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The trade effects of product market regulation in global value chains: evidence from OECD and BRICS countries between 2000 and 2015

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Abstract

Global Value Chains (GVC) have reshaped the landscape of international trade. The quality and intensity of regulation significantly impacts firms' competitiveness and their ability to engage in GVC. Economic literature suggests that regulation of product market competition has a detrimental effect on trade by decreasing productivity, innovation, and economic growth. This paper expands existing knowledge on this relationship by examining the influence of product market regulation (PMR) on value-added trade flows in an augmented gravity model. We constructed a data panel with trade data from 40 OECD and BRICS countries in the period from 2000 to 2015 and combined it with an extensive multi-level indicator set on PMR developed by the OECD. By disentangling the PMR indicators, we account for the heterogeneity of regulation and potential different trade effects. Overall, our evidence suggests that PMR has a negative impact on trade. Further, our results indicate that the negative impact stems largely from barriers to trade and investment. For the BRICS, our results suggest the contrary: We observed an overall positive trade effect of PMR, mainly driven by barriers to trade and investment. Our results support identifying policy areas in which regulatory reform can improve the integration in GVC and emphasize different approaches to economic policy, particularly in emerging economies such as the BRICS. Moreover, the results underline the detrimental effects of increasing protectionism and tariff hikes, a phenomenon that we increasingly observe in recent years from the world's largest economies, such as the United States and China.

Keywords Product market regulation · Global value chains · International trade, trade in value-added · PMR · Gravity model · OECD, BRICS

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1 Introduction

Since 1990, global trade has almost tripled in volume, driving economic growth and development (Alcalá and Ciccone 2004; Ortiz-Ospina and Beltekian 2018). At the same time, the nature of trade has changed significantly and is characterized by globalized and vertical production of multinational companies (Gereffi et al. 2005). Information and Communication Technologies (ICT) facilitated increasing international labor division, where firms from various countries add value to geographically dispersed value chains (Baldwin 2006; Grossman and Rossi-Hansberg 2008). Gereffi et al.'s (2005) theoretical framework introduced the term and concept of 'Global Value Chains' (GVC), which has been broadly adopted in development and trade studies.

This development has also reshaped the role and participation of emerging countries such as the BRICS,[1] in international trade, causing them to gain in importance (Gereffi and Fernandez-Stark 2016). In previous decades, the share of BRICS countries in international trade has significantly increased and now accounts for over a fifth of global trade volume. Today, BRICS countries are highly embedded in GVC and benefit from this participation by increasing income, growth, and employment (Singh and Dube 2014; World Trade Organization 2019). Most of the BRICS are still focused on the production and export of intermediate goods located downstream in GVC. However, countries such as China and India have entered the global service sectors since the 2000s, and particularly China has upgraded its position in GVC (Ye and Voigt 2014).

The increasing international fragmentation of production highlights the role of different domestic and international regulations and economic policies. The quality and intensity of regulation significantly impacts firms' competitiveness and their ability to engage in international markets (Gereffi et al. 2005; Gereffi and Fernandez-Stark 2016; Kaplinsky and Morris 2001). The OECD developed an indicator set called Product Market Regulation (PMR) in order to understand which policy settings promote or inhibit competition. The indicator set allows to disentangle of different kinds of regulations and, for example, measures the extent of state control (e.g., direct governmental support of firms), barriers to entrepreneurship (e.g., administrative burdens), and barriers to trade and investment (e.g., tariff barriers). Moreover, it provides an economy-wide PMR indicator as a composite of the aforementioned sub-indicators. The economy-wide PMR indicator suggests that regulation has been decreasing continuously in OECD and BRICS countries in the last two decades, while it is still significantly higher in the BRICS countries (Koske et al. 2015).

[1] BRICS is an acronym for the emerging countries Brazil, the Russian Federation, India, the People's Republic of China, and the Republic of South Africa. Since 2010, they officially form a geopolitical and economic bloc, although vast economic differences exist between the countries (Singh & Dube 2014).

Regulatory policy needs to be critically reviewed in light of the dynamically changing structure of international trade, and many economists have called for regulatory reform (e.g., Noll 2000). From a policymaker's perspective, it is crucial to understand which regulations might increase domestic production shares and which regulations might harm the country's position in GVC. Notably, emerging countries must embrace policies that support upgrading in GVC, which entails firms evolving from low-value to high-value activities, inherently increasing wealth. Hence, regulation might play a more important role in BRICS countries in shaping their GVC participation.

Precise measurement of the new trade patterns is essential to understanding the effects of different regulations. However, the traditional approach, which measures trade flows using gross exports and imports, is inaccurate. It does not capture the actual value that has been added in the exporting country. Therefore, the increasing complexity of trade flows calls for a more input–output-oriented approach. In recent years, new data on trade in value-added has been provided, and it is now considered a more accurate measure since it captures the actual value added of an exporter and avoids double-counting (Grossman 2013). The OECD (2020c) provides an extensive data set with aggregated and sectoral input and output tables for many countries.

There are only a few studies that directly analyze the trade effects of regulation comprehensively and mainly focus on regulation that directly impacts trade flows, such as tariffs or technical barriers to trade (compare, e.g., Li and Beghin 2012), are sector-specific (Essaji 2008) or focus only on the structural impact of regulation (Marel 2015). Most empirical studies have explored the effects of regulation not directly on trade but instead on *productivity* (Bouis et al. 2016; Bourlès et al. 2013; Duval and Furceri 2018; Griffith et al. 2006), *innovation* (Aghion et al. 2005; Barbosa and Faria 2011; Bassanini and Ernst 2002; Blind 2012; Crafts 2006; Franco et al. 2016), and *economic growth* (Djankov et al. 2006; Koedijk and Kremers 1996; Loayza et al. 2005; Nicoletti and Scarpetta 2003). We are not familiar with any studies so far that have linked PMR to the more accurate measure of trade in value-added. From this large body of literature, we take inspiration to explore the trade effects of product market regulations.

In this paper, we combine trade in value-added data, a more accurate measure of trade flows in GVC, and a comprehensive indicator dataset on PMR to answer the following research questions:

1. How does different product-market regulation influence trade in Global Value Chains?
2. Are the trade effects of product market regulation different in emerging countries?

To investigate these research questions, we constructed a panel of 35 OECD and five BRICS countries between 2000 and 2015. We augmented a standard gravity model as introduced by Tinbergen (1962) and linked bilateral TiVA flows and gross exports to regulation indicators and control variables such as distances, economic masses, trade agreements, institutional quality, and multilateral

resistance terms (Anderson et al. 1979; Anderson and van Wincoop 2003; Baier and Bergstrand 2007; Deardorff 1998). In addition, we disentangled the PMR indicators to account for the heterogeneity of regulation. Finally, we applied a Pseudo-Maximum Likelihood (PPML) estimation in our model (Silva and Tenreyro 2006). PPML is less biased in the presence of heteroscedasticity, and zero trade between countries does not have to be excluded, something which would need to be done for ordinary least squares (OLS) with log-linearization (Silva and Tenreyro 2006).

The paper is structured as follows. The subsequent section presents the study background, providing a brief theoretical and empirical overview of the relationship between regulation and trade, and introduce the product market regulation indicators. We emphasize the shifting paradigms in trade theory that push policymakers to reevaluate their regulatory measures. Section 3 describes our research methods and data before presenting our quantitative analysis in Sect. 4 and discussing it in light of theory and practice. Section 5 briefly discusses the limitations, and the last section concludes the paper with a summary and areas for future research.

2 Theoretical background

2.1 The framework of trade in global value chains

The rejection of the neoclassical assumptions gradually led to the evolution of new paradigms in trade theory and a growing body of research focusing on globalization and increasing international trade in global production networks, also referred to as 'Global Commodity Chains' or 'Global Value Chains' (Gereffi et al. 2001).

The nature of trade has changed significantly during recent decades and is now characterized by multinational companies' globalized and vertical production (Gereffi et al. 2005). The development, production, and marketing of goods and services have become more complex and are increasingly taking place in global commodity chains (Gereffi and Korzeniewicz 1994). In recent decades, the structural shift of the world economy to fragmented production chains has triggered an increasing amount of research utilizing different approaches, such as analyzing input–output structures.

