

$$\begin{aligned} \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)g(\varepsilon)d\varepsilon + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)d\varepsilon[\mu \int_0^{i^D} (r(i)-c)di + (1-\mu) \int_0^{i^*} t(r(i)-c)di] \\ + \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon[\mu \int_0^{i^D} (-c)di - (1-\mu) \int_0^{i^*} (r(i) - t(r(i) - c))] \end{aligned} \quad (45)$$

Domestic firm profits with BIT:

$$\int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \int_0^{i^D} [r(i) - t(r(i) - c)] di - ci^D \quad (46)$$

Foreign firm profits with BIT:

$$\int_0^{i^*} [r(i) - t(r(i) - c)] di - ci^* \quad (47)$$

6.2.3 Comparison

No-BIT of the extended model vs. base model:

$$\varepsilon_{Ext}^{NB} < \varepsilon_{Base}^{NB} \quad \text{and} \quad i_{Ext}^{NB} > i_{Base}^{NB}$$

With-BIT vs. No-BIT of the extended model:

$$\varepsilon^{BIT} < \varepsilon^{NB} \quad \text{and} \quad i^{Foreign} = i^* > i^{Domestic} > i^{NB}$$

With BIT of the extended model vs. base model:

$$\varepsilon_{Ext}^{BIT} > \varepsilon_{Base}^{BIT} \quad \text{and} \quad i_{Ext}^{Domestic} < i_{Base}^{BIT} = i_{Ext}^{Foreign} = i^*$$

Foreign firm difference in profit from introducing a BIT in the extended model (sign positive):

$$\left[\int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon) d\varepsilon + \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) d\varepsilon \right] \int_0^{i^{NB}} [r(i) - t(r(i) - c)] di + \int_{i^{NB}}^{i^*} (1-t)(r(i) - c) di \quad (48)$$

Foreign firms gain from compensation payments, less regulatory expropriation on existing investments, and profits from new investments.

Domestic firm difference in profit from introducing a BIT in the extended model (sign positive):

$$\int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) d\varepsilon \int_0^{i^{NB}} [r(i) - t(r(i) - c)] di + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \int_{i^{NB}}^{i^D} [r(i) - t(r(i) - c)] di - c(i^D - i^{NB}) \quad (49)$$

Domestic firms gain from less regulatory expropriation on existing investments, and profits from new investments. The sum of the latter two terms gives the profits from new investments and is positive by revealed preference.

Government welfare difference from introducing a BIT in the extended model (sign ambiguous):

$$\begin{aligned}
& -(1 - \mu) \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon) d\varepsilon \int_0^{i^*} [r(i) - t(r(i) - c)] di \\
& + \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) [g(\varepsilon) + \mu \int_0^{i^{NB}} r(i) + (1 - \mu) \int_0^{i^{NB}} t(r(i) - c)] d\varepsilon \\
& + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon [\mu \int_{i^{NB}}^{i^D} [r(i) - c] di + (1 - \mu) \int_{i^{NB}}^{i^*} t[r(i) - c] di] + \mu \int_{-\infty}^{\varepsilon^{BIT}} \int_{i^{NB}}^{i^D} (-c) di
\end{aligned} \tag{50}$$

The government loses from compensation payments to foreign firms and regulatory chill. It gains from new tax intakes due to additional investments by both foreign and domestic firms. The overall sign is ambiguous.³²

The overall welfare effect is calculated as the sum of the government's payoff from regulation, and domestic and foreign firm's profit. In the aggregate welfare comparison, the with-BIT scenario is better than no-BIT if the following inequality holds:

$$\begin{aligned}
& \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) d\varepsilon \int_0^{i^{NB}} r(i) di + \mu \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \int_{i^{NB}}^{i^D} r(i) di + (1 - \mu) \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon) d\varepsilon \int_{i^{NB}}^{i^*} r(i) di \\
& > - \int_{\varepsilon^{BIT}}^{\varepsilon^{NB}} f(\varepsilon) g(\varepsilon) d\varepsilon + \mu c(i^D - i^{NB}) + (1 - \mu) c(i^* - i^{NB})
\end{aligned} \tag{51}$$

The LHS gives us the gain in aggregate welfare from a BIT. It includes the gain from having less regulatory expropriations on existing projects, as well as the gain from (unexpropriated) additional investments by domestic and foreign firms. The RHS gives us the loss in aggregate welfare. It consists of regulatory chill and the cost of new projects for domestic and foreign firms. Again, whether a BIT improves upon aggregate welfare depends on industry characteristics. If it does, a fee on firm profits can help to redistribute the gains.

