# THE DOUBLE IMPACT OF INSTITUTIONS: INSTITUTIONAL SPILLOVERS AND ENTREPRENEURIAL ACTIVITY IN THE SOLAR PHOTOVOLTAIC INDUSTRY

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## ABSTRACT

We investigate whether and when institutional spillovers, i.e., institutional effects across national borders, drive domestic entrepreneurial activity. Drawing on data on venture capital (VC) investments in the solar photovoltaic industry, we provide evidence for institutional spillovers and demonstrate that they are moderated by the presence of domestic institutions and the institutional distance between domestic and foreign policy schemes. By showing that domestic institutions not only influence entrepreneurial activity directly, but also facilitate spillovers, our findings demonstrate a double impact of institutions. Overall, we contribute to the literatures on the drivers of VC investments, institutions and entrepreneurship, and environmental entrepreneurship.


## EXECUTIVE SUMMARY

As the prominent examples of First Solar, SolarCity, and Tesla demonstrate, innovative entrepreneurial ventures can play an important role in addressing important environmental challenges, such as climate change, resource depletion, and the degradation of ecosystems (York and Venkataraman, 2010). Yet it remains unclear exactly how policymakers can encourage domestic entrepreneurial ventures in the context of environmental technologies, and how entrepreneurs can best take advantage of policy support. Studies suggest that formal and informal institutions, such as policy incentives and social values, drive entrepreneurial activity, but concentrate on national rather than international effects (Sine and David, 2010). This, however, leaves open whether policymakers need to instigate domestic policies, or whether they can free-ride on those in other countries. Moreover, entrepreneurs need to understand whether they can take advantage of foreign institutions when considering location and internationalization.

To shed more light on the cross-national impact of institutions—so-called "institutional spillovers"—on entrepreneurial activity, we study the link between foreign policy incentives and

venture capital (VC) investments (i.e., high-risk, high-return investments in entrepreneurial ventures) in the global solar photovoltaic (PV) industry. We show that foreign policy incentives for PV increase domestic VC activity, and domestic policy incentives enhance the positive impact of foreign policy incentives on the value of domestic VC deals. Moreover, we find that the similarity between domestic and foreign policy incentives enhances the impact of foreign policy incentives on the number of domestic VC deals, but not their value. For entrepreneurs, our study suggests that, given institutional spillovers, entrepreneurial opportunities around environmental issues may be greater than previous studies suggested. For policymakers, our findings imply that domestic policies may also benefit foreign firms, but that countries cannot simply free-ride on foreign institutions, since domestic policy incentives may be required to reap the benefits of foreign policy incentives.

## INTRODUCTION

The literature demonstrates that entrepreneurial activity is decisively shaped by institutions (Sine and David, 2010), defined as the "rules of the game" (North, 1990). Institutions, such as public policy and social values, shape entrepreneurial activity by creating a favorable market or technological environment and legitimizing entrepreneurial ventures (Meek et al., 2010; Sine and David, 2010).[1]

Entrepreneurship scholars have acknowledged that the impact of institutions may span national borders (Bruton et al., 2010), leading to so-called "institutional spillovers"—i.e., cross-border effects of institutions. Such spillovers may emerge, for example, as entrepreneurs enter foreign markets (McDougall and Oviatt, 2000), so their domestic activities and decisions may be strongly shaped by foreign institutions. An additional, important driver of institutional spillovers is the emergence of a global VC industry, which increasingly considers foreign opportunities when

[1] According to Schwartz (1992) values are universally structured, relatively stable criteria people use to select and justify actions and to evaluate people and events. In this paper, we focus on the impact of public policy incentives as formal institutions.

investing in domestic start-ups (Devigne et al., 2018; Madhavan and Iriyama, 2009). In fact, given the rapid globalization of many industries since the 1990s, we would expect institutional spillovers to play an important role in an increasing number of sectors (Henisz and Swaminathan, 2008).

Yet, while scholars have begun to investigate international entrepreneurship and its variation across countries and jurisdictions, studies on the impact of institutions on entrepreneurial activity have thus far focused on single countries (Bruton et al., 2010), providing only limited insights into how overseas institutions affect domestic entrepreneurial activity. Investigating institutional spillovers across national boundaries is critical, as it allows us to draw a more complete picture of the relation between institutions and entrepreneurial activity. For example, if foreign institutions drive domestic entrepreneurial activity, policymakers might not need to invest in building domestic institutions, but could free-ride on overseas institutional environments instead. Moreover, if entrepreneurial activity is driven by foreign institutions, entrepreneurs might not necessarily need to locate their businesses in countries with favorable institutions.

This paper examines whether and when institutional spillovers across national boundaries affect entrepreneurial activities by developing and testing hypotheses on the drivers of VC investments in the PV industry. Focusing on formal institutions, we argue that foreign policy incentives for technologies increase domestic VC activity, since they create opportunities for start-ups to serve foreign markets. We propose that the degree to which domestic VC activity is driven by such institutional spillovers depends on domestic policy incentives, since domestic institutional support for technologies helps entrepreneurs and investors sense related investment opportunities abroad, reduces investment uncertainty, and gives entrepreneurs the resources to enter foreign markets. Moreover, we posit that a smaller institutional distance—i.e., a greater similarity between domestic and foreign policy incentives—enhances institutional spillovers, since it makes it easier for entrepreneurs to leverage their experience with domestic policy schemes.

We test our hypotheses with a unique dataset containing 1,367 VC deals in the solar PV industry for 26 countries from 1993 to 2012. In doing so, we make three main contributions to the literature. First, we add to the literature on the drivers of VC investments and VC internationalization by showing that, even though VCs tend to invest in local firms (Sorenson and Stuart, 2001), their investments are shaped by foreign institutions. We show that the relationship between foreign policy incentives and the value of domestic VC deals is positively moderated by domestic policy incentives, suggesting that domestic policy incentives may help entrepreneurs seize institutionally induced opportunities abroad. Moreover, we find that the similarity between domestic and foreign policy incentives enhances the impact of foreign policy incentives on the number of domestic VC deals, but not on their value.

Second, we contribute to the literature on entrepreneurship and institutions. Previous work has highlighted the role of domestic institutions in domestic entrepreneurial activity, but offered only limited insights into the impact of foreign institutions (Bruton et al., 2010). We provide evidence for institutional spillovers across countries, implying that locating ventures in countries with favorable institutions might be less important than previously suggested. In addition, our findings suggest that institutions have a double impact: domestic institutions do not merely drive entrepreneurial behavior directly, as previously shown, but also shape entrepreneurs' ability to take advantage of favorable institutional conditions abroad.

Third, by shedding light on the role and drivers of institutional spillovers, we also contribute to the literature on environmental entrepreneurship. Previous work suggests that environmental externalities, such as climate change, offer significant opportunities for entrepreneurs (York and Venkataraman, 2010). Our study suggests that these opportunities might be even greater than suggested, since environmental entrepreneurs can take advantage of both domestic and foreign opportunities. Moreover, we shed new light on earlier studies of the relationship between

environmental policies and national competitiveness (Porter and van der Linde, 1995). Scholars have proposed that policy incentives for environmental technologies help create local markets that make national industries more competitive. Our study suggests that institutional spillovers may limit this effect, but that countries cannot completely free-ride on foreign institutions, since supportive domestic institutions help entrepreneurs reap the benefits of institutional spillovers.

## THEORETICAL BACKGROUND

### Institutions as drivers of VC investments and entrepreneurial activity

VC investments—i.e., high-risk, high-return investments in entrepreneurial ventures—build the foundations of entrepreneurial activity (Bruton et al., 2005). Young firms, in particular, rely heavily on VC funding to develop products, ramp up production, and establish sales channels (Kortum and Lerner, 2000). In principle, these activities can also be financed through private funds or borrowing, but entrepreneurs rarely have sufficient funds and banks are increasingly risk-averse (Hall and Lerner, 2009). Therefore, VC investments are critical for entrepreneurial ventures, especially early on (Stucki, 2014).

Given the pivotal role of VC investments, scholars and policymakers alike have investigated their antecedents (Groh et al., 2010; Lerner and Tåg, 2013). Scholars have pointed out that VC investments and entrepreneurial activities are driven by formal and informal institutions (Bruton et al., 2005; Hiatt et al., 2009; Jennings et al., 2013; Sine and David, 2010). Regarding informal institutions, recent work suggests that culture, social norms, and values may decisively shape entrepreneurial activities and related VC investments, since they enhance ventures' legitimacy, shape consumer preferences, and alert entrepreneurs and investors to opportunities (Li and Zahra, 2012; Meek et al., 2010). Turning to formal institutions, previous work shows that VC investments hinge on a country's general regulatory and policy environment. For example, research demonstrates that

there are more VC activities in countries with less political risk (Groh et al., 2010), stable legal boundary conditions (La Porta et al., 1997), and public R&D incentives (Da Rin et al., 2006; Gompers and Lerner, 1998). Moreover, scholars have shown that formal policy incentives that support demand for specific technologies spur entrepreneurial activities and stimulate VC investments (Sine et al., 2005; York and Lenox, 2014) by creating market opportunities (Hoppmann et al., 2013; Nemet, 2009) and attracting VC investors to the growing industry (Bürer and Wüstenhagen, 2009; Meek et al., 2010).

**The role and channels of institutional spillovers**

While the literature provides convincing evidence that institutions drive VC activities, research has neglected the role of foreign institutions and institutional spillovers. Foreign institutions may shape VC investments in domestic firms through various channels—e.g., when foreign policies are adopted by domestic policymakers (Dobbin et al., 2007), VCs engage in cross-border investments (Dai et al., 2012), or entrepreneurs or investors migrate to a different country (Iriyama et al., 2010; Saxenian, 2002). While all these channels represent plausible mechanisms that can drive institutional spillovers, we focus on spillovers that result when entrepreneurs (plan to) serve foreign markets, resulting in a situation where institutions in foreign markets influence both domestic entrepreneurial activity and VC investments. In fact, the literature on international business demonstrates that many industries have rapidly globalized, implying that domestic activities and the decisions of both entrepreneurs and VC investors are increasingly shaped by foreign institutions (Henisz and Swaminathan, 2008).

Entrepreneurship studies acknowledge that the impact of institutions may span national borders (Li and Zahra, 2012). Yet, thus far, research has focused on the effect of domestic institutions on entrepreneurship and VC investments, and has stressed the localized nature of these activities (Powell et al., 2002). For example, reviewing the literature on institutions and entrepreneurship,

Bruton et al. (2010: 432) state that "multiple country databases are the exception, not the rule, when using institutional theory as a foundation for entrepreneurship studies." Similarly, Sine and David (2010: 11) stress that "it is possible that strong regulation in one [geographical] area might spur entrepreneurial activity in another […], but this issue is little studied within institutional theory."

Shedding more light on institutional spillovers is critical because of their important implications for policymakers and entrepreneurs. For example, if foreign institutions do indeed influence domestic VC activities, policymakers might not have to invest in building domestic institutions, but might be able to free-ride on institutional environments abroad. Moreover, for entrepreneurs, understanding the impact of institutional spillovers is critical for making decisions on firm location, target markets, and internationalization (Meek et al., 2010). For example, if VC investments were driven by domestic institutions, this would suggest that locating businesses in institutionally benign environments is important for growth and survival. However, this may be less important if institutional spillovers exist. To investigate, we derive six specific hypotheses on institutional spillovers and VC activities, focusing on formal policy incentives for technologies, which have increased in recent years.

## HYPOTHESES

### The role of institutional spillovers for VC activities

As our baseline argument, we suggest that, particularly in globalized industries, VC activities are driven by institutional spillovers, since foreign institutions may create opportunities for domestic entrepreneurs and, faced with a rapidly globalizing VC industry, VC investors increasingly consider foreign investment opportunities.

If entrepreneurs operate in and serve domestic markets, entrepreneurial activity is primarily affected by domestic institutions. In recent years, however, firms have taken greater advantage of

entrepreneurial opportunities abroad (McDougall and Oviatt, 2000; Oviatt and McDougall, 2005). In such an environment, even if a venture's main operations are located in its home country, entrepreneurial activity is decisively shaped by foreign institutions, as they influence the demand for the venture's products and services (McDougall and Oviatt, 2000). Indeed, the literature on international business has long shown that foreign institutions decisively shape the attractiveness of international markets and firms' internationalization strategies, e.g. by providing a stable regulatory framework, by affecting consumption patterns, and by facilitating access to critical monetary and human resources (Henisz and Swaminathan, 2008; Pajunen, 2008; Peng et al., 2008). For example, Zhang and White (2016) and Quitzow (2015) show that the Chinese PV industry benefited greatly from policy-induced markets in Europe and the US.