Gereffi and Korzeniewicz (1994) laid the foundation for a new research stream on the increasing occurrence of global production networks, while Hopkins and Wallerstein had already conceptualized commodity chains in 1977, describing them as a "linked set of processes" (Hopkins and Wallerstein 1977, p. 128).

In the 1990s and early 2000s, research in this new field led to observations of increasing outsourcing, integration of international markets, and disintegration of production, as well as vertical specialization across many countries (Hummels et al. 2001), growing trade in intermediates (Yeats 1998), and 'fragmentation' (Arndt and Kierzkowski 2001), to name only a few concepts and scholars. In the following years, the terminology 'Global Value Chains' was predominantly adopted in development economics and international trade studies to account for globally fragmented production. Gereffi et al. (2005) provided the first theoretical framework to describe

governance patterns in Global Value Chains. The underlying concepts of value chain research can be traced back to the 1970s and 1980s, e.g., there was empirical evidence found on increasing labor mobility and locational flexibility of international production (Fröbel et al. 1978) or multi-stage vertical production in different countries within the manufacturing sector (Dixit and Grossman 1982).

Our definition of Global Value Chains (GVC) follows Antràs (2019):

> A global value chain or GVC consists of a series of stages involved in producing a product or service that is sold to consumers, with each stage adding value, and with at least two stages being produced in different countries.f A firm participates in a GVC if it produces at least one stage in a GVC. (Antràs 2019, p. 3).

Most importantly, the value chain of services and goods once produced in only one country is increasingly geographically fragmented and distributed across global production networks. According to the World Trade Organization (2019), more than two-thirds of world trade occurred in GVC in 2018 (World Trade Organization 2019).

In the past years, the analysis of GVC has demonstrated the importance of emerging countries such as China or India for driving international trade (Gereffi and Fernandez-Stark 2016). Trade in GVC has facilitated emerging countries to participate in global trade and is associated with increasing income, economic growth, and jobs (World Trade Organization 2019). Pietrobelli and Rabellotti (2011) highlighted the knowledge spillover that developing countries experience when participating in GVC and argued that this increases innovation in emerging countries. In addition, Kowalski et al. (2015) pointed out that GVC allow "firms to join international production networks rather than having to build their own from scratch" (Kowalski et al. 2015, p. 7).

Particularly the emerging countries of Brazil, Russia, India, China, and South Africa, collectively known as BRICS countries, have contributed to global trade dynamics in recent decades and the increasing importance of fragmented value chains. While in 1990, their GDP share only accounted for approximately 10% of the world's gross domestic product and less than 4% of the global trade, they now account for over a fifth of the worldwide economy (Singh and Dube 2014; World Trade Organization 2019). Since 1990, the BRICS countries' share of total gross exports to BRICS and OECD countries has increased from 6.23% to 20.67%, based on OECD (2020c) data. Also, overall trade, as measured by gross exports between BRICS and OECD countries, increased by 194.82% within these 25 years (OECD 2020c). Due to this more dynamic growth of the BRICS, we assume different trade effects of regulation for these countries in this study (see subsection 2.6).

2.2 Measurement of trade in global value chains

Multiple empirical studies in international trade economics analyzing GVC have been published in recent years (Aichele and Heiland 2018; Antràs and Chor 2013; De Backer and Miroudot 2013; Grossman and Rossi-Hansberg 2008; Lee and Yi

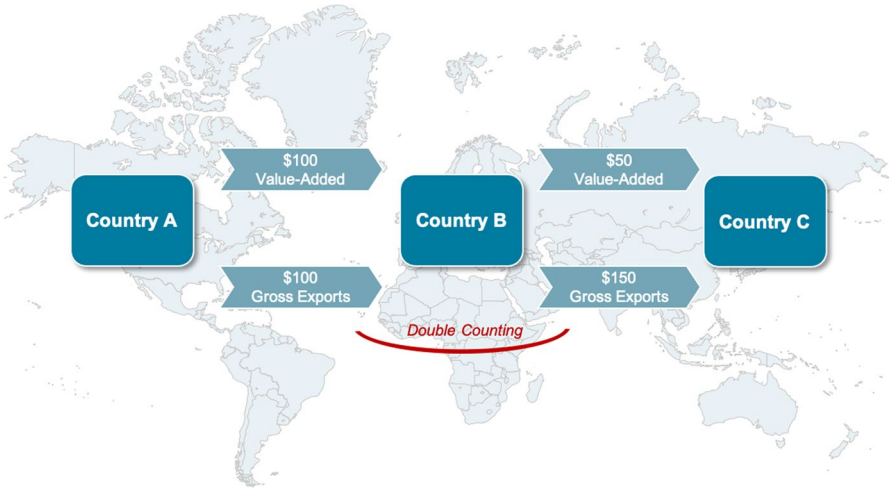

Fig. 1 The difference between value-added exports and gross exports (own illustration, adapted from Ahmad 2013)

2018; Miroudot et al. 2015; Timmer et al. 2014; Ye et al. 2020). As these studies emphasize, measuring trade flows accurately is crucial to draw conclusions for our research questions. Traditionally, trade flows have been measured as gross exports. A good or service, intermediate or final, generates trade whenever it moves along a GVC, crossing borders from one country to another. Hence, the values of products and services that cross several borders (even multiple times) are falsely included in the statistics and lead to an inaccurate measure of the actual trade (Miroudot and Yamano 2013).

Trade in GVC is measured by value-added data, a more accurate measure of trade flows. Data on Trade in value-added (TiVA) considers only the value produced in the exporting country without including the amounts that came into the GVC before that stage. This lets us see the actual value of the exporting country's contribution to the final good or service (Ahmad 2013). Fig. 1 shows the trade flows of a product[2] provided in a GVC from country A to country C via country B. The upper arrows illustrate the value added after each production stage.

In contrast, the lower arrows show the estimates for gross exports between the two countries. After the first production stage of the value chain, the intermediate product is exported from country A to country B. In this case, the estimations for value-added equals the gross exports. After the second production stage in country B, the intermediate product is exported from country B to country C. Value-added measures precisely what has been added to the product in country B. In contrast, gross exports aggregate the amount of value added in a particular stage with the value-added in previous stages (i.e., the value-added from country A). This phenomenon is called *double counting*.

[2] For simplification, we assume a product here, although it can be either a product or a service.

Gross exports are an inaccurate measure of global production patterns in GVC. They do not capture a single country's economic contribution but instead the entire value from the previous production chain. Moreover, measures on gross exports incapsulate tariffs and other trade costs. Consequently, tariffs and additional trade costs from all previous production steps are aggregated in the measurement and increase the gap even further, contributing to a distorted picture of a country's actual value-added and an overestimated trade flow (Ahmad 2013). TiVA of OECD and BRICS countries has increased considerably in recent decades. Between 1995 and 2015, it rose by 174.01% from $3.168 trillion to $8.680 trillion.

The production and value creation source along the chain is crucial to accurately address research questions in trade research (Grossman 2013). Hence, using value-added data, we can more precisely analyze the effects of product-market regulation on trade. In the following section, we introduce the role of regulation for international trade in GVC, discuss related works, and describe the regulation indicators of Product Market Regulation (PMR) used in this paper.

2.3 The role of regulation for international trade

Regulation is a major research area of economics and a political battleground of ideology (Laffont 1994). Douglas North's (1986) defines institutions as '*rules of the game'* for markets. Institutional frameworks consist of regulations and the law on the one hand and their enforcement, including informal factors (e.g., norms), on the other (North 1990). Regulations provide a legal framework for recurring interactions between actors on the market and aim to decrease transaction costs and market inefficiencies in the economy. A market without regulation sometimes produces inefficient results (North 1990). In addition, regulation can be crucial to addressing market failure (Stiglitz 2008). The legal framework of regulation comprises rules for competition, business conduct, labor market rules, employee protection, environmental protection, and specific negative external effects (Nicoletti et al. 2000).

Traditional economic theory suggests that trade is associated with growth and income gains (see, e.g., Frankel and Romer 1999). Freund and Bolaky (2008) have shown that bad institutional quality and regulation, such as market entry and labor market regulations, have a negative moderating effect on the positive influence of trade on growth and income. Higher quality of institutions is also hypothesized to foster international trade (Francois and Manchin 2013).