³²The gain in tax from investments that now do not suffer from regulatory expropriation any more is outweighed by the loss from regulatory chill. This can be seen by revealed preference.

6.3 Extension: Exports vs. FDI

6.3.1 No BIT

Government payoff function:

$$\text{No regulation: } u_G = g(\varepsilon)$$

$$\text{Regulation: } u_G = 0$$

The regulation threshold is $\varepsilon^{NB} = 0$. If $\varepsilon < 0$, the government will regulate.

A firm can choose between FDI and exporting. FDI has a fixed cost c , while exporters face iceberg transport costs τ .

$$\text{FDI: } \pi_i = p(\varepsilon > 0)r_i - c$$

$$\text{Export: } \pi_i = p(\varepsilon > 0)\frac{r_i}{\tau}$$

Comparing the two, we find that firms with $i < i^{NB} = r^{-1}[\frac{\tau}{(\tau-1)p(\varepsilon>0)}c]$ choose FDI. Less productive firms will choose to export.

Government welfare under no BIT:

$$U_G = \int_0^\infty f(\varepsilon)g(\varepsilon)d\varepsilon \quad (52)$$

Firm profits under no BIT:

$$\int_0^\infty f(\varepsilon)d\varepsilon \int_0^{i^{NB}} r(i)di - ci^{NB} + \int_0^\infty f(\varepsilon)d\varepsilon \int_{i^{NB}}^\infty \frac{r(i)}{\tau}di \quad (53)$$

It consists of profits from firms engaging in FDI and firms choosing exports.

6.3.2 With BIT

Government payoff function:

$$\text{No regulation: } g(\varepsilon)$$

$$\text{Regulation: } - \int_0^{i^{BIT}} r(i)di$$

The regulation threshold is $\varepsilon^{BIT} = g^{-1}[- \int_0^{i^{BIT}} r(i)d]$.

A firm can choose between FDI and exporting. FDI now has the additional benefit of getting compensation in case of regulatory expropriation, delivering a guaranteed profit.

$$\text{FDI: } \pi_i = r_i - c$$

$$\text{Export: } \pi_i = p(\varepsilon > \varepsilon^{BIT}) \frac{r_i}{\tau}$$

Comparing the two, we find that firms with $i < i^{BIT} = r^{-1}[\frac{\tau}{\tau - p(\varepsilon > \varepsilon^{BIT})}c]$ choose FDI. Less productive firms will choose to export.

Government welfare with a BIT:

$$\int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)g(\varepsilon)d\varepsilon - \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon \int_0^{i^{BIT}} r(i)di \quad (54)$$

Firm profits with a BIT:

$$\int_0^{i^{BIT}} r(i)di - ci^{BIT} + \int_{\varepsilon^{BIT}}^{\infty} f(\varepsilon)d\varepsilon \int_{i^{BIT}}^{\infty} \frac{r(i)}{\tau} di \quad (55)$$

6.3.3 Comparison

No-BIT of the extended model vs. base model:

$$\varepsilon_{Ext}^{NB} = \varepsilon_{Base}^{NB} = 0 \text{ and } i_{Ext}^{NB} < i_{Base}^{NB}$$

With-BIT vs. No-BIT of the extended model:

$$\varepsilon^{BIT} < \varepsilon^{NB} = 0 \text{ and } i^{BIT} > i^{NB}$$

With BIT of the extended model vs. base model:

$$\varepsilon_{Ext}^{BIT} > \varepsilon_{Base}^{BIT} \text{ and } i_{Ext}^{BIT} < i_{Base}^{BIT}$$