Institutionally induced opportunities abroad allow domestic entrepreneurs to leverage core competencies, serve overseas markets (Cohen and Winn, 2007; Russo, 2001; York and Lenox, 2014), and grow their businesses (Root, 1994). Previous research indicates that this growth, in turn, is important for attracting VC investments in emerging firms, since it generates positive cash flows (Hoppmann et al., 2013; Nemet, 2009), raises firm valuations (Bartov and Bodnar, 1994), and enhances the likelihood of successful company liquidation (Pagano et al., 1998). Therefore, even if VC investors are geographically close to the venture and make no cross-border investments (Samila and Sorenson, 2017), foreign institutions might still affect their investments if they consider international markets. In fact, recent research shows that the VC industry has rapidly globalized since the 1990s (Devigne et al., 2018; Madhavan and Iriyama, 2009). In a global market, VCs pay more attention to foreign institutions, and have more experience in judging related risks and opportunities, which lowers investment uncertainty (Patzelt et al., 2009; Schertler and Tykvová, 2011; Vedula and Matusik, 2017). We therefore argue that, given the increasingly global scope of entrepreneurial and

VC activities, policy incentives supporting a technology in other countries exert a positive effect on both the number and value of domestic VC deals for that technology:

H1a: The greater the strength of foreign policy incentives for a technology, the greater the number of domestic VC deals for that technology.

H1b: The greater the strength of foreign policy incentives for a technology, the greater the value of domestic VC deals for that technology.

**Domestic institutions as a moderator of institutional spillovers**

Our first hypotheses suggest that foreign policy incentives directly impact domestic VC activities. Yet we argue that the extent to which entrepreneurs can benefit from overseas institutions is not uniform across countries, but depends on formal domestic institutions, since they enhance firms' ability to sense and seize foreign opportunities created by policy incentives, and reduce the uncertainty VC investors face when investing in entrepreneurial ventures.

First, we argue that domestic policy incentives enhance the ability of both entrepreneurs and investors to sense foreign policy-induced opportunities. Previous work in institutional theory shows that by defining what is socially or legally appropriate, formal institutions affect decision makers' perceptions and decisions (Meuleman et al., 2017; Meyer and Rowan, 1977). Concretely, firms operating in a specific policy environment develop corresponding routines and mental models, which they use to make decisions under uncertainty (Denzau and North, 1994). These mental models, in turn, are an important basis for entrepreneurs and VC investors to understand policy processes overseas, and notice corresponding opportunities (Minniti and Bygrave, 2001; Wiedersheim-Paul et al., 1978). For example, Delios and Henisz (2003) show how Japanese manufacturing firms' knowledge of specific policies helped them judge policy-related opportunities and risks abroad. Other

studies show that VC investors accumulate expertise on domestic policies, which they use to evaluate investment targets (Dai et al., 2012).

Second, domestic policy incentives may give entrepreneurs resources to seize foreign policy-induced opportunities and reduce VC investors' uncertainty. Studies show that young firms rarely have the capabilities and resources to enter foreign markets from the start, but build them up over time (Johanson and Vahlne, 2009). Domestic policy support allows firms to generate resources to develop high-quality, exportable offerings and set up international sales channels (Root, 1994; Westhead et al., 2001). We argue that the more access entrepreneurs have to resources necessary to export technologies, the more VC investors will invest in these start-ups when foreign policymakers support these technologies with incentives. In addition, domestic policy incentives may complement foreign ones, as they help reduce the Knightian uncertainty VC investors face when investing in start-ups—in both technological and market terms. Even when VC investors have identified an opportunity, they cannot be sure that a possible investment target can exploit it. In such situations, domestic policy incentives that complement foreign ones can significantly reduce uncertainty, as they improve the likelihood of future cash flows, and shield firms and investors from the inherent risks of international expansion (Lu et al., 2014; Luo and Tung, 2007). In sum, we therefore expect domestic VC activities to be more strongly driven by policy incentives in foreign countries if start-ups enjoy a favorable policy environment at home. We thus hypothesize:

H2a: The relationship between foreign policy incentives for a technology and the number of domestic VC deals is positively moderated by the strength of domestic policy incentives supporting the technology.

H2b: The relationship between foreign policy incentives for a technology and the value of domestic VC deals is positively moderated by the strength of domestic policy incentives supporting the technology.

**Institutional distance as a moderator of institutional spillovers**

The previous section suggests that domestic institutions moderate the relationship between foreign policy incentives and domestic VC activity. However, studies on international business indicate that institutional spillovers may also depend on institutional distance, defined as the difference between home and host institutional environments (Kostova, 1999). Concretely, in our context, we conceptualize institutional distance as the extent to which foreign policymakers use types of policy incentives that differ from those used domestically.

The literature on international business suggests that firms entering foreign countries have a disadvantage compared to domestic firms, as they are less familiar with the local context (Berry et al., 2010). Prior work shows that this "liability of foreignness" is particularly acute for firms that originate in countries whose institutions greatly differ from the host country's (Hymer, 1960). The larger the distance between the institutions in the two countries, the less firms are able to apply existing routines and knowledge (Vedula and Matusik, 2017). As a result, as institutional distance grows, the risk for firms and investors increases (Kostova, 1999).

Building on these arguments, we posit that a greater difference between foreign and domestic policy incentives reduces firms' ability to take advantage of foreign policy incentives. As stated above, domestic policy incentives give firms experience of policy schemes, raising their awareness of foreign policy incentives. However, if foreign policy incentives differ from domestic one, it is harder for firms to judge risks related to potential policy changes. It also raises the risk and cost of entry and hampers firms' ability to transfer core capabilities (Bae and Salomon, 2010). In other words, the larger the distance between domestic and foreign policy incentives, the less firms can apply their knowledge of policy-specific processes at home when they expand abroad (Salomon and Wu, 2012). Indeed, Binz and Anadon (2018) show how many entrepreneurs in the Chinese PV

industry initially focused on the home market because they were more familiar with local policy conditions—even though markets abroad were more attractive.

Greater institutional distance is also problematic for VCs investing in entrepreneurial ventures, as it makes their investments riskier (Li et al., 2014). If an investor is familiar with foreign markets, investing in an international venture does not pose a major challenge (Guler and Guillén, 2010). Yet the literature shows that—due to so-called "home bias"—VC investors are often located geographically near to the venture and are more familiar with the domestic environment (Samila and Sorenson, 2017; Sorenson and Stuart, 2001). As a result, if a venture enters international markets, institutional distance both represents a challenge for the venture itself, and also usually reduces VCs' ability to mentor entrepreneurs and monitor investments, which are core tasks for them (Li et al., 2014; Sorenson and Stuart, 2001). In sum, we thus expect a larger distance between domestic and foreign policy incentives to reduce the positive influence of foreign policy incentives on domestic VC investments.[2]

H3a: The positive relationship between foreign policy incentives for a technology and the number of domestic VC deals for that technology is greater for countries with a small distance between domestic and foreign policy incentives than for countries with a large distance.

H3b: The positive relationship between foreign policy incentives for a technology and the value of domestic VC deals for that technology is greater for countries with a small distance between domestic and foreign policy incentives than for countries with a large distance.

## METHODS

[2] The previous arguments might suggest hypotheses that, similar to H2a and H2b, propose a moderating effect of policy distance on the relationship between foreign policy incentives and the number/value of VC deals. However, as we explain in more detail in the methods section, we opted instead to investigate the impact of institutional distance on institutional spillovers by splitting the foreign policy variable into foreign policy incentives in countries with a small and large institutional distance between foreign and domestic policy incentives, since using this procedure allows us to avoid biases in our analysis.

To test our hypotheses, we drew on a unique set of panel data on VC investments in 26 countries from 1993 to 2012. Below we provide more details on the research context, data collection, variables, and statistical estimation.

**Research setting**

We chose the solar photovoltaic (PV) industry as our research setting. PV technologies convert solar energy into electric power using semiconductor technologies. This industry is well suited for our purpose, as previous studies show that both formal and informal institutions have played an important role in its development. The rise of PV is closely connected to the emergence of pro-environmental values since the 1970s, which have spurred a search for alternative means of power generation from fossil fuels and nuclear sources (Jacobsson and Lauber, 2006). Moreover, due to its ecological benefits, solar PV has enjoyed considerable formal policy support since its inception (Quitzow et al., 2014). Such support was important since, throughout the period of investigation, PV electricity was generally far more expensive than that from conventional energy sources. Policymakers therefore legislated heavily to support the diffusion of PV technologies (Hoppmann et al., 2013) and foster the emergence of domestic high-tech industries (Quitzow et al., 2014).

Schmoch (2007) described the development of the solar PV industry in terms of three phases: (i) first boom, (ii) stagnation, and (iii) second boom. The first boom, between 1974 and 1985, was mainly driven by direct public funding of R&D. This study focuses on the second boom, which began in the early 90s when demand for solar PV was increased by new demand-side policies to foster the diffusion of PV technologies (Hoppmann et al., 2013).

Anecdotal evidence suggests that institutional spillovers might have played an important role in creating PV industries in several countries (Peters et al., 2012; Quitzow, 2015). So far, however, we lack empirical evidence on their impact on VC investments, both domestically and abroad.

Providing first evidence of a positive relationship, Figures 1 and 2 show a close correlation between the strength of policy incentives and the number and value of VC deals in the PV industry over time.

Insert Figures 1 and 2 about here

**Data collection**

Previous research indicates that there is no single, comprehensive source for VC investment deals. Therefore, to develop a database on VC investments in PV that had broad coverage but no geographic bias, we combined data from Zephyr and Thomson VentureXpert. Zephyr has better coverage of European deals, while Thomson VentureXpert offers the most data on the United States.

To find VC deals in the PV industry, we applied the search string "solar OR photovoltaic*" to the business description of investment targets. Subsequently, we manually screened out deals where "solar" was used in non-PV contexts (e.g., solar thermal or solar heating). In this context, we considered investments in companies across the entire PV value chain, i.e., firms producing PV modules, so-called "balance of system" (BOS) components, and manufacturing equipment but also firms offering value-adding activities in the PV industry, such as engineering, procurement, financing, and installation of PV systems. The search was limited to deals announced between 1993 and 2012 with the status "completed" or "assumed completed." This resulted in a total of 3,101 deals, for which we collected deal comments, deal value in USD, acquired VC stake, investor, target business descriptions, and country codes. The target country code was used to assign the deals to the countries in our sample. To consolidate the data sources, we manually deleted duplicates and incomplete records.[3] All deal values were converted to 2012 USD values using the Consumer Price

[3] For firms with headquarters in the tax havens of Bermuda, the British Virgin Islands, and the Cayman Islands, the country code was changed to the location of the firm's largest office. We did so since country data on these tax havens is not easily available but retaining these firms in the sample was important, as they comprise some of the largest solar PV companies, such as GCL-Poly Energy Holdings, LDK Solar, and Hanwha Solar.

Index. The final database contained information on 1,367 VC investment deals in the PV industry, making it, to our knowledge, the most comprehensive database on VC deals for this industry.

Policy incentives were calculated based on data from various sources, notably the Trends in Photovoltaic Applications Report of the International Energy Agency (IEA, 2015), the IEA/IRENA Joint Policies and Measures Database (IEA, 2017), and REN21 (2016). Data on country-level controls was collected from various sources, including the World Bank, the International Energy Agency, Thomson EIKON, and the World Values Survey (WVS) Database (WVS, 2017). The VC investment data was combined with the data on policy incentives and controls to yield a consistent panel data set containing country-year observations for 39 countries over an average period of 19.2 years. These 39 countries cover 97% of the worldwide installed PV capacity and 99% of all VC investment deals in PV. Since data on social values and interest rates was not available for all of these countries, however, the final sample included only 26 countries.[4]

## Variables and measures

Our hypotheses suggest links between the number and value of VC deals—the dependent variables—and foreign policy incentives, domestic policy incentives, and institutional distance—the independent variables.

### *Dependent variables*

In line with the prior literature, we measured *number of VC deals* as the count of VC deals per country per annum. *VC deal value* was measured as the total annual deal value, in USD, of VC deals in a specific country[5], and log-transformed to bring the data closer to a normal distribution.

[4] These countries comprise Argentina, Australia, Brazil, Bulgaria, Canada, China, Finland, Germany, Hong Kong, Hungary, India, Japan, Malaysia, the Netherlands, Norway, Poland, Romania, Russia, Singapore, South Korea, Spain, Sweden, Switzerland, Thailand, Ukraine, and the United States.

[5] It should be noted, however, that for 32% of the deals contained in our database, the deal value was not available, such that our measure of *number of VC deals* includes deals that are not considered when calculating *VC deal value*. To ensure that the missing data on deal value did not introduce a bias into our analysis, we conducted a Probit analysis to investigate whether the factor influenced the likelihood of a deal's value being reported. The results of the analysis suggest that the likelihood of a deal value being reported does not depend on the country, the year, our independent variables, or other

***Independent variables***

Accurately measuring *policy incentives* for PV is challenging because countries use different policy instruments, such as feed-in tariffs, renewable portfolio standards, public procurement, and financing schemes, that operate in parallel and at different levels (Johnstone et al., 2009). Much previous work has used dummies indicating whether a policy was in place or not to measure policy incentives, but this does not accurately capture the strength of policy incentives, since the effectiveness of policy instruments strongly depends on their detailed design, such as the level of feed-in tariffs, the targets of renewable portfolio standards, or the level of tax credits (Kemp and Pontoglio, 2011). For example, many studies show that the design of feed-in tariffs differs significantly across countries and has evolved over time, leading to marked differences in policy effectiveness (del Río González, 2008; Hoppmann et al., 2014).