This paper focuses on institutions' regulatory aspects and analyzes the trade effects of PMR using more accurate value-added data. We use an indicator set of the OECD, which is described in detail in subsection 2.4. We focus on PMR that directly interferes with market competition. However, the quality and effectiveness of different regulations can be analyzed and assessed from various viewpoints (e.g., their stated public policy goal). For instance, the variables applied for PMR in this paper do not imply environmental regulation, although several studies have provided evidence for the Porter hypothesis (see below, Porter 1991), according to

which environmental regulations have a positive effect on innovation and also positive trade effects (see, e.g., Ambec et al. 2013).

The quality of PMR has a significant impact on competition. There has been a consensus in economic policy that less strict PMR induces competition (Amable et al. 2016). PMR has both an internal scope and an external scope. On the one hand, domestic PMR in a country affects the firms, sectors, or the entire economy within the economic system and their exporting activities. On the other hand, PMR also influences international trade and affects actors from foreign markets who must comply with the regulatory framework as they seek to export to the domestic market.

Studies have found that intense product market competition increases innovative activity (see, e.g., Blundell et al. 1999) and economic growth (Aghion et al. 1997). Policies such as removing entry barriers, opening up trade, and emphasizing research education are considered catalysts for growth (Aghion et al. 2014). Besides this, evidence suggests that increasing the number of competitors leads to higher factor productivity (see, e.g., Nickell 1996). Poorly designed PMR that decreases product market competition inhibits innovation and, thus, economic growth. Under the assumption of innovation as an exogenous force driving international trade (Dollar 1986; Krugman 1979), PMR then harms trade.

Additional PMR is not necessarily trade-hampering if it leads to harmonizing regulatory frameworks between trading partners, decreasing information asymmetries. Regulatory heterogeneity causes additional transaction costs in international trade (Faubert and Janzwood 2016; WTO 2018). Mainly, trade in services is negatively influenced by differing regulations because professionals (e.g., lawyers, accountants) have to deal with different regulatory systems regarding requirements such as licenses and permits.

We conclude from the review that restrictive and flawed PMR can reduce competition, leading to reduced innovative activity, less productivity, and potentially less trade. Particularly policymakers in the EU have pursued less stringent PMR policies in the previous years to promote growth (Amable et al. 2016). We now turn to a brief introduction of the PMR indicator that we are using in this study to measure the trade effects of regulation.

2.4 Measuring product market regulation: the OECD's PMR indicator

The OECD provides a comprehensive dataset of indicators that measures the intensity of product market regulation in all OECD countries and a few emerging countries, such as the BRICS. The OECD compiles a database based on questionnaires with over 1400 standardized questions on economy-wide and industry-specific regulatory provisions distributed among the different governments (Vitale et al. 2020).

Based on the data, the OECD is aggregating an economy-wide indicator of PMR, which is a composite of several sub-indicators and measures the quality of regulation in an economy. The tree structure of the indicator set is depicted in Fig. 2. In the hypotheses of this study, we focus on the aggregate PMR indicator (economy-wide PMR indicator) and the first levels of sub-indicators to differentiate the trade effects

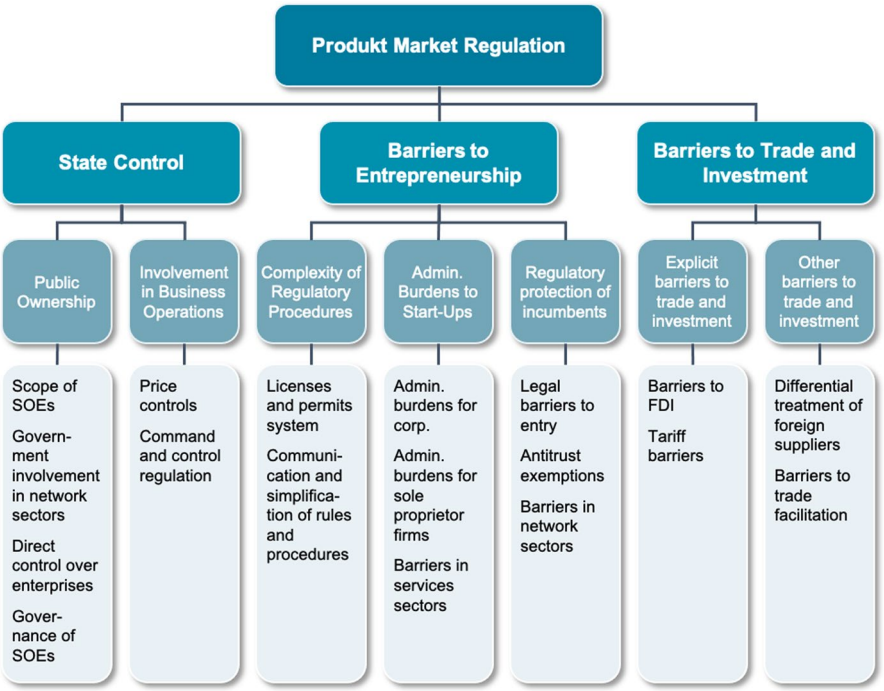

Fig. 2 Tree structure of the OECD Product Market Regulation Indicator dataset adapted from Koske (2015)

of various types of PMR. The first level of sub-indicators consists of three pillars: S*tate control*, *Barriers to entrepreneurship*, and *Barriers to trade and investment*.

The first pillar, *State control*, measures the government's actual involvement in the market through state-owned enterprises and direct supervision of companies and natural monopolies. State control can be essential in addressing market failures, for example, mitigating externalities, providing public goods, or preventing monopolistic power abuse (Stiglitz 2008). In addition, state control can serve specific policy objectives or the public interest, for example, price controls to regulate behavior in markets (den Hertog 1999). However, it can also cause market distortion and inefficiency by interfering with the resource allocation of markets.

The second pillar, *Barriers to entrepreneurship,* measures the complexity of regulatory procedures (e.g., the license and permit system), administrative burdens to entrepreneurs (e.g., bureaucratic costs), and the regulatory protection of incumbent market actors (e.g., market entry barriers or antitrust exemptions). These regulatory measures have the objective of reducing information asymmetries and ensuring a certain quality of products and services (Svorny 1999).

The third pillar of the PMR indicator consists of *Barriers to trade and investments.* The regulatory measures under this pillar directly relate to trade in GVC. Tariffs and barriers to trade directly impact the flow and price of goods and services and can be summarized as 'at-the-border' regulations. Other non-tariff measures with

direct relationships to trade are the differential treatment of foreign suppliers or barriers to trade facilitation, including standards. However, a review of the empirical literature shows no clear evidence of the trade effects of standards, and the effects depend on the interaction with other economic factors (Swann 2010). Policymakers determine tariffs to generate revenue or protect domestic industries against foreign competitors when they are newly established and evolving (Black 1959). The concept of import substitution for infant industries as an economic policy approach for developing countries originated from Prebisch (1950). Since then, it has been echoed in several studies by development economists, and policymakers have set tariffs as a tool for import substitution to protect domestic production against price dumping from international competitors. In addition, to maintain jobs, these trade barriers might even be used to protect older domestic industries that are not as efficient as the global competition (Black 1959).

In this study, we investigate the three upper levels of PMR and its influence on trade in GVC, differentiating between the OECD countries and the emerging BRICS countries. The following sub-chapter discusses the related works and empirical evidence from previous studies.

2.5 Related works

Empirical evidence on the macroeconomic effects of regulation is diverse. In some studies, evidence suggests that regulation fosters international trade through competition, productivity, and innovation, whereas other studies suggest negative effects on overall economic performance. A great share of macroeconomic empirical research focuses on PMR's effects on innovation, total factor productivity, and the ability to participate in international markets. Only a few studies examine the direct relationship between PMR and trade flows in GVC: For example, Marel (2015) conducted an empirical study on 58 countries where they found a negative effect of PMR on the participation in GVC (backward and forward linkages).