Firm difference in profit from introducing a BIT in the extended model (sign positive):

$$\begin{aligned} & \int_{-\infty}^0 f(\varepsilon)d\varepsilon \int_0^{i^{NB}} r(i)di + \int_{\varepsilon^{BIT}}^0 f(\varepsilon)d\varepsilon \int_{i^{BIT}}^{\infty} \frac{r(i)}{\tau} di \\ & + \int_{i^{NB}}^{i^{BIT}} [r(i) - c]di - \int_0^{\infty} f(\varepsilon)d\varepsilon \int_{i^{NB}}^{i^{BIT}} \frac{r(i)}{\tau} di \end{aligned} \quad (56)$$

Firms gain from compensation payments, less regulatory expropriation on existing investments and exporters, and switching from exporting to FDI.

Government welfare difference from introducing a BIT in the extended model (sign negative):

$$\int_{-\varepsilon^{BIT}}^0 f(\varepsilon)g(\varepsilon)d\varepsilon + \int_{-\infty}^{\varepsilon^{BIT}} f(\varepsilon)d\varepsilon \int_0^{i^{BIT}} r(i)di \quad (57)$$

The government loses from compensation payments and regulatory chill.

In the aggregate welfare comparison, the with-BIT scenario is better than no-BIT if the following inequality holds:

$$\begin{aligned} \int_{\varepsilon^{BIT}}^0 f(\varepsilon)d\varepsilon \int_0^{i^{BIT}} r(i)di + \int_{\varepsilon^{BIT}}^0 f(\varepsilon)d\varepsilon \int_{i^{NB}}^{\infty} \frac{r(i)}{\tau} di - \int_0^{\infty} f(\varepsilon)d\varepsilon \int_{i^{NB}}^{i^{BIT}} \frac{r(i)}{\tau} di \\ > - \int_{\varepsilon^{BIT}}^0 f(\varepsilon)g(\varepsilon)d\varepsilon + c(i^{BIT} - i^{NB}) \end{aligned} \quad (58)$$

The aggregate gain from a BIT on the LHS includes gains from less regulatory expropriation and firms switching from exporting to FDI. The aggregate loss on the RHS include regulatory chill and the cost of new investments. The overall sign of the change depends on industry characteristics, but any aggregate welfare gain can be redistributed with a fee on firm profits.

7 Appendix C: Data appendix

Data on ratified BITs and a list of lawsuits invoking a BIT or NAFTA were obtained from the investment policy hub of UNCTAD at www.investmentpolicyhub.unctad.org. Data on inward and outward FDI were provided by UNCTADstat at unctadstat.unctad.org/EN. The property rights index (Series Code A.01.01.01) from the Global Competitiveness Index by the World Economic Forum (WEF) was available at reports.weforum.org/global-competitiveness-report-2014-2015. It is an aggregate measure of the perception of physical and intellectual property rights, with a value of 1 denoting extremely weak protection, and a value of 7 denoting strong property rights. The voice and accountability index was obtained from ‘Worldwide Governance Indicators’, a research programme of the World Bank. It reflects perceptions of the extent to which a country’s citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Estimate of governance ranges from -2.5 (weak governance performance) to +2.5 (strong governance performance). The TFP values for various country groups were obtained from Arndt and Spies (2012), with our regression using the TFP measures from the OLS approach. If the values for a variable were missing in a particular year, the most recent values (or values closest in time) were used.

Later calculations of the compensating insurance fee used figures from the German Central Bank and Amadeus. The German Central Bank publishes inward FDI figures into Germany by source country in their annual publication ‘Bestandserhebungen über Direktinvestitionen’, which gives us total revenue of US affiliates in Germany. We used the 2013 edition to compute revenue from 2010-13. The Amadeus database contains, amongst others, information on firms in Germany by ownership. Restricting ourselves to US-owned firms by using the ‘US global ultimate owner’ filter and aggregating the profit margin in 2010-13 across all firms delivers the profit margin of 3.5% used in the later calculations.