Moreover, since monetary and non-monetary policy incentives operate in parallel in all countries, and policy effects are not clearly attributable, we cannot estimate policy incentives at the level of individual policy types. For example, in a country that uses both a renewable portfolio standard and tax credits, the adoption of PV may be completely driven by the standard, even though investors do take advantage of additional tax incentives. Rather than trying to measure the different policies individually, we therefore used an aggregate measure that directly captures the strength of policy incentives as an independent variable, and additionally included dummies for the policy instruments used in each country as controls.

To obtain a measure of PV policy incentives for PV technologies in each country, we calculated the difference costs between the electricity generated from PV and conventional sources

variables that influence the deal value, such that we have no reason to assume that the missing data on deal value introduces a bias into our analysis. We also considered using Heckman's two-step procedure. However, a more detailed analysis showed that this procedure could not be applied in our case, since we test the impact of institutional spillovers on VC investments at the country level, whereas the missing values occur at the level of individual deals.

in each country, then multiplied this difference by the total volume of electricity generated from those PV plants installed in the focal year. This measure—which is also commonly employed in policy monitoring (BMWi, 2015)—is based on the assumption that, for PV plants to be installed in the first place, policy incentives have to cover the gap between the cost of electricity from PV and the (lower) cost of electricity from conventional technologies in the market (Sarzynski et al., 2012).[6] For example, say that in 2001 PV plants were installed in the US that generated 885,000 MWh of electricity over their lifetime. If the cost of electricity from these plants and from conventional sources was 0.34 USD/kWh and 0.05 USD/kWh, respectively, then the annual policy funding required to make investments in PV profitable is (0.34-0.05)*(885,000,000) = USD 256.56M.

Following this approach, to obtain measures for *domestic policy incentives*, we calculated the annual difference costs of solar PV for each of the countries and years in our sample based on country-specific investment costs and irradiation conditions.[7] The resulting strength of policy incentives is in line with previous studies and official government statistics for those countries where data on policy costs is available. For example, our measure of policy incentives is highly correlated (Pearson correlation of 0.90) with the official costs reported by the German government for its feed-in tariff scheme (BMWi, 2015). To determine the *foreign policy incentives* for PV within each country and year, we subtracted the annual policy costs of the focal country from the total annual policy cost of all 39 countries in our original database (Peters et al., 2012).[8]

To measure whether foreign policy incentives in countries with a smaller institutional distance from the focal country have a stronger impact on domestic policy incentives than those with

[6] In practice, environmentally conscious buyers may invest in PV even though it is not profitable. Our measure assumes that, in line with the literature, such unprofitable investments in PV made for environmental reasons only constitute a very small part of the large and growing market for PV technologies (Sommerfeld et al., 2017).

[7] A detailed description of the procedures is available in an online appendix supplementing the paper.

[8] Our measure of policy incentives captures the overall cost to a society without making any assumption about the policy instruments used (i.e., how the incentives are provided to investors in PV plants) or about how the cost is distributed to different members of society (e.g., electricity consumers, taxpayers, firms).

a larger institutional distance, we split foreign policy incentives into two categories.[9] The first measure (*foreign policy incentives in countries with small policy distance*) captures the sum of annual foreign policy incentives for all countries that show a small policy distance, i.e. a large overlap with the focal country in the types of policy incentives used to support a technology, while the second (*foreign policy incentives in countries with large policy distance*) captures the sum of annual foreign policy incentives for all countries that show a large policy distance, i.e. a small overlap with the focal country in the types of policy incentives.

To gauge the policy distance between countries (i.e., overlap between the types of policy incentives), we identified the most important policy instruments used in the PV industry, namely (1) feed-in tariffs; (2) renewable portfolio standards; (3) tax credits; and (4) grants, subsidies, and loans (see, e.g., IEA, 2017; REN21, 2016). Data on the instruments was obtained from the IEA/IRENA Joint Policies and Measures Database (IEA, 2017), REN21 (2016), and the KPMG database on taxes and incentives for renewable energy (KPMG, 2015). For each country, we then tabulated which of the incentives was used in a specific year and created an index (0–4) indicating the overlap with each of the other countries in our sample. For example, if in 2001 Germany and the US were both using feed-in tariffs and tax credits, while the countries would differ with regard to all other policy instruments, the index would be 2 for these two countries in this year. We disregard policies unless both countries have them in place. For each country and year, we then calculated the median index

[9] We used a variable split instead of interaction terms, since, when using average policy distance as a moderating factor, our model cannot detect whether an increase in foreign policy incentives takes place in countries that are institutionally close or distant in terms of policy incentives, which is critical for testing our hypothesis. Concretely, since our level of analysis is the country level, measuring the interaction effect of policy distance on the relationship between foreign policy incentives and the number/value of VC deals in a specific country would require us to multiply the total amount of policy funding in all other countries by the average policy distance of the country from all other countries. The problem with this measure is that, due to the use of averages, the strength of policy incentives in a specific foreign country is not multiplied by the specific distance of policy incentives between this country and the focal country. Instead, the total amount of foreign policy incentives is multiplied by the average distance of policy incentives. As a result, a detailed analysis of our data showed that using average policy distance as a moderator can lead to results that would suggest an increase in foreign policy incentives in countries with large institutional distance, even though the opposite is the case. The procedure we use is in line with previous work that has studied geographic spillovers (Bode, 2004; Corradini et al., 2014). For example, analyzing how institutional spillovers influenced patenting behavior in the PV industry, Peters et al. (2012) use a similar procedure to us when they split their policy-incentive variable into "intercontinental" and "continental" to study whether spillovers differ for countries that are more or less geographically proximate.

and, drawing on the median as the threshold value, calculated the two measures *foreign policy incentives in countries with small policy distance* and *foreign policy incentives in countries with large policy distance* by adding up the foreign policy incentives with an overlap below and above the median distance respectively. For example, if the median distance of foreign policy incentives for the US in 2001 was 2.4, the variable *foreign policy incentives in countries with small policy distance* for this year captures the sum of foreign policy incentives for all countries with a distance ≤ 2.4, whereas *foreign policy incentives in countries with large policy distance: far* captures the sum for all countries with a distance > 2.4.

***Control variables***

To isolate the influence of our focal variables, we controlled for many factors that previous research has identified as drivers of VC investments. First, studies have shown that VC investments depend on higher-level institutional conditions (Da Rin et al., 2006; Gompers and Lerner, 1998; Jeng and Wells, 2000). We therefore included a country's *GDP growth, inflation, unemployment,* and *interest rates* as control variables.

Second, previous studies indicate that the size and quality of a country's stock market determine the ease with which firms can go public, which represents an important incentive for venture capitalists to invest in start-ups (Jeng and Wells, 2000). We controlled for stock market activity by including *market capitalization per GDP, market capitalization growth,* and *stock turnover ratio.* Data was gathered from the World Bank World Development Indicators (and from the Taiwan Stock Exchange for Taiwan). All other financial data was gathered from the International Monetary Fund. In line with previous work, we also included a control for *corporate tax levels*, as this affects the attractiveness of VC investments (Da Rin et al., 2006).

Third, VC investments in PV may be driven by the size and quality of a country's *VC market* (Jeng and Wells, 2000). To control for this, we included a variable to measure the total number or value of annual VC investments across all industries in a specific country, as retrieved from Thomson EIKON.[10] This ensured that the trends in PV VC funding we observed were not simply driven by the size of countries or general trends in VC funding.

Fourth, previous studies suggest that VC investments may be stimulated by *public R&D funding* (Da Rin et al., 2006). To account for this, we obtained data on public R&D funding for solar PV energy from the International Energy Agency (Peters et al., 2012).[11]

Fifth, *demand uncertainty*, e.g., uncertainty resulting from abrupt changes in regulation or a lack of long-term goals, can act as a barrier to VC investments (Hoffmann et al., 2008). To control for this, we followed previous research and included the standard deviation of the percentage change in market size for the four years prior to the focal year (Eisenhardt and Schoonhoven, 1996). A sharp fluctuation in market size implies greater difficulty in predicting developments, such that the standard deviation provides a good proxy for demand uncertainty.

Sixth, VC activities may be directly influenced by the *type of policy incentives* used (Meek et al., 2010). We therefore included dummies for (1) feed-in tariffs; (2) renewable portfolio standards; (3) tax credits; and (4) grants, subsidies, and loans. They take a value of 1 if the country used the instrument to support PV in a specific year and 0 otherwise.

Seventh, previous studies indicate that entrepreneurial activities and VC funding may be affected by informal institutions within a country, such as its *social values* (Rokeach, 1973). To

[10] We included the total annual number of VC deals across all sectors in a country as a control in all models that estimated the number of VC deals in PV and the total annual value of VC deals across all sectors in a country as a control in all models that estimated the value of VC deals in PV.

[11] Detailed data on public R&D is only available for member countries of the Organization for Economic Co-operation and Development (OECD). Since OECD countries account for 80–90% of the funding in recent years, and the majority of countries fall into this category, for our main models we assume public R&D funding for all other countries to be zero (Breyer et al., 2013). We ran robustness checks to see whether this assumption affected our results.

measure the degree to which a country's social values support PV technologies in each year, we used country-level data on membership of environmental organizations from the World Values Survey (WVS) database (WVS, 2017), which contains longitudinal data on human beliefs and values from almost 400,000 respondents in around 100 countries since 1981. Based on this data, we calculated the proportion of a country's population that belonged to *any* environmental organization as a proxy for environmental values.[12] We selected this measure since pro-environmental social values are most closely related to our PV case. Moreover, previous research shows that non-governmental organizations articulate the underlying social values of a society (Durand and Georgallis, 2018), such that membership in environmental organizations can be seen as reflecting the importance of environmental issues to the population more broadly. Given that joining an organization usually involves some cost and commitment, we regard membership of organizations as a better measure of environmental values than survey-based, direct measures, which may be significantly affected by social desirability biases and norms. Studies show that respondents are very likely to say they value the environment, irrespective of their actual behavior (Chao and Lam, 2011).[13]

Since the data on environmental membership in the WVS database is available at the individual level, we first aggregated the data to the country-year level, yielding the percentage of citizens who belong to an environmental organization for each country. Moreover, since the WVS data is only available in 5-year intervals and has some missing observations, we used linear

[12] Since the WVS survey questions related to membership of environmental organizations have used different variables in different countries at different points in time, to construct our measure, we merge the responses to questions A071 ("Member: Belong to conservation, the environment, ecology, animal rights"), A071B ("Member: Belong to conservation, the environment, ecology"), and A103 ("Active/inactive membership of environmental organization").

[13] Previous research on social movement organizations has used counts of members in environmental organizations (e.g., the Sierra Club or Greenpeace) to measure how organizations promoting specific values shape firm strategies and entrepreneurship (Sine and Lee, 2009). In contrast to these studies, however, we are not interested in measuring the influence of individual environmental movement organizations, but rather in measuring pro-environmental values within a society more broadly, which is why we have calculated the proportion of individuals who are members of *any* environmental organization. To ensure that our measure actually reflects broader social values and does not just capture the values of a select group, we conducted robustness checks with alternative measures of pro-environmental values contained in the WVS. For example, we used question B008, "Personal values protecting environment vs. economic growth," to calculate an index (0–1) for each country and year, with 1 indicating a higher proportion of individuals valuing environmental protection over economic growth. Running our analysis with this alternative measure led to the same results as those we present in the results section. We nevertheless decided to stick with the measure based on environmental group membership, since our data availability for this measure is better, thus reducing the number of observations we lose due to missing data.

interpolation to estimate intervening values. This procedure, which has been used by other researchers, was considered appropriate since informal institutions can be expected to change in a rather continuous, incremental fashion (Meek et al., 2010).

Eighth, prior research indicates that VC activities may also be influenced by *industry associations*, which may promote specific technologies and therefore contribute to entrepreneurial opportunities (Sine et al., 2005). We therefore included a dummy variable indicating whether a national industry association for solar PV existed within a specific year for each country. Data was obtained from ENF Solar (2017) and the associations' websites.

Finally, we also controlled for *entrepreneurial entry* by counting the firms that were active in the production of PV cell and modules within a specific country in a specific year. We focused on the entry of PV cell and module producers, since reliable and comparable cross-country data is only available for this stage of the value chain, and entry at this stage can be assumed to be highly correlated with entrepreneurial activity at other parts. Data on entrepreneurial entry was obtained from the two leading industry magazines, *Photon* and *PV News*, which have collected and published survey data on the annual production volume of all major PV producers through 2012 (Durand and Georgallis, 2018; Kapoor and Furr, 2014).

**Model estimation**

We employed two types of models to test our hypotheses. For the models including the number of VC deals as the dependent variable, we used a negative binomial model (O'Hara and Kotze, 2010). The Poisson and negative binomial models are generally suited to count data. However, a test indicated problems with overdispersion (G2=180.2 p=0.000), making the negative binomial model preferable. For the models including the value of VC deals as the dependent variable, we used

ordinary least squares regression, since the data for the dependent variable in this case consists of nonnegative, real-valued data.