The relationship between PMR and innovation has been investigated in various empirical studies. Crafts (2006) analyzed the regulation of product markets in OECD countries. They found evidence that regulation, particularly if it hampers market entry, has a strong negative effect on productivity by decreasing incentives to invest and innovate. This negative impact is not linear: If countries with a restrictive level of regulation (e.g., BRICS countries) conduct regulatory reforms, it has a more substantial effect than those with a lower level of regulation (Crafts 2006). Bassanini and Ernst Field (2002) found a negative influence of PMR on innovation in another study with data from OECD countries. Barbosa and Faria (2011) reached a similar conclusion in their analysis of innovation and PMR in EU countries. In contrast, Amable et al.'s (2016) study on innovation and productivity growth in the manufacturing sector of 17 OECD countries between 1977 and 2005 did not find evidence for a negative relationship between PMR and innovation. Instead, the authors found a positive influence of PMR on innovation and, a particularly interesting result, no innovation-spawning effect of liberalization policies (Amable et al. 2016).

Turning more to the direct relationship between regulation and productivity and, thus, trade, Griffith and Harrison (2004) examined the effect of product market regulation in EU countries in the 1980s and 1990s. Their results highlighted that reducing tariffs, price controls, and easing market entry through PMR reform positively affect total factor productivity (Griffith and Harrison 2004). In addition to that, Bourlès et al. (2013) presented evidence that anticompetitive regulation that constrains business operations and market entry decreases productivity growth. Even if the regulation is sector-specific, their results show indirect negative effects on the entire economy through input–output linkages. Besides, this effect is even more substantial when the observations are closer to the technology frontier (Bourlès et al. 2013) in line with theoretical models from Acemoglu et al. (2003), among others. Furthermore, Bouis et al. (2016) investigated the role of the OECD PMR indicator for productivity in five different sectors. Their results indicate that particularly reductions in barriers to entering markets increase productivity, and this increase shows up with a time lag of five years (Bouis et al. 2016).

Another strand of empirical literature focuses on the effect of PMR on economic growth and suggests a negative relationship between the two. Multiple studies found a negative impact of regulation on economic performance. Koedijk and Kremers (1996) analyzed the role of PMR for economic growth in eleven EU countries and provided evidence for a clear negative relationship between regulation and economic performance (Koedijk and Kremers 1996). Similarly, Nicoletti and Scarpetta (2003) analyzed data from specific sectors in 18 OECD countries. They concluded that regulatory reforms and deregulation that promote private governance and competition drive productivity and growth. Additionally, Wölfl et al. (2010) used the PMR indicator from the OECD to estimate the effect of regulation on growth. They found that an improvement in the PMR sub-indicator barriers to entrepreneurship by 0.5 index points would translate into 0.4% higher GDP growth. However, in low-income countries, this effect is inhibited by other structural weaknesses, such as trade barriers (Wölfl et al. 2010). This is in line with the findings of the descriptive analysis of this relationship by Scarpetta and Nicoletti (2005).

Another well-researched area in the empirics of regulation focuses on the trade effects of non-tariff regulation in the agricultural, food, and manufacturing sector. These regulations and standards are considered technical barriers to trade (TBT). The WTO explicitly allows member countries sovereignty regarding achieving their public policy goals (Ghodsi 2018). Overall, empirical studies concerning the trade effects of TBT have produced mixed evidence (Bao and Qiu 2012; Disdier et al. 2008; Ehrich and Mangelsdorf 2018; see, e.g., Essaji 2008; Li and Beghin 2012). This is mainly caused by the variation of data samples, different methods, proxies, focal industries, and aggregation levels (Li and Beghin 2012).

We conclude from the review that there is considerable evidence from the empirical literature on the relationship suggesting a negative but non-linear impact of PMR on economic performance. In contrast, environmental regulation and specific technical trade barriers can have positive effects, particularly if they harmonize regulatory frameworks. Moreover, empirical studies suggest differences in the economic impact of regulation in high-income and low-income

countries. Only a few studies investigate the direct links between regulation and trade. To our knowledge, no studies analyze the effects of PMR as measured by the indicator dataset of the OECD. In the following, we present the hypotheses that underlie this paper.

2.6 Hypotheses

In this section, we derive our hypotheses based on the theoretical considerations and empirical evidence of the previously presented studies to answer our research questions about the trade effects of regulation in OECD and BRICS countries.

With the first research question, we seek to explore the trade effects of regulation measured by the more accurate trade in value-added figures across a heterogenous sample of OECD and BRICS countries that cover most of the world's trade. We specified the following research question:

> **RQ1** How does different product-market regulation influence trade in Global Value Chains?

No studies to our knowledge analyze different levels of the PMR indicator and its influence on trade data as measured by trade in value-added. Few scholars have investigated the direct relationship between regulation and trade. The literature on the relationship between regulation and economic performance that we analyzed and discussed above is heterogeneous. Still, the overall evidence suggests a negative impact of the economy-wide PMR indicator on trade (e.g., Marel 2015, regarding the participation in GVC). Moreover, we assume that regulation in both countries plays a role in trade, as most of the studies provided evidence for the negative effects of regulation on productivity (e.g., Bourlès et al. 2013) and growth (e.g., Loayza et al. 2005) as well as mixed evidence on innovation (e.g., positive: Amable et al. 2016; negative: Bassanini and Ernst 2002). Therefore, we hypothesize the following:

> **H1** Restrictive product-market regulation measured by the economy-wide PMR indicator in importing and exporting countries has a negative effect on trade in Global Value Chains.

The PMR indicator's composite structure allows a disaggregation to disentangle the trade effects of different regulatory measures, which is also a goal of *RQ1*. Our second hypothesis focuses on the three sub-indicators of PMR from both trading countries. Again, based on previously discussed empirical studies and theoretical arguments, we assume a negative effect of regulation of the type S*tate control* (see, e.g., Griffith and Harrison 2004), *Barriers to entrepreneurship* (see, e.g., Bouis et al. 2016; Bourlès et al. 2013; Wölfl et al. 2010), and *Barriers to trade and investment* (see, e.g., Koedijk and Kremers 1996) on trade in GVC:

> **H2** All three sub-types of PMR, namely State control, Barriers to entrepreneurship, and Barriers to trade and investment, in the importing and exporting country, have a negative effect on trade in GVC

We do not test further sublevels of the PMR indicators with the hypotheses and instead use the third level of PMR indicators only for explorative analysis and

specification for testing *H2*. We do not consider the fourth level of PMR indicators. The results would not be reliable because there is a high risk of bias and statistical overfitting when analyzing 18 sub-indicators for two countries (which would result in 36 variables).

In the second research question, we are interested in whether the trade effects of PMR are different between OECD countries and the emerging BRICS countries. Economic policy in the new economic powers, such as the BRICS countries, differs strongly from the embraced policies of the old economic powers, such as the OECD countries. While the BRICS countries have increasingly been adopting liberal economic policies in recent years, their regulations still follow the state-guided pattern of markets (Stephen and Parízek 2019).

RQ2 Are the trade effects of product market regulation different in emerging countries such as the BRICS than in the OECD countries?

Based on the above considerations, we similarly assume that regulation has a negative trade effect in BRICS. Looking at the PMR indicator database, BRICS countries have the highest PMR values in the sample, indicating restrictive regulatory frameworks. Empirical studies have shown that regulatory reform (i.e., a decrease in PMR) in countries with a high regulation level has a more substantial impact than in other countries (Crafts 2006). Therefore, we expect this effect to be more substantial in those cases. Hence, a decrease in regulatory reform in BRICS countries is hypothesized to have a more positive impact on trade:

H3 PMR in BRICS countries has a more substantial negative effect on trade in GVC than for OECD countries.

The hypotheses were rigorously tested with a large panel dataset in an augmented gravity model. Our methods and data sources are introduced in the next chapter.

3 Methodology

3.1 Baseline model

To analyze the hypotheses, we augmented a standard gravity model introduced by Tinbergen (1962) and linked bilateral TiVA flows to regulation indicators and control variables such as distances, economic masses, trade agreements, and institutional quality. In the last 60 years, the gravity model of international trade has become a standard approach for empirical studies investigating trade flows between countries and the interaction effects with framework conditions such as regulation or other external factors (Shepherd 2016). Thousands of publications and working papers have been published using this model since Tinbergen (1962) introduced its basic specification.

Since Tinbergen's (1962) foundational work, the gravity model has been further developed by different scholars such as Anderson (1979), who explained the multiplicative form of the gravity equation, or Bergstrand (1985), as well as

Deardorff (1998) who modeled transportation costs and showed the robustness of the gravity equation. Anderson and van Wincoop (2003) introduced multilateral resistances terms to account for the trade costs of exporter *i* and importer *j* relative to the trade costs with other countries in the world. Other institutional factors and control variables have been introduced since then, such as the effects of free trade agreements by (Francois and Manchin 2013).

We applied a Pseudo-Maximum Likelihood (PPML) estimation in our model (see Silva and Tenreyro 2006). Silva and Tenreyro (2006) concluded that the former standard approach to estimating gravity models using ordinary least squares (OLS) is biased in the presence of heteroscedasticity. Therefore, they proposed a PPML estimation as introduced by Gourieroux et al. (1984) for gravity models of trade and perform Monte Carlo simulations that provide evidence for PPML as a more robust estimator than OLS for gravity models (see Silva and Tenreyro 2006; 2011). First, the PPML estimator is less biased in the presence of heteroscedasticity. Second, zero trade between countries does not have to be excluded, which would be necessary for OLS with log linearization.

We performed a heteroscedasticity diagnostic test with our sample using the Breusch-Pagan test. The test results provided significant evidence that the null hypothesis of homoscedasticity is rejected; hence, we also assumed heteroscedastic error terms.

We use country-level and time-specific fixed effects separately to account for multilateral resistance terms (MRT) following Anderson and van Wincoop (2003). These resistance terms control for monetary and non-monetary trade costs that directly affect price levels and, accordingly, trade volumes. Usually, MTR can be entirely captured using time-varying country-level fixed effects (Baldwin and Taglioni 2006). However, our primary variable of interest, the indicator for PMR, has a time-specific and country-specific dimension. Therefore, PMR is expected to be significantly correlated with these fixed effects. In order to avoid bias in our model specification, we include these MRT as country-level fixed effects and time-specific fixed effects in addition to other control variables that control for other effects, such as the quality of institutions or cultural proximity. Moreover, we test the robustness by using country-pair and time-fixed effects.

Our baseline estimation model is a standard gravity equation to which we added several control variables. With the baseline model, we tested **H1**. Besides, we sought to explore and disentangle the effects of PMR to understand the trade effects of regulation better. The dependent variable describes the trade in value-added flows from *country i* to *country j* at *time t*.

$$TiVA_{ijt} = \beta_0 + \beta_1 ln(GDP)_{it} + \beta_2 ln(GDP)_{jt} + \beta_3 \ln(dis)_{ij} + \beta_3 contig_{ij} + \beta_4 comlang_{ij} + \beta_5 PMR_{it} + \beta_6 PMR_{jt} + \beta_7 WGI_{it} + \beta_8 WGI_{jt} + \beta_9 RTA_{ijt} + fe + \varepsilon_{ijt}$$

Model I Augmented gravity model to test for H1

3.2 Data

Our dependent variable, *TiVA,* was retrieved from the trade in value-added database updated by OECD in December 2018 (OECD 2020c) and builds on previously published databases of the OECD (OECD 2016). The 2018 edition provides indicators for 64 economies (OECD 2019). We focused on the 35 OECD countries and the five emerging BRICS countries, and the *TiVA* data is complete for the last 20 years. The OECD calculates the *TiVA* data from input–output tables for each country (De Backer and Miroudot 2013). It measures the domestic value-added embodied in foreign final domestic demand, i.e., it can be regarded as exports of value-added. The trade is reported as bilateral value-added trade volumes between the trading partners. Therefore, the strictly bilateral nature of the data allows us to utilize an augmented gravity trade model. Although there are other databases, such as the World Input–Output Database (WIOD) funded by the European Commission, they are limited in the period they cover.

In addition, we used *gross exports* as a robustness check to address a significant limitation of the baseline specification, using only TiVA data, in which non-GVC trade (or trade in value chains with short length) tends to be overestimated. However, if we had only used gross exports as a measure, the limitation would have had the opposite consequence. Furthermore, we did not include exports sent via third countries that are not in the sample because this would unnecessarily increase complexity.

Our primary variable of interest, *PMR*, was retrieved from the OECD *PMR* database (OECD 2020b) for countries *i* and *j* (see, Koske et al. 2015, for documentation). The economy-wide *PMR* indicator is a composite of three more levels of sub-indicators (see Sect. 2.2). We used the economy-wide indicator to test **H1**. The indicator is split into three sub-indicators on the second level to test **H2**. On the third level, the indicator is further divided into seven sub-indicators. On the fourth level, it is split up into eighteen indicators that we used for additional explorative insight for **H2**. Every five years, the OECD collects the underlying data from a survey with 800 questions regarding different aspects of domestic PMR. The indicator ranges from 0 to 6, with a lower value indicating a more competition-friendly regulatory environment (Koske et al. 2015). We removed all outliers that exceeded the sample mean by more than three times the standard deviation for each variable.

We matched the trade data with PMR data as follows: The PMR indicator is available for the years 1998, 2003, 2008, and 2013 and we assumed a time lag of two years for the effect of PMR on markets and bilateral trade. Hence, the PMR data from 1998 matches the trade data from the year 2000, the PMR data from 2003 matches the trade data from 2005, and so forth. Consequently, our panel is unbalanced, covering bilateral trade of 41 countries and four points in time for each bilateral trade pair between 2000 and 2015.

Using lagged PMR variables controls for the possible endogeneity of trade and regulation. In addition, the use of five-year intervals minimizes the risk of reverse causality as reliably as possible when exogenous instruments to control for it are

unavailable. Nonetheless, we acknowledge the potential presence of endogeneity and carefully interpret the models' results.

In 2018, the OECD updated the TiVA database (OECD 2018). While the 2016 edition of the TiVA database is only available from 1995–2009, the 2018 update covers the period from 2005 and 2016 (see OECD 2020c). Using only the new dataset (2018 edition), we could include another PMR observation for 2015 in the panel. At the same time, we had to omit the first available PMR observations for the year 2000, which is only available in the 2016 edition. We could not merely merge both datasets because the OECD changed the methodology of calculating the TiVA values. While the 2016 edition is based on the 1993 System of National Accounts (SNA) concepts using an industry list based on the ISIC Rev.3 classification, the 2018 version applies 2008 SNA concepts and an industry list based on ISIC Rev.4 and higher coverage of trading countries (see OECD 2018 for a detailed discussion on the database differences). Nevertheless, the authors of the database highlight the similarity of general trends over time in both datasets (OECD 2018). In their comparison of both databases, the OECD (2018) applied backward induction of growth rates (OECD 2018, p. 3). We followed this approach and combined both datasets to maximize our observations. We applied the growth rates of bilateral trade from the 2016 edition backward to the 2018 edition of the database to estimate the relevant observations for the year 2000 for both *TiVA* and *gross exports*.

As independent gravity variables, we used the nominal gross domestic product *GDP*, the geographical distance between the trading partners *dis* and dummies for contiguity and common language for the trading partners, *contig,* and *comlang*. We extracted the variable *dis* and the dummies *contig* and *comlang* from the GeoDist database by Mayer and Zignago (2011). The distance variable is a weighted measure of the countries' geographical distance that considers the urban agglomerations and their share of the total population (Mayer and Zignago 2011). We also performed a robustness check by using country-pair importer-exporter fixed effects. Due to perfect multi-correlation, we reduced the gravity model by excluding the variables for distance, common language, and contiguity in this robustness check.