We log-transformed the independent variables for domestic and foreign policy to bring the data closer to normal form and reduce the influence of outliers. A Hausman test rejected the assumption of random effects ($p<0.001$). Accordingly, we employed models with country-fixed effects in our analysis, eliminating the influence of all time-invariant, country-specific factors that could influence VC investments, such as static differences in culture (Meek et al., 2010).[14] In line with earlier studies, all independent variables were lagged by one year. Moreover, for all hypothesis tests we used heteroscedasticity-robust estimation techniques. We also considered including year-fixed effects. However, the year dummies turned out to be highly correlated with our variable foreign policy incentives, causing biases in our model estimations. We therefore decided to investigate the impact of year fixed effects using additional robustness tests and in our main model directly control for general time-variant trends by including a large number of controls and the variable *VC markets*, which captures general trends in VC investments over time. Tests using correlations and the variance inflation factor (VIF) indicated that multicollinearity was not a problem. Table 1 shows descriptive statistics and correlations. As expected, both the number and value of VC deals are positively correlated with domestic ($r=0.46$; $r=0.62$) and foreign policy incentives ($r=0.26$; $r=0.44$), specifically in countries with a low policy distance ($r=0.29$; $r=0.47$).

Insert Table 1 about here

## RESULTS

[14] In the case of the negative binomial model, using country-fixed effects does not allow us to estimate coefficients for those countries with all-zero outcomes, such that the sample size is reduced to 20 countries and 279 observations. To ensure that this did not bias our results, we also estimated a model without country-fixed effects. The results of this estimation led to outcomes that are very similar, and would yield the same conclusions for our hypothesis tests.

Since our models include two different dependent variables, we present two sets of models: one estimating the influence of policy incentives on the *number of VC deals* (Models 1 to 6 in Table 2) and one on the *value of VC deals* (Models 1 to 6 in Table 3). For each set of models, we first present a model containing only the controls (Model 1) and then sequentially add the independent variable (Model 2) and interaction terms (Model 3). Moreover, to test whether institutional distance affects the relationship between foreign policy incentives and VC investments, for both sets we present models in which we have split the foreign policy variable up into the two variables *foreign policy incentives in countries with small policy distance* and *foreign policy incentives in countries with large policy distance* (Models 4 to 6). We tested Hypotheses 1a and 1b using the models that contain only the main effects (Model 2), and Hypotheses 2a and 2b using the full models (Model 3). To test hypotheses 3a and 3b, we used F-tests for identity of coefficients to test whether the impact of foreign policy incentives from countries with large institutional distance does indeed differ from the impact of foreign policy incentives from countries with small institutional distance in Model 6.

Insert Tables 2 and 3 about here

Hypotheses 1a and 1b suggested that foreign policy incentives for a technology are positively related to the number and value of domestic VC deals for that technology. We find support for both hypotheses. Model 2 in Table 2 shows that when regressing the *number of deals* on *domestic policy incentives*, the resulting coefficient is both positive and highly significant ($\beta=0.643$, $p<0.001$, incidence rate ratio (IRR)=exp(0.643)=1.90). Similarly, Model 2 in Table 3 shows a positive and significant relationship between *foreign policy incentives* and the *value of VC deals* ($\beta=0.829$, $p<0.05$). These results indicate that a unit-increase in the funding for foreign policy incentives (logged USD) would, on average, increase the rate of domestic VC deals by 90 percent compared to the current number of investments. In addition, a 1 percent increase in funding for foreign policy

incentives in USD would, on average, result in a 0.83 percent increase in the value of domestic VC deals.

Hypotheses 2a and 2b suggested that the relationship between foreign policy incentives and the number (2a) and value (2b) of VC deals is positively moderated by domestic policy incentives. We find support for Hypothesis 2b, but not 2a. As can be seen in Model 3 in Table 3, the coefficient for the interaction term between *domestic policy incentives* and *foreign policy incentives* is positive and highly significant for our analysis of *VC deal value* ($\beta=0.266$, $p<0.001$). This implies that a one-percent increase in domestic policy incentives would increase the elasticity of the value of domestic VC deals with respect to foreign policy incentives by 27 percent. However, contrary to our hypothesis 2a, the coefficient for the interaction term between *domestic policy incentives* and *foreign policy incentives* is not significantly different from zero for our analysis of *number of VC deals* (see model 5 in Table 2; $\beta=-0.0257$, $IRR=\exp(-0.0257)=0.975$, $p>0.1$). In line with the methodology suggested by Zelner (2009) and also used by York et al. (2018) and Vedula et al. (2018), Figure 3 shows the predicted values for our model with number of VC deals as the dependent variable for the entire range of foreign policy incentives (logged) and strong (mean+1 standard deviation) and weak (mean–1 standard deviation) domestic policy incentives respectively. Figure 3 confirms that the interaction between foreign policy incentives and domestic policy incentives never becomes significant, as indicated by the overlap in the confidence intervals of our graphs for weak and strong domestic policy incentives (see also Figure 4, which shows the corresponding difference graph).

Insert Figures 3 and 4 about here

Finally, Hypotheses 3a and 3b suggested that the positive relationship between foreign policy incentives and the number (3a) and value (3b) of domestic VC deals is greater for countries with a small distance between domestic and foreign policy incentives than for countries with a large

distance. We find support for Hypothesis 3a, but not for 3b. An F-test for identity of coefficients indicated that in Model 6 of Table 2 the coefficient of *foreign policy incentives in countries with small policy distance* (β=0.502) is indeed significantly greater than the coefficient of *foreign policy incentives in countries with large policy distance* (β=0.0520), lending support to Hypothesis 3a ($Chi^2$=15.57, p<0.001). However, the coefficients of *foreign policy incentives in countries with small policy distance* (β=0.450) and *foreign policy incentives in countries with large policy distance* (β=0.363) in Model 6 of Table 3 do not significantly differ ($Chi^2$=0.18, p>0.1).

**Robustness tests**

We conducted several robustness checks. First, a potential problem with our analysis could be endogeneity. Specifically, one might assume that *domestic policy incentives* do not just drive VC investments, but are also adjusted depending on the volume of VC investments observed in reality (Pacheco et al., 2014). To account for this, and to gain insights into causality, we followed Peters et al. (2012) in conducting a two-stage least-squares (2SLS) endogeneity test. First, we regressed the potentially endogenous variable *domestic policy incentives* on a number of instrumental variables (IV), as well as on the remaining independent variables. Subsequently, we included the residuals of this estimation as an independent variable in our original model to test the null hypothesis "*domestic policy incentives* is exogenous," which would be rejected if the coefficient of the variable *residuals* differed significantly from zero.

As instruments for *domestic policy incentives*, we chose *installed wind capacity*, *installed biomass capacity*, and *installed geothermal capacity* (all logarithmized). We selected these instruments since they simultaneously meet the relevance and exogeneity criteria (Stock and Watson, 2007). Regarding the relevance criterion, incentives for PV are generally part of broader government efforts to support renewables, such that governments almost always offer incentives for several

renewable energies simultaneously, or decide to support specific renewable technologies at the expense of others (Peters et al., 2012). Incentives for installing PV are thus strongly correlated with the installed capacity for wind, biomass, and geothermal. At the same time, the instruments meet the exogeneity criterion. This is because these parallel incentives do not directly drive VC investments in PV firms, since it is the incentives specific to PV that are decisive in investors' decisions. For example, in the early 1990s, the Feed-in Law in Germany offered the same level of feed-in remuneration for all renewable energies (Jacobsson and Lauber, 2006). Since PV electricity cost considerably more than wind power at that point, the main result was the installation of wind power plants and the growth of the wind industry. Investments in PV start-ups only picked up when policymakers provided specific and sufficient economic incentives for PV (Jacobsson and Lauber, 2006). This suggests that it is the specific level of PV incentives that drives VC activity in PV, not the level of renewable support in general.

To verify the strength of our instruments, we followed Pacheco et al. (2014) and conducted a Stock and Yogo (2005) test based on our first-stage regression. The test indicated that domestic policy incentives are very well instrumented by our choice of instruments ($F=34.53/F_{crit}=7.80$). Since data on the instruments was available only for OECD countries, the IV estimation was conducted for the reduced sample. The coefficient for *residuals* is not significantly different from zero, and thus we cannot reject the hypothesis that *domestic policy incentives* is exogenous.

Second, we tested whether the influence of domestic and foreign policy incentives changed when including different countries. Low-cost manufacturing locations, such as China, Malaysia, Singapore, and India, have come to dominate production of PV cells and modules, which may bias our results. Moreover, despite the importance of these countries, no data on public R&D was available for them. We therefore checked whether our findings held when excluding them; they remained the same as our original models in Tables 2 and 3 (see Model 1 in Tables A.1 and A.2).

Moreover, as discussed above, our sample is constrained by the lack of social-values data for all countries. We therefore conducted an additional analysis excluding *social values* as a control variable to see if our findings held for a larger sample of 38 countries. The results for all hypotheses are the same (see Model 2 in Tables A.1 and A.2; tests for hypotheses 3a and 3b not reported).

Third, previous research indicates that VC investments depend on the broader regulatory and political environment (Groh et al., 2010). Following the taxonomy of Slangen and van Tulder (2009), we therefore built an aggregate variable that measured *governance* by country in five separate dimensions: political stability, government effectiveness, regulatory quality, rule of law, and corruption levels. Data was obtained from the Worldwide Governance Indicators project from the World Bank. To control for *country risk*, we gathered data on the different countries' credit ratings from Fitch, then used the scale from Cantor and Packer (1996) to convert the ratings into numerical data. Not surprisingly, both *governance* and *country risk* turned out to be highly correlated with *VC market*. We therefore decided not to include separate controls for governance and country risk, because *VC market* is most directly related with our dependent variable and represents the outcome of governance and country risk factors, such that separately controlling for these factors did not affect the results. As a robustness check, we included the individual measures for *governance* as controls, which also left the results unchanged.

Fourth, in addition to policy distance, institutional spillovers may be affected by geographic distance or alternative measures of institutional distance, such as the CAGE framework of cultural, administrative, geographic, and economic distance (Berry et al., 2010). To investigate the effect of geographic distance, we ran our models with an alternative measure of foreign policy incentives, as part of which foreign policy incentives for a specific country and specific year were calculated as the sum of foreign policy incentives weighted by the geographic distance between the focal country and the respective foreign country. Our models were robust against using such a measure (see Model 3

in Tables A.1 and A.2), and our results also remain the same when using CAGE distance instead of policy distance.

Fifth, to account for unobserved, time-specific factors, such as technological change, we also ran all our models including year-fixed effects. These tests yielded results that lead to the same conclusions as our hypotheses tests (see Models 4 and 5 in Tables A.1 and A.2), except that *foreign policy incentives in countries with small policy distance* is no longer significantly greater than that of *foreign policy incentives in countries with large policy distance*, such that hypothesis 3a is no longer supported. This difference is due to the fact that our main independent variable foreign policy incentives shows limited variance across countries but strong variance across years, which is why this variable is highly correlated with the year dummies.

Sixth, as noted above, to test Hypothesis 3, we used two separate variables for foreign policy incentives, which allowed us to measure the impact of policy distance more precisely than including average policy distance as a moderator of the relationship between foreign policy incentives and the number/value of domestic VC deals. However, to test how using a conventional interaction effect would change our results, we estimated additional models where we included average policy distance as an interaction effect. These yielded the same results as our original models, except that policy distance not only moderates the relationship between foreign policy incentives and the number of VC deals, but also between foreign policy incentives and the value of VC deals.

Seventh, to better understand how foreign policy incentives influenced the size of individual deals, we ran our models using the average and median VC deal value for each country and year as the dependent variables. These models (Models 6 and 7 in Table A.2) yielded the same results as those using total annual VC value.

Eighth, since including country-fixed effects in our models estimating the number of VC deals reduced our sample size, we tested whether excluding them would yield different results. As

Model 6 in Table A.1 shows, this estimation leads to outcomes very similar to those presented in Table 2, and would yield the same conclusions for our hypothesis tests (also for our tests on Hypotheses 3a and 3b; not reported).

Finally, we split our sample into firms pursuing mature PV technologies and those pursuing immature PV technologies, to gain additional insights into the mechanisms connecting our variables. PV modules can be manufactured from different materials, which has led scholars to differentiate three types of technologies: crystalline PV, thin-film PV and emerging PV (Green, 2006). We expected that, if internationalization requires time and resources, the effect of foreign policy incentives would be particularly pronounced for firms pursuing mature technologies. Thus, we gathered information on whether, at the time of each deal, the target was active in mature technologies (crystalline silicon or thin-film PV), immature technologies (emerging PV), or both. Based on this, we conducted separate analyses using only the number and value of VC deals for mature and immature technologies as the dependent variable. Models 7 and 8 in Table A.1 and Models 8 and 9 in Table A.2 (Appendix A) show the results from Model 2 in Tables 2 and 3 split into mature and immature PV technologies. Table A.1 shows that the impact of foreign policy incentives on the number of VC deals holds for both technology types. Interestingly, however, Table A.2 shows that the value of VC investments is driven by foreign policy incentives for mature technologies only.