Furthermore, we included the variable *WGI* as a control variable for governance quality to avoid the absorption of the institutional framework's impact by our PMR variables. We first considered the institutional quality dataset by Kunčič (2014), which offers aggregate indicators that rate the quality of the country's legal, political, and economic institutions. However, this database lacked specific data points, particularly for the most recent years of our analysis. Therefore, we focused on Kaufmann and Kraay (2020)'s Worldwide Governance Indicators (WGI) database that reports aggregated governance indicators from the World Bank in six dimensions of governance for over 200 countries in the period from 1996 to 2018. These six dimensions, namely voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption, are based on a large number of surveys, and each range from −2.5 to 2.5 with a higher value indicating a higher quality in these dimensions. To decrease the

Table 1 Summary of variable sources and expected directions

Variable	Short name	Expectation	Source
Trade in value-added	*TiVA*	/	OECD (2016, 2018, 2020c)
Gross exports	*GrEx*	/	OECD (2016, 2018, 2020c)
Gross domestic product	*GDP*	+	OECD (2020a)
Distance between trade partners	*dis*	–	Mayer and Zignago (2011)
Contiguity of trade partners	*contig*	+	Mayer and Zignago (2011)
Common language	*comlang*	+	Mayer and Zignago (2011)
Product market regulation	*PMR*	/	OECD (2020b)
World governance indicator	*WGI*	+	Kaufmann and Kraay (2020)
Regional trade agreements	*RTA*	+	Bergstrand and Baier (2017), WTO (2020)

risk of multicollinearity, we followed other studies such as Setyastuti et al. (2018) and aggregated these dimensions, calculating a mean which results in one *WGI* variable for each *country i* and *country j* and time observation in our model.

Regional trade agreements (RTA) encourage or obligate their contracting parties to harmonize their trade-related regulation, such as TBTs (Cadot and Gourdon 2015). Therefore, we included RTAs in our model as a variable to control for the harmonization of regulatory frameworks. The variable accounts for any economic integration agreements between the trading partners. We assumed a positive influence of RTAs based on previous empirical studies, such as Carrère (2006) or Franco-Bedoya and Frohm (2020). For modeling the RTA variable, we used the historical database by Bergstrand and Baier (2017) that documented the entry into and exit from economic integration agreements for 200 countries in the period 1960 to 2012. These agreements are ranked differently by the depth of economic integration using a discrete scale from 0 (i.e., no economic integration agreement at all) over 1, little economic integration (i.e., preferential terms and customs concessions) to 6, illustrating the highest degree of economic integration (i.e., an economic union). We then transformed the variable into a dummy, with 1 meaning that there is any sort of economic integration and 0 for no economic integration. This was done because we could not measure the actual distance between two kinds of economic integration agreements. As Bergstrand and Baier's (2017) database was only available until 2012, we manually extended the dataset until 2015 using the database on regional trade agreements by the WTO (World Trade Organization 2020). Our variable covers all instances of economic integration. Controls for the European Union and the Euro Area, e.g., are accounted for by this variable.

Finally, the vector fe_{ijt} contained the country dummies as well as dummies for the year. The last term was the standard error term ε.

In Table 1, we present a summary of all variables, their sources, and the expected direction of influence.

Table 2 Descriptive statistics

Variable	Description	Obs	Mean	SD	Min	Max
TiVA	Trade in value-added (in mil. US$)	6.560	3.946	14.074	0.624	434.929
GrEx	Gross exports (in mil. US$)	6.560	5.111	17.951	0.300	489.185
GDP	Gross domestic prod. (in trill. US$)	6.560	47.34	193.00	0.062	1.564
dis	Distance	6.560	5.908	5.010	160.9	19.539
contig	Contiguity	6.560	0.06	0.24	0	1
comlang	Common language	6.560	0.06	0.28	0	1
PMR	PMR indicator	5.520	1.814	0.524	0.915	3.399
StateControl	State control	5.520	2.498	0.684	1.153	4.423
Entrepreneur	Barriers to entrepreneurship	5.520	2.118	0.589	1.092	4.119
TradeInvest	Barriers to trade and invest	5.560	0.821	0.609	0.118	3.148
WGI	Mean of WGI indicator	6.560	0.996	0.690	−0.856	1.952
RTA	Dummy for trade agreements	6.560	0.674	0.469	0	2
BRICS	Dummy for BRICS countries	6.560	0.122	0.327	0	1

3.3 Modified empirical models

In **H2**, we disentangled the PMR indicator and explicitly tested for the three sub-indicators of the economy-wide PMR, namely *State control, Barriers to entrepreneurship,* and *Barriers to trade and investment*.

For this, we adjusted the baseline gravity model to the following:

$$\begin{aligned} TiVA_{ijt} = {} & \beta_0 + \beta_1 ln(GDP)_{it} + \beta_2 ln(GDP)_{jt} + \beta_3 \ln(dis)_{ij} + \beta_3 contig_{ij} \\ & + \beta_4 comlang_{ij} + \beta_5 StateControl_{it} + \beta_6 StateControl_{jt} \\ & + \beta_7 Entrepreneur_{it} + \beta_8 Entrepreneur_{jt} + \beta_9 TradeInvest_{it} \\ & + \beta_{10} TradeInvest_{jt} + \beta_{11} WGI_{it} + \beta_{12} WGI_{jt} + \beta_{13} RTA_{ijt} + fe + \varepsilon_{ijt} \end{aligned}$$

Model II Augmented gravity model to test H2 and the trade effects of the three PMR sub-indicators.

We were further interested in potential differences in the trade effects of PMR in emerging and developed economies and hypothesized that the negative effects were more substantial for BRICS countries, no matter whether they were importers or exporters. Therefore, we introduced the dummy variable *BRICS* for *country i* and *j* to our model, where the value 1, e.g., for $BRICS_i$, implied that the exporter was one of the five BRICS countries. Further, we added two interaction terms, $BRICS_i$* PMR_i and $BRICS_j$* PMR_j, to account for potentially different trade effects of regulation in the OECD and BRICS countries. Consequently, the third model was further adjusted to:

Table 3 Correlation matrix of the main variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) GDP	1.000										
(2) dis	0.272	1.000									
(3) comlang	0.035	0.064	1.000								
(4) contig	−0.051	−0.424	0.207	1.000							
(5) PMR	0.168	0.077	−0.060	−0.012	1.000						
(6) StateControl	−0.048	−0.044	−0.086	0.024	0.880	1.000					
(7) Entrepreneur	0.163	−0.008	−0.075	−0.014	0.833	0.641	1.000				
(8) TradeInvest	0.361	0.271	0.021	−0.051	0.764	0.466	0.475	1.000			
(9) WGI	−0.292	−0.120	0.063	0.023	−0.807	−0.671	−0.642	−0.697	1.000		
(10) RTA	−0.339	−0.808	−0.152	0.214	−0.071	0.048	0.057	−0.304	0.099	1.000	
(11) BRICS	0.217	0.181	−0.013	−0.024	0.596	0.419	0.386	0.693	−0.574	−0.187	1.000

Table 4 Average PMR index in the observation period

Type of PMR index	OECD and BRICS				BRICS	
	2000	2005	2010	2015	2010	2015
Economy-wide PMR	2.21	1.78	1.77	1.61	2.89	2.59
State control	2.86	2.43	2.47	2.07	3.54	3.33
Barriers to entrepreneurship	2.67	2.12	2.03	1.82	3.00	2.66
Barriers to trade and investment	1.08	0.79	0.80	0.69	2.12	1.77

$$
\begin{aligned}
TiVA_{ijt} = & \beta_0 + \beta_1 ln(GDP)_{it} + \beta_2 ln(GDP)_{jt} + \beta_3 ln(dis)_{ij} + \beta_3 contig_{ij} \\
& + \beta_4 comlang_{ij} + \beta_5 PMR_{it} + \beta_6 PMR_{jt} + \beta_7 WGI_{it} + \beta_8 WGI_{jt} \\
& + \beta_9 RTA_{ijt} + \beta_{10} BRICS_{it} + \beta_{11} BRICS_{jt} + \beta_{12} BRICS_{it} * PMR_{it} \\
& + \beta_{13} BRICS_{jt} * PMR_{jt} + fe + \varepsilon_{ijt}
\end{aligned}
$$

Model III Gravity model differentiating between the trade effects of PMR in OECD and BRICS countries

In Table 2, we present the descriptive statistics of the datasets. Differences in the number of observations resulted from omitting outliers and missing PMR observations for the BRICS countries and some OECD countries (e.g., Lithuania) in 2000 and 2005.

In Table 3 we report the correlations between the main variables of the models. Unsurprisingly, the quality of the institutional framework (*WGI*) is negatively correlated (−0.807) with our main variable of interest, *PMR*. Countries with weaker institutions tend to have lower-quality of regulations and policies. Besides, the dummy variable for BRICS countries (*BRICS*) is positively correlated (0.596) with *PMR*, which is in line with previous studies that BRICS countries tend to have more restrictive regulation (see, e.g., Crafts 2006).

Table 4 shows the development of the average PMR index in the observation period for our panel. We observe a decline of the economy-wide PMR by more than 25% from 2.21 in 2000 to 1.61 in 2015 and a continuous decline in all sub-indicators in the total panel (including the 35 OECD and the BRICS countries), indicating that regulation has become more competition friendly. *Barriers to trade and investment* are the least regulated types of PMR in the sample, with a value of 0.69 in 2015. *Barriers to Entrepreneurship* experienced the largest decline in absolute terms from 2.67 in 2000 to 1.82 in 2015, leading to the interpretation that the countries in the panel have undertaken efforts to reform PMR and strengthen entrepreneurs and start-ups.

In relative terms, we observed the largest decline in *Barriers to trade and investment,* with the PMR value decreasing from 1.08 to 0.69 (i.e., 36.1%) in the observation period. We also see this trend if we mainly focus on the BRICS countries (last two columns), for which we only have PMR data available for the years 2010 and 2015. Here, we see the largest decline in *Barriers to trade and investment* (in absolute and relative terms) from a high level. The WTO accessions of India (1995),

Table 5 Main regression results for the gravity model using the first-level and second-level variable of the PMR indicator

Variables	(1) TiVA	(2) TiVA	(3) TiVA	(4) TiVA	(5) TiVA	(6) Exports	(7) Exports	(8) Exports	(9) Exports	(10) Exports
GDP_i	6.771*** (0.57)	5.519*** (0.93)	4.537*** (0.76)	5.194*** (0.78)	4.268*** (0.62)	6.345*** (0.52)	5.446*** (0.92)	4.610*** (0.79)	4.976*** (0.72)	4.204*** (0.58)
GDP_j	6.969*** (0.57)	4.335*** (0.70)	3.450*** (0.58)	4.068*** (0.58)	3.331*** (0.49)	6.582*** (0.59)	4.366*** (0.79)	3.370*** (0.67)	4.036*** (0.60)	3.269*** (0.51)
distance	−0.629*** (0.04)	−0.621*** (0.04)	−0.620*** (0.04)			−0.753*** (0.04)	−0.744*** (0.05)	−0.743*** (0.05)		
common language	0.170* (0.09)	0.161* (0.09)	0.162* (0.09)			0.192** (0.10)	0.187* (0.10)	0.188* (0.10)		
contiguity	0.278*** (0.08)	0.278*** (0.08)	0.278*** (0.08)			0.315*** (0.08)	0.313*** (0.09)	0.312*** (0.09)		
RTA dummy	0.143** (0.07)	0.165** (0.08)	0.170** (0.08)	0.081 (0.05)	0.109 (0.07)	0.122 (0.08)	0.147* (0.09)	0.154* (0.09)	0.078* (0.04)	0.108* (0.06)
WGI_i	0.222** (0.09)	0.108 (0.09)	0.122 (0.09)	0.138 (0.09)	0.163* (0.09)	0.254** (0.10)	0.164* (0.10)	0.198** (0.09)	0.186** (0.09)	0.233*** (0.08)
WGI_j	0.475*** (0.06)	0.359*** (0.08)	0.465*** (0.08)	0.471*** (0.07)	0.595*** (0.07)	0.458*** (0.07)	0.352*** (0.08)	0.444*** (0.09)	0.486*** (0.06)	0.597*** (0.07)
PMRi		−0.177*** (0.04)		−0.154*** (0.03)			−0.235*** (0.04)		−0.217*** (0.04)	
PMR_j		−0.118* (0.06)		−0.101*** (0.04)			−0.206*** (0.06)		−0.172*** (0.04)	
$StateControl_i$			−0.105*** (0.03)		−0.100*** (0.03)			−0.130*** (0.03)		−0.129*** (0.03)
$StateControl_j$			−0.143*** (0.04)		−0.145*** (0.03)			−0.167*** (0.04)		−0.163*** (0.03)

Table 5 (continued)

Variables	(1) TiVA	(2) TiVA	(3) TiVA	(4) TiVA	(5) TiVA	(6) Exports	(7) Exports	(8) Exports	(9) Exports	(10) Exports
$Entrepreneur_i$			0.072		0.079*			0.047		0.055
			(0.05)		(0.04)			(0.05)		(0.05)
$Entrepreneur_j$			0.175***		0.173***			0.148***		0.145***
			(0.05)		(0.04)			(0.05)		(0.04)
$TradeInvest_i$			−0.197***		−0.174***			−0.181***		−0.160***
			(0.03)		(0.03)			(0.03)		(0.03)
$TradeInvest_j$			−0.109***		−0.067***			−0.157***		−0.100***
			(0.03)		(0.03)			(0.04)		(0.03)
Constant	−6.404***	−0.187	1.836	−10.579***	−4.735***	−4.059***	1.312	3.278*	−13.799***	−5.129***
Fixed effects (FE)	$Country_i$ FE, $Country_j$ FE, Time FE			Country-pair FE, Time FE		$Country_i$ FE, $Country_j$ FE, Time FE			Country-pair FE, Time FE	
Observations	6560	4748	4748	4748	4748	6560	4748	4748	4748	4748
R-squared	0.929	0.932	0.933	0.987	0.989	0.917	0.920	0.920	0.988	0.990

China (2001), and Russia (2012) contributed to at-the-border restrictions being eased (Bureau et al. 2019).

Although, in general, we similarly observe a declining trend of PMR in this period for BRICS countries, the PMR values in the year 2015 for BRICS countries are higher than the values of the total panel 15 years before in 2000. Mainly, *State control* was still high in 2015 and by far higher than in the overall panel. This observation is not surprising as the economic system in countries such as China is much more state-oriented (Stephen and Parízek 2019).

4 Results and discussion

4.1 Hypothesis 1

In Table 5 we present the results for the tests of hypotheses 1 and 2. The first five columns represent the main regressions with *TiVA* as a dependent variable. Columns (6) to (10) are robustness checks with the dependent export variable *exgr.* The regressions consist of the same variables as the previous regressions from columns (1) to (5). Our focus lies on the first five columns.

In the models of the first three columns, we assumed fixed effects for *country i* and *country j* and time-fixed effects for each observation year. Column (1) is our baseline augmented gravity model, including all standard gravity variables and the institutional quality control variable, *WGI.* Column (2) shows the results for the economy-wide *PMR* indicator addressing **H1**. Column (3) depicts the three main pillars (second level) of the PMR indicator: *PMRStateControl*, *PMREntrepreneur,* and *PMRTradeInvest* for **H2**. In columns (4) and (5), we perform additional robustness checks for *TiVA* as a dependent variable using country-pair fixed effects. As these country-pair fixed effects raise multicollinearity issues, the variables *dist*, *contig,* and *comlang* are excluded. Consequently, we regressed the aggregated first-level PMR indicators and the three second-level PMR indicators again. The goodness-of-fit is very good in all model specifications, as indicated by the R-squared ≥ 0.93. This means the variables describe at least 93% of the variance in all model specifications.

All ten model specifications align with the expectations based on theory and empirical research of gravity models (Anderson et al. 1979; Anderson and van Wincoop 2003; Baier and Bergstrand 2007; Bergstrand 1985; Deardorff 1998). Both logged *GDP* variables for *country i* and *country j* have significant and positive effects on trade across all model specifications. As expected, the logged distance *dis* between trading partners has a significant negative influence on trade, while the dummy variables for common language and contiguity positively affect trade in all specifications.

The control variables for the quality of the institutional framework and institutional actors *WGI* are consistently positive for the importing country for both *TiVA* and *exgr* across all specifications. For the exporting country, though, the results of *WGI* are mixed. In the baseline model (column 1) and the robustness check model, including the second-level PMR indicators (column 5) with *TiVA* as a dependent

variable, it is significantly positive. In contrast, no argument can be made in the other three TiVA model specifications because the values are not significant. However, in the case of *exgr*, the models (columns 6–10) provide evidence of significant and positive effects of both *WGI* indicators on trade in line with theory. These differences in the significance levels provide further evidence that working with more accurate TiVA data to measure trade can lead to a different conclusion than working with the traditional measure of gross exports.