## DISCUSSION

This study advances our understanding of the role and drivers of institutional spillovers for entrepreneurial activity. To our knowledge, we are the first to systematically test the impact of institutional spillovers across national boundaries on VC activity and show that both the number and value of VC deals are driven by foreign policy incentives for a specific technology. Focusing on the PV industry, we show that the influence of foreign policy incentives on the value of VC deals is

positively moderated by the presence of domestic policy incentives supporting the technology, while the relationship between foreign policy incentives and the number of VC deals is strengthened when there is a smaller distance between foreign and domestic formal institutions. However, we do not find support for our hypotheses that the presence of domestic policy incentives means more VC deals, or that a similarity between domestic and foreign policy incentives boosts the value of domestic VC investments. These findings hold when controlling for a large number of alternative explanations. For example, we show that foreign institutions exert an important influence on domestic VC activity even when controlling for domestic institutions, the general investment climate, technological maturity, and entrepreneurial entry. Moreover, while one might assume that foreign policy incentives only matter when countries are geographically close, we show that spillovers also occur across greater distances.

Taken together, our study contributes to the literatures on international business and VC internationalization by suggesting that VC investments are increasingly shaped by foreign variables, even if investments remain local. Moreover, our findings represent an important step forward for the literatures on institutions and entrepreneurship—as well as environmental entrepreneurship—by suggesting that supportive domestic institutions do not just drive entrepreneurial behavior directly, but also enhance entrepreneurs' ability to take advantage of favorable conditions abroad. Below, we discuss these contributions in more detail.

**Drivers of VC investments**

First, our study advances the literature on the drivers of VC investments. While scholars have begun to investigate cross-border investments (Dai et al., 2012) and have pointed to an increasing internationalization of VC activities (Schertler and Tykvová, 2011), previous studies have stressed the predominantly local nature of VC investments, pointing out that VC investors exhibit a home

bias and are strongly influenced by domestic institutions (Powell et al., 2002; Sorenson and Stuart, 2001). Our study adds to this literature by showing that, even though VCs favor local firms, their investments are strongly shaped by foreign institutions, since such institutions may give rise to international opportunities, which VC investors consider when investing in domestic ventures. These arguments are in line with the literature on the internationalization of VC activities and international business (Devigne et al., 2018; Vedula and Matusik, 2017), as they suggests that VC investors take an increasingly international view when making investment decisions. In contrast to existing studies of VC internationalization, which focus on how foreign institutions affect investments in foreign countries (often studying cross-border investments), we show that foreign institutions can also affect VC investments in domestic start-ups. In this sense, our study provides a new perspective on VC internationalization, as it suggests that, even if VCs invest in local start-ups, their activities are increasingly shaped by foreign variables, since start-ups may have overseas opportunities that VCs must consider when making investment decisions.

Our study also adds to the literature on the drivers of VC activities and the literature on VC internationalization by identifying some factors that moderate the relationship between foreign policy incentives and domestic VC activity. Concretely, by showing that domestic policy incentives enhance the impact of foreign policies on the value of VC deals, our findings suggest that when making VC investments, investors consider both the foreign and domestic institutional environments. Interestingly, however, while a stronger domestic policy environment enhances the impact of foreign policy incentives on the number of domestic VC deals, it does not positively moderate the relationship between foreign policy incentives and the value of VC deals. A potential explanation is that domestic institutions alert investors to foreign opportunities and reduce investment uncertainties, such that the overall number of deals increases. At the same time, stronger domestic institutions do not seem to reduce investment uncertainties to such an extent that investors are willing to raise the

overall value of investments. In fact, as our analysis shows, the value of investments is primarily driven by the support levels of foreign, rather than domestic institutions, as well as the similarity between foreign and domestic policy incentives.

We also expected the distance between domestic and foreign institutions to shape the relationship between foreign policy incentives and VC investments in domestic firms. Interestingly, however, we find that only the relationship between foreign policies and the number of VC deals (not deal value) is related to institutional distance. A potential explanation for this finding is that institutional distance not only raises the risk of investment, but potentially also lowers return. For example, for high-risk investors in particular, start-ups that aim to take advantage of lucrative opportunities in institutionally distant countries may be interesting investment targets because the opportunities in such countries may not be on the radar of established firms. As a result, while institutional distance makes VC investors less likely to strike a deal, it does not negatively affect the cumulative deal value.

**Institutions and entrepreneurship**

Our study also bears implications for the broader literature on institutions and entrepreneurship (Sine and David, 2010). Even though researchers in this field have acknowledged that entrepreneurial activities may be driven by foreign institutions, empirical work has mainly focused on domestic institutions (Bruton et al., 2010; Sine and David, 2010). By studying institutional spillovers, our work contributes to a more nuanced understanding of the role institutions play for entrepreneurship, and challenges existing findings in this literature.

Previous studies investigating the relationship between institutions and entrepreneurship have argued that, due to the positive impact of domestic institutions on legitimacy and resource provision, entrepreneurs should locate their businesses in environments characterized by favorable institutions

(Meek et al., 2010). Our results confirm that domestic institutions are indeed important, as they drive VC investments and help firms generate the resources needed to build international sales channels. However, our results also indicate that locating businesses in countries with favorable institutions may be less important than has been previously assumed, since firms may take advantage of policy incentives abroad. In this context, our study also suggests that entrepreneurs might want to focus on countries with policy schemes similar to those in their home countries, since formal institutional proximity raises the likelihood that VC investors will invest in their firms.

Overall, by showing that domestic institutions drive entrepreneurial activity directly and that they also moderate institutional spillovers, our findings suggest that institutions have a double impact with interesting parallels to mechanisms described in the literature on absorptive capacity (Cohen and Levinthal, 1990). This literature stresses that investments in R&D directly contribute to innovation, but also help firms absorb external knowledge. By investing in R&D, firms build internal knowledge, which helps them identify and exploit external knowledge. Our findings suggest that institutions may play a similar dual role for countries. Favorable institutions in a country not only directly drive entrepreneurial activities (as has previously been demonstrated), but also influence the degree to which entrepreneurs (and VC investors) can take advantage of favorable institutional conditions abroad.

**Environmental entrepreneurship**

Finally, our study also contributes to the literature on environmental entrepreneurship, which studies how entrepreneurship can help solve pressing environmental issues (Dean and McMullen, 2007). This literature has argued that environmental externalities, such as climate change, may offer significant opportunities for entrepreneurial activity (Cohen and Winn, 2007; York and Venkataraman, 2010) and has investigated the role that related institutions (such as policy incentives

for renewable energy) play in driving entrepreneurship (Georgallis and Durand, 2016; Meek et al., 2010; Sine and Lee, 2009). As in the literature on entrepreneurship and institutions, however, empirical studies have thus far concentrated on domestic or local entrepreneurial activities. By highlighting that entrepreneurs can also take advantage of environmental opportunities abroad, our study suggests that the opportunities for environmental entrepreneurs might be even larger than previously suggested. Our study therefore represents positive news for environmental entrepreneurs, and the environment itself, as it highlights the immense growth opportunities connected with the emergence of environmental institutions.

Our study also bears important insights for policymakers wishing to support domestic environmental entrepreneurship. Scholars have proposed that public policies incentivizing the use of environmental technologies do not merely help reduce environmental externalities, but can also enhance the competitiveness of national industries (Porter and van der Linde, 1995). This is because by incentivizing the use of specific technologies, policymakers create local markets that allow firms to develop and eventually export new products (Quitzow et al., 2014). Our study complements and extends existing findings on environmental policy and national competitiveness. While we find that environmental policies boost both the number and the value of VC deals, we provide evidence that environmental policies not only drive domestic VC investments but also foster VC activities abroad. These spillovers limit the degree to which environmental policies can be used to foster national competitiveness, as they allow countries to free-ride on favorable institutional environments abroad. Interestingly, however, our study indicates that, despite these spillovers, countries cannot merely rely on institutions abroad, since domestic institutions influence the extent to which countries can take advantage of foreign institutions. In this sense, despite providing evidence for spillovers, our study makes the case for domestic market support, since domestic policies strongly enhance investments in domestic start-ups that enjoy favorable institutional environments abroad.

**Limitations and future research**

Our study has several limitations, which could offer promising avenues for future research. First, the question arises of how far our findings can be generalized to other industries. We would expect our findings to hold in all industries where markets are global (i.e., barriers to trade and/or foreign investment are low), where VC activity is more internationalized, and where policy incentives drive demand. In fact, policy incentives have played an important role in biotechnology, pharma, and IT, suggesting that the impact of institutional spillovers may not be limited to PV (Mazzucato, 2013). Yet, it should be kept in mind that products in the PV industry are heavily commoditized and manufactured at a mass scale, which may influence the extent and drivers of institutional spillovers (Hoppmann, 2018). Moreover, different types of policy incentives may differ in the extent to which they stimulate foreign trade and investment. Future research should therefore investigate how far our findings hold for other industries, technologies, and types of institutions.

Second, while we carefully designed our study to control for alternative explanations, given the lack of an exogenous shock, we cannot provide conclusive evidence that foreign policy incentives are causally related to domestic VC investments. We therefore call for future qualitative and quantitative research that sheds more light on the causal mechanisms and tests them based on alternative methods (e.g., case studies, experiments, and difference-in-difference models). For example, what are the specific factors that allow entrepreneurs and investors to identify favorable institutional environments abroad? How exactly do formal and informal domestic institutions influence entrepreneurs' ability to reap foreign opportunities? And which organizational attributes help organizations absorb knowledge on domestic institutions that can be leveraged in international activities? Addressing these questions has the potential to provide detailed insights into how foreign and domestic institutions shape VC investments and entrepreneurial activity, and could lead to potentially important implications for entrepreneurs and policymakers.

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## FIGURES

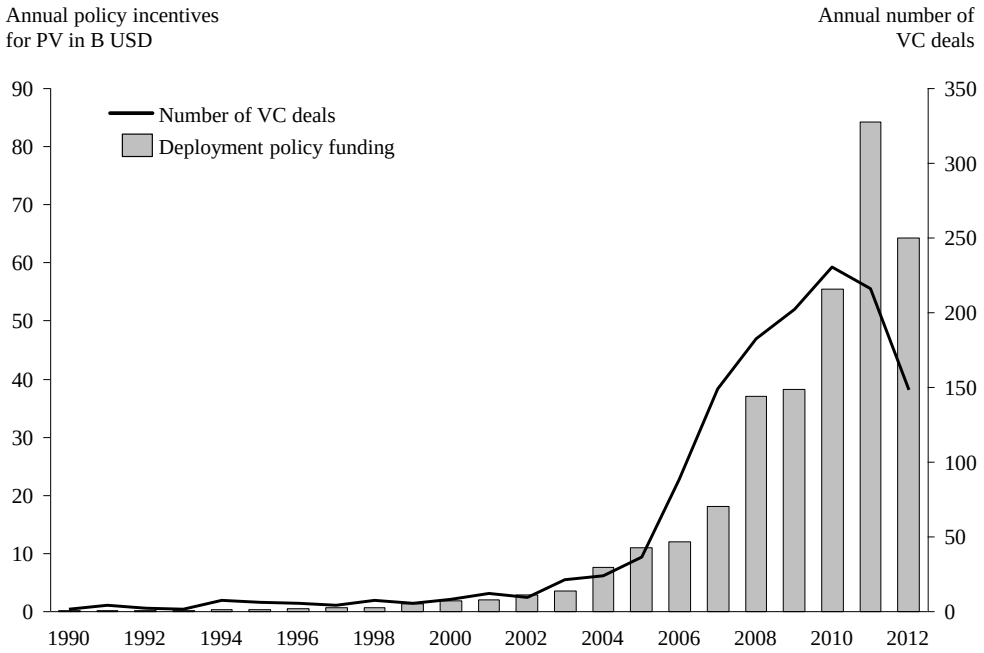


**Figure 1: Global demand-side policy incentives and number of VC deals in the PV industry over time**

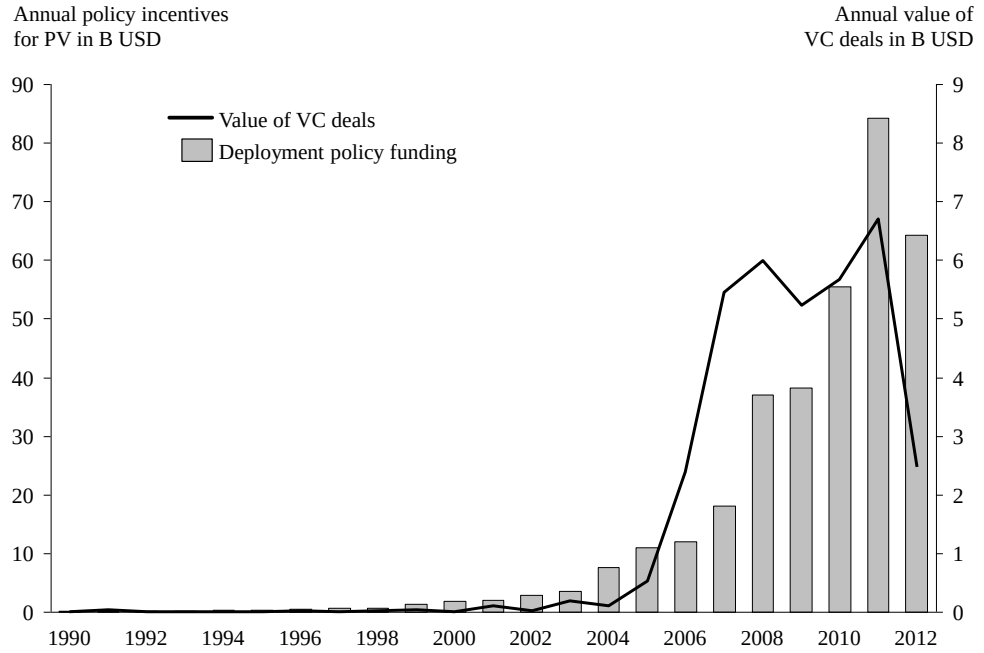


**Figure 2: Global demand-side policy incentives and value of VC deals in the PV industry over time**

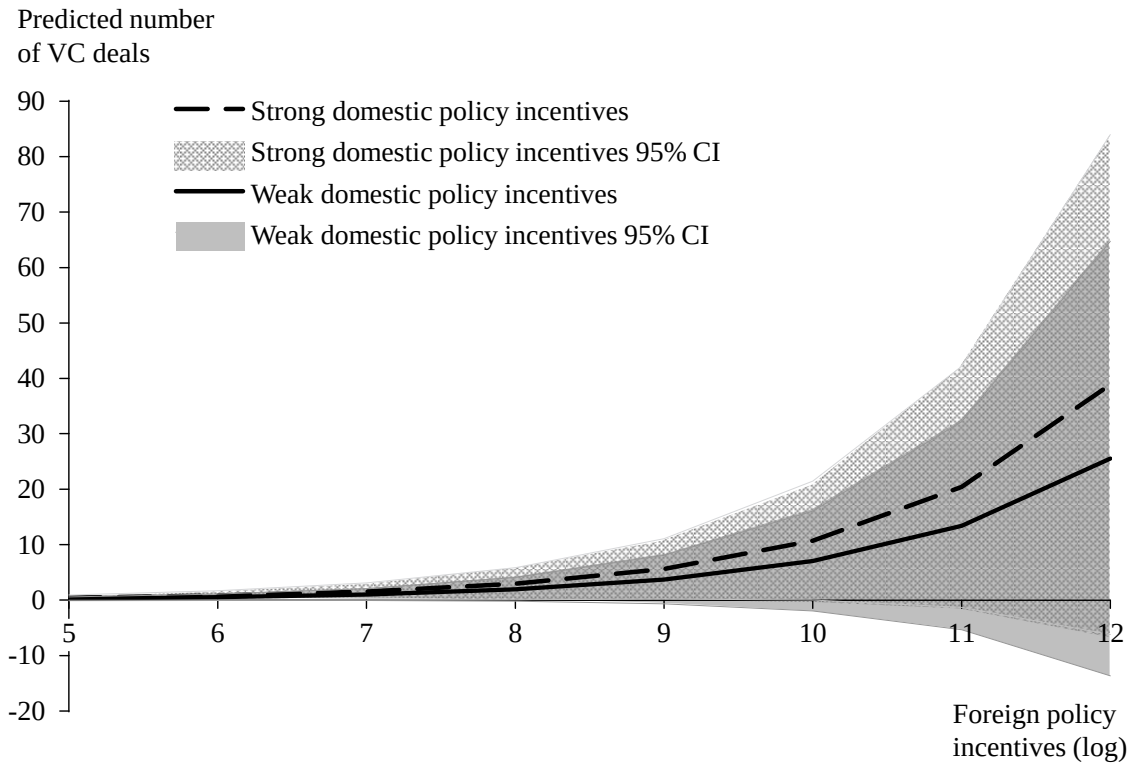


**Figure 3: Impact of foreign deployment incentives on the predicted number of VC deals for weak and strong domestic policy incentives**

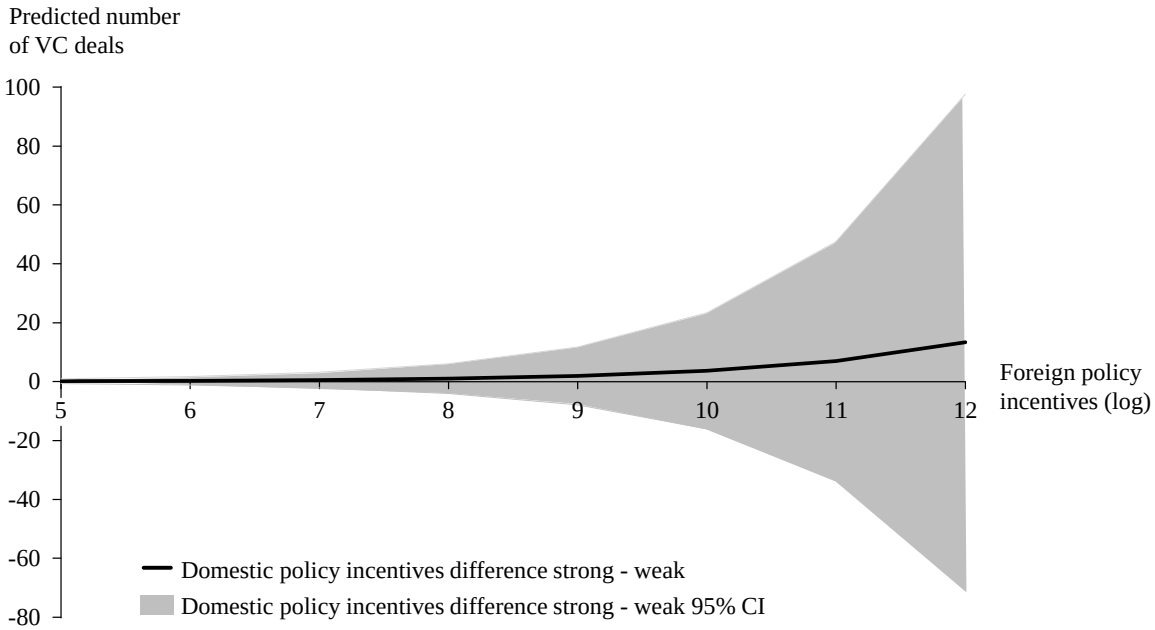


**Figure 4: Impact of foreign deployment incentives on the predicted number of VC deals for weak and strong domestic policy incentives (delta)**

# TABLES

**Table 1: Descriptive statistics**

| | | Mean | S.D. | Min | Max | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Number of VC deals | 1.81 | 6.99 | 0.00 | 82.00 | 1.00 | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Value of VC deals | 2.31 | 4.39 | 0.00 | 14.83 | 0.57 | 1.00 | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Foreign policy incentives | 8.11 | 1.88 | 5.12 | 11.34 | 0.26 | 0.44 | 1.00 | | | | | | | | | | | | | | | | | | | | | |
| 4 | Domestic social values | 0.09 | 0.07 | 0.00 | 0.47 | 0.15 | 0.29 | 0.12 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| 5 | For. pol. inc.: low pol. distance | 7.32 | 2.35 | 0.00 | 11.34 | 0.29 | 0.47 | 0.93 | 0.10 | 1.00 | | | | | | | | | | | | | | | | | | | |
| 6 | For. pol. inc.: high pol. distance | 6.31 | 2.12 | 0.00 | 10.87 | 0.03 | 0.10 | 0.58 | -0.05 | 0.34 | 1.00 | | | | | | | | | | | | | | | | | | |
| 7 | Domestic policy incentives | 2.11 | 2.48 | 0.00 | 10.17 | 0.46 | 0.62 | 0.41 | 0.30 | 0.48 | 0.04 | 1.00 | | | | | | | | | | | | | | | | | |
| 8 | GDP growth | 3.22 | 3.64 | -14.80 | 14.78 | -0.05 | -0.02 | -0.07 | 0.09 | -0.09 | 0.03 | -0.18 | 1.00 | | | | | | | | | | | | | | | | |
| 9 | Inflation | 5.69 | 12.74 | -4.02 | 154.76 | -0.07 | -0.12 | -0.19 | -0.18 | -0.18 | -0.12 | -0.22 | -0.12 | 1.00 | | | | | | | | | | | | | | | |
| 10 | Unemployment | 7.25 | 3.93 | 0.00 | 23.90 | -0.02 | -0.08 | -0.08 | -0.20 | -0.03 | -0.13 | -0.07 | -0.16 | 0.11 | 1.00 | | | | | | | | | | | | | | |
| 11 | Interest rate (real) | 6.17 | 9.72 | -30.24 | 97.47 | -0.07 | -0.15 | -0.15 | -0.12 | -0.16 | -0.11 | -0.17 | -0.23 | 0.19 | 0.20 | 1.00 | | | | | | | | | | | | | |
| 12 | Stock turnover ratio | 77.84 | 61.07 | 0.12 | 538.20 | 0.35 | 0.37 | 0.15 | 0.18 | 0.12 | 0.06 | 0.36 | 0.00 | 0.01 | -0.18 | -0.16 | 1.00 | | | | | | | | | | | | |
| 13 | Market capitalization growth | 76.77 | 74.82 | 0.04 | 606.00 | 0.06 | 0.15 | 0.13 | 0.26 | 0.07 | 0.14 | 0.00 | 0.14 | -0.23 | -0.36 | -0.13 | 0.10 | 1.00 | | | | | | | | | | | |
| 14 | Market capitalization per GDP | 1.05 | 18.48 | -0.89 | 495.00 | -0.01 | -0.03 | -0.05 | -0.06 | -0.06 | -0.01 | -0.04 | 0.00 | 0.11 | 0.05 | -0.02 | -0.05 | -0.04 | 1.00 | | | | | | | | | | |
| 15 | Corporate tax levels | 30.85 | 7.89 | 10.00 | 58.15 | 0.09 | 0.03 | -0.45 | 0.15 | -0.33 | -0.50 | 0.19 | -0.08 | 0.01 | 0.10 | 0.12 | 0.08 | -0.25 | -0.06 | 1.00 | | | | | | | | | |
| 16 | VC market | 4.82 | 2.71 | 0.00 | 11.89 | 0.38 | 0.52 | 0.40 | 0.34 | 0.40 | 0.10 | 0.49 | -0.02 | -0.29 | -0.17 | -0.11 | 0.42 | 0.33 | -0.06 | 0.07 | 1.00 | | | | | | | | |
| 17 | Demand uncertainty | 1.37 | 17.61 | 0.00 | 478.42 | 0.00 | 0.00 | 0.10 | 0.34 | 0.09 | 0.07 | 0.12 | -0.02 | -0.02 | 0.07 | -0.07 | -0.04 | -0.04 | 0.00 | -0.06 | -0.05 | 1.00 | | | | | | | |
| 18 | Public R&D funding | 0.89 | 1.39 | 0.00 | 5.90 | 0.40 | 0.40 | 0.08 | 0.19 | 0.18 | -0.16 | 0.65 | -0.27 | -0.19 | -0.09 | -0.13 | 0.30 | 0.09 | -0.03 | 0.39 | 0.47 | -0.01 | 1.00 | | | | | | |
| 19 | Feed-in tariff | 0.45 | 0.50 | 0.00 | 1.00 | 0.24 | 0.36 | 0.42 | 0.36 | 0.47 | 0.02 | 0.45 | -0.12 | -0.18 | 0.00 | -0.04 | 0.15 | -0.03 | -0.04 | 0.05 | 0.21 | 0.08 | 0.30 | 1.00 | | | | | |
| 20 | Renewable portfolio standard | 0.31 | 0.46 | 0.00 | 1.00 | 0.30 | 0.45 | 0.57 | 0.25 | 0.67 | 0.02 | 0.55 | -0.17 | -0.15 | 0.04 | -0.16 | 0.20 | -0.03 | -0.04 | -0.10 | 0.43 | 0.10 | 0.39 | 0.38 | 1.00 | | | | |
| 21 | Tax credits | 0.29 | 0.46 | 0.00 | 1.00 | 0.29 | 0.33 | 0.34 | 0.14 | 0.42 | -0.12 | 0.41 | -0.12 | -0.06 | -0.02 | 0.09 | 0.10 | 0.00 | -0.03 | 0.12 | 0.38 | 0.01 | 0.32 | 0.33 | 0.47 | 1.00 | | | |
| 22 | Grants, subsidies, and loans | 0.37 | 0.48 | 0.00 | 1.00 | 0.21 | 0.29 | 0.38 | 0.03 | 0.54 | -0.20 | 0.43 | -0.16 | -0.16 | 0.04 | 0.00 | 0.05 | 0.00 | -0.04 | 0.04 | 0.30 | 0.08 | 0.30 | 0.29 | 0.49 | 0.45 | 1.00 | | |
| 23 | Industry association | 0.42 | 0.49 | 0.00 | 1.00 | 0.18 | 0.23 | 0.21 | 0.19 | 0.26 | -0.02 | 0.44 | -0.24 | -0.21 | 0.08 | -0.15 | 0.10 | 0.03 | -0.04 | 0.16 | 0.20 | 0.08 | 0.47 | 0.25 | 0.34 | 0.32 | 0.23 | 1.00 | |
| 24 | Entrepreneurial entry | 2.15 | 7.43 | 0.00 | 97.00 | 0.53 | 0.50 | 0.25 | 0.09 | 0.29 | 0.06 | 0.49 | 0.08 | -0.07 | -0.06 | -0.10 | 0.28 | 0.01 | -0.01 | 0.04 | 0.31 | -0.01 | 0.25 | 0.22 | 0.28 | 0.23 | 0.19 | 0.09 | 1.00 |

**Table 2: Results of negative binomial regression (dependent variable: no. of VC deals)**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Domestic policy incentives | 0.341*** | 0.0849 | 0.120 | 0.0641 | 0.289*** | 0.0500 |
| | (0.0729) | (0.0862) | (0.0954) | (0.0877) | (0.0783) | (0.0915) |
| Domestic social values | 10.30*** | 8.929** | 8.563** | 8.733** | 10.56*** | 8.859** |
| | (2.416) | (2.740) | (2.812) | (2.831) | (2.481) | (2.834) |
| GDP growth | 0.0295 | 0.0260 | 0.0315 | 0.0222 | 0.0268 | 0.0196 |
| | (0.0329) | (0.0288) | (0.0293) | (0.0294) | (0.0318) | (0.0291) |
| Inflation | 0.0290 | 0.00418 | 0.00721 | 0.00777 | 0.0168 | 0.00111 |
| | (0.0212) | (0.0277) | (0.0282) | (0.0267) | (0.0238) | (0.0285) |
| Unemployment | 0.0900 | -0.0230 | -0.00587 | 0.0360 | 0.0726 | 0.0254 |
| | (0.0664) | (0.0580) | (0.0610) | (0.0548) | (0.0612) | (0.0556) |
| Interest rate (real) | -0.00985 | 0.0346 | 0.0386+ | 0.0292 | -0.00363 | 0.0308 |
| | (0.0272) | (0.0221) | (0.0229) | (0.0229) | (0.0260) | (0.0231) |
| Stock turnover ratio | 0.00390** | 0.000814 | 0.000804 | 0.00138 | 0.00195 | 0.000815 |
| | (0.00140) | (0.00120) | (0.00120) | (0.00121) | (0.00144) | (0.00131) |
| Market capitalization growth | 0.00180 | 0.00194 | 0.00136 | 0.00140 | 0.00220 | 0.00181 |
| | (0.00183) | (0.00223) | (0.00240) | (0.00241) | (0.00178) | (0.00254) |
| Market capitalization per GDP | -0.0394 | -0.0139 | -0.0145 | -0.0122 | -0.0125 | -0.00961 |
| | (0.132) | (0.0482) | (0.0482) | (0.0475) | (0.0637) | (0.0498) |
| Corporate tax levels | -0.0614+ | 0.0320 | 0.0284 | -0.00694 | -0.0239 | -0.000277 |
| | (0.0315) | (0.0358) | (0.0371) | (0.0399) | (0.0335) | (0.0430) |
| VC market | -0.000255+ | -0.000131 | -0.000127 | -0.000124 | -0.000186 | -0.000132 |
| | (0.000144) | (0.000107) | (0.000107) | (0.000110) | (0.000118) | (0.000107) |
| Demand uncertainty | -0.333*** | -0.164+ | -0.157 | -0.185* | -0.301** | -0.184+ |
| | (0.0933) | (0.0968) | (0.0965) | (0.0931) | (0.0950) | (0.0943) |
| Public R&D funding | -0.198 | -0.121 | -0.110 | -0.148 | -0.163 | -0.137 |
| | (0.157) | (0.133) | (0.135) | (0.134) | (0.155) | (0.136) |
| Feed-in tariff | 0.910** | 0.300 | 0.308 | 0.421 | 0.860* | 0.419 |
| | (0.337) | (0.327) | (0.325) | (0.317) | (0.347) | (0.317) |
| Renewable portfolio standard | -0.121 | -0.212 | -0.247 | -0.414 | -0.0366 | -0.388 |
| | (0.325) | (0.329) | (0.329) | (0.340) | (0.339) | (0.362) |
| Tax credits | 0.188 | 0.391 | 0.400 | 0.355 | 0.306 | 0.407 |
| | (0.320) | (0.302) | (0.303) | (0.301) | (0.305) | (0.303) |
| Grants, subsidies, and loans | 0.435 | 0.110 | 0.0112 | -0.247 | 0.456 | -0.175 |
| | (0.290) | (0.274) | (0.295) | (0.277) | (0.284) | (0.286) |
| Industry association | 0.629 | 0.615 | 0.612 | 0.596 | 0.506 | 0.575 |
| | (0.569) | (0.578) | (0.583) | (0.565) | (0.590) | (0.575) |
| Entrepreneurial entry | -0.0118+ | -0.00329 | -0.000255 | -0.00107 | -0.00647 | 0.000660 |
| | (0.00694) | (0.00689) | (0.00762) | (0.00680) | (0.00704) | (0.00707) |
| Foreign policy incentives | | 0.643*** | 0.708*** | | | |
| | | (0.0981) | (0.122) | | | |
| Foreign policy incentives x domestic policy incentives | | | -0.0257 | | | |
| | | | (0.0285) | | | |
| Foreign policy incentives in countries with small policy distance | | | | 0.533*** | | 0.502*** |
| | | | | (0.0860) | | (0.0913) |
| Foreign policy incentives in countries with large policy distance | | | | | 0.137** | 0.0520 |
| | | | | | (0.0460) | (0.0458) |
| Constant | -1.572 | -7.495*** | -7.998*** | -4.753** | -3.240* | -4.927** |
| | (1.177) | (1.583) | (1.741) | (1.710) | (1.293) | (1.836) |
| Observations | 279 | 279 | 279 | 279 | 279 | 279 |
| Number of Countries | 20 | 20 | 20 | 20 | 20 | 20 |
| Country FE | YES | YES | YES | YES | YES | YES |
| Log Likelihood | -288.5 | -267.2 | -266.8 | -268.9 | -284.3 | -268.3 |

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05

**Table 3: Results of ordinary least squares regression (dependent variable: value of VC deals)**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Domestic policy incentives | 0.639** | 0.369 | -0.204 | 0.437+ | 0.555** | 0.390+ |
| | (0.206) | (0.239) | (0.246) | (0.232) | (0.194) | (0.226) |
| Domestic social values | 15.18*** | 11.26** | 10.72** | 13.04*** | 14.97*** | 13.15*** |
| | (3.512) | (3.726) | (3.456) | (3.394) | (3.558) | (3.488) |
| GDP growth | 0.0758+ | 0.0866+ | 0.0541 | 0.0743+ | 0.0966* | 0.0929* |
| | (0.0423) | (0.0425) | (0.0449) | (0.0402) | (0.0432) | (0.0405) |
| Inflation | 0.0298* | 0.0395** | 0.0236* | 0.0342** | 0.0364** | 0.0394** |
| | (0.0114) | (0.0124) | (0.0109) | (0.0119) | (0.0102) | (0.0115) |
| Unemployment | 0.0714 | 0.0844 | -0.0411 | 0.0916 | 0.0704 | 0.0880 |
| | (0.0940) | (0.0956) | (0.102) | (0.0895) | (0.0997) | (0.0934) |
| Interest rate (real) | 0.0183 | 0.0306+ | 0.0214 | 0.0299+ | 0.0193 | 0.0293+ |
| | (0.0144) | (0.0172) | (0.0142) | (0.0162) | (0.0136) | (0.0152) |
| Stock turnover ratio | 0.00255 | -0.00113 | -0.00545 | 0.000814 | -0.000469 | -0.00162 |
| | (0.00560) | (0.00496) | (0.00374) | (0.00525) | (0.00495) | (0.00501) |
| Market capitalization growth | 0.00153 | 0.00119 | 0.00328 | 0.00138 | 0.00175 | 0.00159 |
| | (0.00764) | (0.00748) | (0.00801) | (0.00754) | (0.00734) | (0.00729) |
| Market capitalization per GDP | 0.00238+ | 0.00378* | 0.00157 | 0.00381* | 0.00310* | 0.00425* |
| | (0.00125) | (0.00165) | (0.00120) | (0.00143) | (0.00147) | (0.00164) |
| Corporate tax levels | -0.155+ | -0.0939 | -0.0957 | -0.128 | -0.0997 | -0.0831 |
| | (0.0820) | (0.0941) | (0.0869) | (0.0874) | (0.0800) | (0.0853) |
| VC market | 0.330** | 0.204 | 0.266* | 0.262* | 0.281** | 0.228+ |
| | (0.0907) | (0.121) | (0.101) | (0.104) | (0.0979) | (0.115) |
| Demand uncertainty | -0.136 | 0.141 | 0.345 | 0.0386 | 0.0167 | 0.150 |
| | (0.232) | (0.243) | (0.247) | (0.243) | (0.215) | (0.232) |
| Public R&D funding | -0.0872 | -0.0896 | -0.318 | -0.123 | -0.157 | -0.179 |
| | (1.485) | (1.362) | (0.970) | (1.418) | (1.454) | (1.401) |
| Feed-in tariff | 1.935+ | 1.141 | 1.037 | 1.426 | 1.767+ | 1.345 |
| | (0.995) | (0.880) | (0.772) | (0.937) | (0.953) | (0.930) |
| Renewable portfolio standard | 0.238 | -0.308 | -0.702 | -0.400 | 0.376 | -0.192 |
| | (0.715) | (0.744) | (0.728) | (0.787) | (0.737) | (0.769) |
| Tax credits | 1.653 | 1.367 | 1.777 | 1.442 | 1.612 | 1.434 |
| | (1.309) | (1.198) | (1.229) | (1.270) | (1.155) | (1.128) |
| Grants, subsidies, and loans | -0.351 | -0.846 | -0.808 | -1.205 | 0.0189 | -0.763 |
| | (0.772) | (0.842) | (0.845) | (0.937) | (0.794) | (0.929) |
| Industry association | -0.718 | -1.234 | -0.921 | -1.087 | -1.136 | -1.407 |
| | (1.369) | (1.457) | (1.159) | (1.472) | (1.316) | (1.404) |
| Entrepreneurial entry | 0.0539+ | 0.0624* | 0.0465+ | 0.0600* | 0.0563* | 0.0612** |
| | (0.0299) | (0.0227) | (0.0247) | (0.0247) | (0.0220) | (0.0193) |
| Foreign policy incentives | | 0.829* | 0.877*** | | | |
| | | (0.331) | (0.223) | | | |
| Foreign policy incentives x domestic policy incentives | | | 0.266*** | | | |
| | | | (0.0465) | | | |
| Foreign policy incentives in countries with small policy distance | | | | 0.520* | | 0.450+ |
| | | | | (0.239) | | (0.228) |
| Foreign policy incentives in countries with large policy distance | | | | | 0.411** | 0.363** |
| | | | | | (0.117) | (0.101) |
| Constant | 0.566 | -5.697 | -3.748 | -2.367 | -3.193 | -5.294 |
| | (2.648) | (3.834) | (3.500) | (3.202) | (2.597) | (3.182) |
| Observations | 352 | 352 | 352 | 352 | 352 | 352 |
| Number of Countries | 26 | 26 | 26 | 26 | 26 | 26 |
| Country FE | YES | YES | YES | YES | YES | YES |
| R-squared | 0.425 | 0.447 | 0.493 | 0.440 | 0.442 | 0.454 |
| Adjusted R-squared | 0.392 | 0.414 | 0.461 | 0.406 | 0.409 | 0.419 |

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, † p<0.1

# APPENDIX A

**Table A.1: Results of negative binomial regression (dependent variable: no. of VC deals)**

| | Model 1<br>Excl. low-cost country | Model 2<br>Excl. social values | Model 3<br>Weighted geogr. dist. | Model 4<br>Incl. year fixed effects | Model 5<br>Incl. year fixed effects | Model 6<br>Excl. country fixed effects | Model 7<br>Immature technology | Model 8<br>Mature technology |
|---|---|---|---|---|---|---|---|---|
| Domestic policy incentives | 0.235* | 0.182* | 0.111 | 0.237*** | 0.199+ | 0.181* | 0.109 | 0.138 |
| | (0.109) | (0.0717) | (0.0971) | (0.0717) | (0.109) | (0.0874) | (0.107) | (0.147) |
| Domestic social values | 7.543 | | 9.105*** | 4.810+ | 5.029+ | 8.017*** | 5.273 | 13.28** |
| | (4.769) | | (2.705) | (2.610) | (2.657) | (2.402) | (3.559) | (4.322) |
| GDP growth | 0.0321 | -0.00348 | 0.0332 | 0.0625+ | 0.0621+ | 0.0152 | 0.0349 | -0.0147 |
| | (0.0345) | (0.0252) | (0.0305) | (0.0335) | (0.0335) | (0.0285) | (0.0349) | (0.0495) |
| Inflation | 0.0209 | 0.0233 | 0.0158 | 0.00439 | 0.00338 | -0.00370 | 0.0296 | -0.104 |
| | (0.0375) | (0.0277) | (0.0276) | (0.0244) | (0.0246) | (0.0245) | (0.0384) | (0.0695) |
| Unemployment | -0.113 | -0.0463 | 0.0289 | -0.0107 | -0.0176 | -0.0324 | 0.0127 | -0.139 |
| | (0.0878) | (0.0542) | (0.0613) | (0.0463) | (0.0488) | (0.0492) | (0.0724) | (0.0993) |
| Interest rate (real) | 0.0357 | 0.0445* | 0.0280 | 0.00742 | 0.00550 | 0.0184 | 0.0569* | -0.00436 |
| | (0.0251) | (0.0208) | (0.0235) | (0.0227) | (0.0231) | (0.0239) | (0.0275) | (0.0535) |
| Stock turnover ratio | 0.00297* | 0.000191 | 0.00162 | -0.00270** | -0.00272** | 0.00139 | 0.00249+ | -0.000886 |
| | (0.00132) | (0.00110) | (0.00123) | (0.001000) | (0.00100) | (0.00106) | (0.00133) | (0.00170) |
| Market capitalization growth | 0.00615* | 0.00408* | 0.00156 | 0.000811 | 0.000976 | 0.00240 | 0.00554 | 0.00172 |
| | (0.00300) | (0.00193) | (0.00209) | (0.00176) | (0.00179) | (0.00177) | (0.00362) | (0.00240) |
| Market capitalization per GDP | -0.0141 | -0.0217 | -0.0193 | -0.213 | -0.220 | -0.000617 | -0.0594 | 0.0905 |
| | (0.0493) | (0.0442) | (0.0533) | (0.160) | (0.160) | (0.0310) | (0.226) | (0.0964) |
| Corporate tax levels | 0.00903 | -0.0240 | 0.0244 | 0.0459+ | 0.0476+ | 0.0571* | -0.0223 | 0.0548 |
| | (0.0442) | (0.0300) | (0.0360) | (0.0274) | (0.0276) | (0.0274) | (0.0586) | (0.0530) |
| VC market | -0.000358* | 6.58e-06 | -8.69e-05 | 0.000100 | 9.67e-05 | -8.39e-05 | -0.000148 | -5.09e-05 |
| | (0.000150) | (9.38e-05) | (0.000109) | (9.50e-05) | (9.52e-05) | (9.49e-05) | (0.000152) | (0.000129) |
| Demand uncertainty | -0.149 | -0.0245 | -0.164+ | 0.0986 | 0.104 | -0.122 | -0.196 | -0.151 |
| | (0.107) | (0.0619) | (0.0948) | (0.0892) | (0.0903) | (0.0899) | (0.148) | (0.105) |
| Public R&D funding | -0.154 | 0.0290 | -0.186 | 0.196 | 0.189 | -0.0779 | -0.270+ | 0.125 |
| | (0.118) | (0.102) | (0.136) | (0.119) | (0.120) | (0.120) | (0.152) | (0.244) |
| Feed-in tariff | 0.106 | 0.333 | 0.536 | 0.0843 | 0.113 | 0.275 | -0.0378 | 0.492 |
| | (0.375) | (0.272) | (0.336) | (0.244) | (0.252) | (0.288) | (0.420) | (0.576) |
| Renewable portfolio standard | -0.585+ | -0.274 | -0.0396 | -0.307 | -0.297 | -0.176 | -0.420 | -0.123 |
| | (0.340) | (0.259) | (0.318) | (0.220) | (0.221) | (0.277) | (0.459) | (0.447) |
| Tax credits (dummy) | 0.155 | 0.539* | 0.314 | 0.625* | 0.623* | 0.415 | 0.163 | 0.902+ |
| | (0.462) | (0.261) | (0.297) | (0.251) | (0.251) | (0.279) | (0.385) | (0.485) |
| Grants, subsidies, and loans | 0.126 | -0.323 | 0.0339 | -0.121 | -0.0979 | 0.0562 | 0.141 | -0.181 |
| | (0.439) | (0.270) | (0.280) | (0.240) | (0.244) | (0.267) | (0.339) | (0.475) |
| Industry association | 0.404 | -0.255 | 0.752 | -0.194 | -0.222 | 0.197 | 1.709+ | -1.046 |
| | (0.572) | (0.345) | (0.650) | (0.394) | (0.398) | (0.444) | (0.883) | (0.862) |
| Entrepreneurial entry | 0.0378 | -0.00375 | -0.00423 | 0.0119* | 0.0109+ | -0.00165 | 0.00421 | -0.00433 |
| | (0.0284) | (0.00644) | (0.00707) | (0.00564) | (0.00601) | (0.00694) | (0.00861) | (0.0102) |
| Foreign policy incentives | 0.614*** | 0.728*** | 0.608*** | 3.690* | 3.249+ | 0.612*** | 0.762*** | 0.539*** |
| | (0.166) | (0.101) | (0.111) | (1.478) | (1.773) | (0.117) | (0.138) | (0.135) |
| Foreign policy incentives x domestic policy incentives | -0.0296 | -0.0390 | -0.00799 | | 0.0173 | -0.0132 | | |
| | (0.0359) | (0.0239) | (0.0308) | | (0.0374) | (0.0272) | | |
| Constant | -5.200 | -5.579*** | -8.310*** | -36.21 | -34.44 | -8.310*** | -6.712* | -7.316** |
| | (3.183) | (1.465) | (1.704) | (0) | (0) | (1.459) | (2.947) | (2.462) |
| Observations | 235 | 458 | 279 | 352 | 352 | 352 | 262 | 208 |
| Number of Countries | 17 | 26 | 20 | 26 | 26 | 26 | 19 | 14 |
| Country FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Log Likelihood | -204.7 | -379.6 | -272.1 | -320.6 | -320.5 | -357.7 | -178.5 | -185.8 |

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05

**Table A.2: Results of ordinary least squares regression (dependent variable: VC deal value)**

| | Model 1<br>Excl. low-cost country | Model 2<br>Excl. social values | Model 3<br>Weighted geogr. dist. | Model 4<br>Incl. year fixed effects | Model 5<br>Incl. year fixed effects | Model 6<br>Median deal value | Model 7<br>Average deal value | Model 8<br>Immature technology | Model 9<br>Mature technology |
|---|---|---|---|---|---|---|---|---|---|
| Domestic policy incentives | -0.241 | 0.0942 | -0.0528 | 0.628** | -0.0669 | -0.237 | -0.278 | 0.537+ | 0.0749 |
| | (0.348) | (0.239) | (0.276) | (0.213) | (0.329) | (0.209) | (0.200) | (0.267) | (0.230) |
| Domestic social values | 1.600 | | 12.71** | 11.01* | 9.430+ | 10.59** | 10.54** | 5.997 | 10.19** |
| | (11.32) | | (3.554) | (4.076) | (4.656) | (3.480) | (3.420) | (4.968) | (3.242) |
| GDP growth | 0.0553 | 0.0196 | 0.0528 | 0.0510 | 0.0149 | 0.0314 | 0.0339 | 0.0612+ | 0.0617 |
| | (0.0461) | (0.0292) | (0.0463) | (0.0348) | (0.0417) | (0.0358) | (0.0338) | (0.0344) | (0.0400) |
| Inflation | 0.0235* | 0.0235** | 0.0203+ | 0.0299* | 0.0181 | 0.0192+ | 0.0194* | 0.0287** | 0.0317* |
| | (0.0104) | (0.00848) | (0.0106) | (0.0111) | (0.0111) | (0.00962) | (0.00938) | (0.00990) | (0.0114) |
| Unemployment | -0.0301 | -0.0782 | -0.0360 | 0.0743 | -0.0229 | -0.0713 | -0.0703 | 0.142 | 0.0467 |
| | (0.0932) | (0.0690) | (0.111) | (0.128) | (0.128) | (0.0989) | (0.0982) | (0.0887) | (0.0918) |
| Interest rate (real) | 0.0144 | 0.00637 | 0.0165 | 0.0246 | 0.0188 | 0.0170 | 0.0162 | 0.0213+ | 0.0266 |
| | (0.0130) | (0.0108) | (0.0124) | (0.0173) | (0.0162) | (0.0132) | (0.0127) | (0.0124) | (0.0160) |
| Stock turnover ratio | -0.00292 | -0.00398 | -0.00247 | -0.00372 | -0.00594 | -0.00524+ | -0.00532+ | 0.00449 | -0.000639 |
| | (0.00547) | (0.00376) | (0.00395) | (0.00511) | (0.00377) | (0.00297) | (0.00296) | (0.00528) | (0.00360) |
| Market capitalization growth | 0.00664 | 0.00833* | 0.00484 | -0.00341 | -0.00158 | 0.00316 | 0.00310 | 0.00730 | 0.00119 |
| | (0.00599) | (0.00354) | (0.00839) | (0.0108) | (0.0115) | (0.00803) | (0.00787) | (0.00657) | (0.00747) |
| Market capitalization per GDP | 0.00148 | 0.00143 | 0.00130 | 0.00363* | 0.00230 | 0.00140 | 0.00135 | 0.00360** | 0.00279+ |
| | (0.00133) | (0.00103) | (0.00110) | (0.00170) | (0.00147) | (0.00124) | (0.00118) | (0.00116) | (0.00143) |
| Corporate tax levels | -0.0970 | -0.0182 | -0.0945 | -0.110 | -0.0860 | -0.0988 | -0.0977 | -0.0405 | -0.0863 |
| | (0.0849) | (0.0451) | (0.0818) | (0.0981) | (0.0924) | (0.0773) | (0.0763) | (0.0760) | (0.0833) |
| VC market | 0.175 | 0.131+ | 0.275* | 0.307** | 0.285* | 0.266** | 0.256** | 0.0681 | 0.224* |
| | (0.102) | (0.0651) | (0.117) | (0.107) | (0.121) | (0.0924) | (0.0905) | (0.106) | (0.103) |
| Demand uncertainty | 0.377 | 0.00320 | 0.195 | 0.298 | 0.457 | -0.0272 | 0.0337 | -0.316* | -0.0377 |
| | (0.279) | (0.180) | (0.247) | (0.314) | (0.320) | (0.201) | (0.208) | (0.152) | (0.214) |
| Public R&D funding | -0.399 | 0.0358 | -0.429 | 0.494 | -0.108 | -0.675 | -0.648 | -0.569 | -0.256 |
| | (0.968) | (0.722) | (1.279) | (1.150) | (0.956) | (0.728) | (0.670) | (1.288) | (0.992) |
| Feed-in tariff | 0.658 | 0.761 | 1.539+ | 0.830 | 0.798 | 1.405+ | 1.239 | 1.092 | 1.202 |
| | (0.779) | (0.560) | (0.866) | (0.720) | (0.676) | (0.811) | (0.746) | (0.864) | (0.881) |
| Renewable portfolio standard | -0.356 | -0.174 | -0.309 | -0.800 | -1.005 | -0.168 | -0.0798 | 0.0477 | -0.175 |
| | (0.766) | (0.553) | (0.686) | (0.762) | (0.704) | (0.676) | (0.660) | (0.623) | (0.788) |
| Tax credits | 0.463 | 0.943 | 1.760 | 1.791 | 2.128+ | 1.208 | 1.140 | 0.283 | 1.104 |
| | (0.960) | (0.948) | (1.434) | (1.103) | (1.151) | (0.752) | (0.724) | (1.165) | (1.550) |
| Grants, subsidies, and loans | -0.347 | -0.937 | -0.825 | 0.0919 | -0.275 | -0.369 | -0.305 | -0.252 | -1.039 |
| | (0.799) | (0.643) | (0.886) | (0.768) | (0.752) | (0.725) | (0.676) | (0.648) | (0.926) |
| Industry association | 0.0722 | -0.863 | -0.593 | -1.194 | -1.008 | -1.396 | -1.309 | 0.655 | -1.737 |
| | (1.209) | (0.708) | (1.318) | (1.447) | (1.131) | (0.952) | (0.921) | (1.806) | (1.080) |
| Entrepreneurial entry | 0.0309 | 0.0657** | 0.0540+ | 0.0589** | 0.0419* | 0.0383+ | 0.0241 | 0.0830** | 0.0710* |
| | (0.160) | (0.0219) | (0.0282) | (0.0204) | (0.0192) | (0.0195) | (0.0190) | (0.0270) | (0.0255) |
| Foreign policy incentives | 0.815** | 0.774*** | 0.637** | 12.25*** | 1.790 | 0.562* | 0.555* | 0.479 | 0.691* |
| | (0.272) | (0.189) | (0.214) | (2.949) | (4.167) | (0.228) | (0.238) | (0.288) | (0.291) |
| Foreign policy incentives x domestic policy incentives | 0.291*** | 0.229*** | 0.272*** | | 0.285** | 0.225*** | 0.220*** | | |
| | (0.0516) | (0.0511) | (0.0672) | | (0.0874) | (0.0412) | (0.0421) | | |
| Constant | -2.323 | -4.673* | -3.788 | -66.60*** | -8.033 | -0.659 | -0.575 | -5.754 | -3.654 |
| | (3.970) | (2.012) | (3.069) | (16.66) | (23.38) | (3.145) | (3.156) | (3.378) | (3.608) |
| Observations | 301 | 617 | 352 | 352 | 352 | 352 | 352 | 352 | 352 |
| Number of Countries | 22 | 38 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| Country FE | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| R-squared | 0.414 | 0.477 | 0.462 | 0.521 | 0.546 | 0.425 | 0.397 | 0.443 | 0.367 |
| Adjusted R-squared | 0.370 | 0.459 | 0.428 | 0.462 | 0.487 | 0.388 | 0.358 | 0.410 | 0.329 |

Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, $^{\dagger}$ p<0.1