As expected, the dummy variable to control for bilateral trade agreements, RTA, is significant and positive in the first three TiVA specifications. This is in line with the assumptions of standard economic theory and recent empirical trade literature that trade agreements significantly affect global trade (e.g., Maluck et al. 2018). In our baseline model, the coefficient for RTA is highly significant, with a value of 0.143. From this, we can infer that the prevalence of a trade agreement increases trade by 15.37% on average.[3] These results are robust with gross export data. However, in our models' robustness checks using country-pair and time-fixed effects, the dummy for *RTA* is not significant. This is not surprising, as the variable's variance is low because most of the OECD countries already had trade agreements before 2000 (e.g., the large share of EU countries within the sample), and these changes are absorbed by the country-pair fixed effects.

We now turn to the results of the economy-wide PMR variable, which is crucial for hypothesis 1. We focus on the model with TiVA as a dependent variable in column 2. The economy-wide *PMR* indicator in both the exporting and importing countries has a significant and negative effect on trade flows measured by *TiVA* (column 2) and *exgr* (column 7). These results are robust when using country-pair and time-fixed effects (columns 4–5 and 9–10). Another finding suggests that the negative impact of *PMR* is always larger in the exporting country. According to the estimations in column 2 with our baseline model, when including country-specific and time-fixed effects, bilateral *TiVA,* on average, decreases by 16.22% if *PMR* increases by one unit in the exporting country. Besides this, it decreases on average by 11.13% if *PMR* in the importing country is one unit higher. These results are highly significant for both importing ($p < 0.1$) and exporting ($p < 0.01$) countries. They are also in line with hypothesis 1 and with the findings by Antràs and Helpman (2004) and Melitz (2003), who argue that the regulation of competition leads to a reduction of productivity and, consequently, a decline in trade as firms cannot enter international markets. Overall, these results follow previous findings reported by Nicoletti and Scarpetta (2003), Bourlès et al. (2013), Marel (2015), or Duval and Furceri (2018). Thus, the regulation of product markets by both trading parties seems to decrease bilateral trade. However, the economy-wide PMR indicator covers a heterogeneous set of regulations, and we, therefore, need to look closely at the sub-indicators in the following subsection.

4.2 Hypothesis 2

For hypothesis 2, we focused on the second level of the PMR indicator, disaggregated into three sub-indicators, *StateControl*, *Entrepreneur,* and *TradeInvest,* to have

[3] $\exp(0.143) - 1)*100\%$

Table 6 Results of PPML with TiVA and gross exports with the third-level PMR indicators as independent variables

Variables	(1)	(2)
	TiVA	Exports
GDP_i	5.682***	5.733***
GDP_j	3.676***	3.761***
distance	−0.623***	−0.745***
common language	0.163*	0.188*
contiguity	0.275***	0.311***
RTA dummy	0.164**	0.146*
WGI_i	0.077	0.132
WGI_j	0.452***	0.402***
PubOwni	−0.033	−0.037
PubOwnj	−0.086***	−0.083***
InvolvedBusinessi	−0.020	−0.048**
InvolvedBusinessj	0.018	−0.020
$ComplexReg_i$	0.053***	0.043**
$ComplexReg_j$	0.085***	0.074***
$AdminBurden_i$	−0.019	−0.022
$AdminBurden_j$	0.026	0.029
$ProtectInc_i$	0.003	−0.012
$ProtectInc_j$	0.040	0.015
$ExplicitBarrier_i$	0.057	0.043
$ExplicitBarrier_j$	0.038	0.016
$OtherBarrier_i$	−0.157***	−0.146***
$OtherBarrier_j$	−0.097***	−0.127***
Constant	−0.327	1.074
Fixed Effects (FE):	$Country_i$ FE, $Country_j$ FE, Time FE	
Observations	4748	4748
R-squared	0.937	0.923

a differentiated perspective on the impact of different types of PMR. The results are depicted in column 3 of Table 5 with country-specific and time-fixed effects.

The coefficient for *StateControl* is negative and significant ($p < 0.01$) for both exporting and importing countries. According to the model, on average, a one-unit increase of the sub-indicator StateControl in the exporting country leads to a 9.97% decrease in trade activity measured with *TiVA*. This result is in line with the textbook economic theory that considers direct government intervention into free markets as detrimental if there are no externalities. *StateControl* includes coercive regulation, political interference in enterprises, and price controls that might distort competition, decrease innovation and productivity, lead to market inefficiencies, and, ultimately, fewer export activities. This result ties in with previous findings by Griffith and Harrison (2004), who similarly found a negative influence of state control, in particular price controls, on total factor productivity.

The effect of *StateControl* is even slightly more negative in importing countries, with a decrease of 13.3% if the indicator increases by one unit. The same arguments as above apply and prevent firms from importing and thus participating in GVC. In addition, politicized import decisions (e.g., driven by political tensions) can create market distortions (domestic business favoritism). Increasing state ownership also raises the risk of discriminatory policies (Davis et al. 2019). These results are robust with gross exports as a dependent variable (column 8) and different fixed effects (columns 5 and 10).

We looked more closely at the negative effect of *StateControl* and performed additional regressions using the more disaggregated third-level variables of the PMR indicator public ownership (*PubOwn*) and involvement in business operations (*InvolvedBusiness*). The results are presented in Table 6. Column 1 shows the results for *TiVA* as the dependent variable. In column 2, we performed a robustness check with gross exports as the dependent variable.

PubOwn is only significant in the importing country and has a negative effect (−0.086) on trade. These results remain robust using gross exports as a dependent variable (column 2). *PubOwn* includes the direct governmental control of companies and the number of state-owned companies in critical network sectors. Direct governmental interference in markets likely results in a preference for domestic sourcing rather than the potentially more efficient import of goods and services for the simple reason that the domestic economy is to be supported and protected, which explains the negative coefficient. For *InvolvedBusiness*, we cannot draw any conclusion because the significance levels are not robust. We next turn to the coefficients of the second-level indicator *Entrepreneur,* which implies barriers to entrepreneurship in the importing and exporting countries (see Table 5). *Entrepreneur* is not significant for the exporting country in our main model. Thus, we cannot draw any conclusions. This is similar in the models using gross exports as the dependent variable (columns 8 and 10), and it is only slightly significant ($p < 0.1$) in the additional robustness check model with TiVA and country-pair fixed effects in column 5.

However, the *Entrepreneur* indicator for importing countries is consistently significant ($p < 0.01$) and positive across all models with TiVA (columns 3 and 5) and also with gross exports as a dependent variable (columns 8 and 10). Looking at the primary model in column 3, the coefficient 0.175 implies that for each increase of the *Entrepreneur* indicator by one unit, trade, as measured by TiVA, grows by 19.12% in the importing country. Consequently, a higher amount of barriers to entrepreneurship in the importing country, on average, leads to higher bilateral trade, according to the model. This unintuitive effect calls for a closer look into the disaggregation of this indicator in Table 6, where the variables for *Entrepreneur* are split up into the complexity of regulatory procedures (*ComplexReg*), administrative burdens on start-ups (*AdminBurden*), and regulatory protection of incumbents (*ProtectInc*). According to the disaggregated regression model (column 1), only the variable *ComplexReg* is significant for both the importing and exporting country, with coefficients that indicate a positive influence on trade. These results are robust if we use gross exports as a dependent variable (column 2). *ComplexReg* comprises the regulation of licenses and permits, communication, and simplification of rules. Licenses and permits can be an effective economic policy tools to avoid market

failure. For example, markets can be distorted by asymmetric information on the quality of goods and services (Akerlof 1970). In these markets, buyers or sellers cannot assess the quality of a business transaction ex-ante or even ex-post. Hence, means of signaling are necessary. Occupational licensing can alleviate moral hazard problems within these markets (Shapiro 1986). According to an empirical study on the US labor market by Klein and Krueger (2010), occupational licensing grew labor costs by 15% in 2006, explaining the rise of volume in bilateral trade if an importer has extensive regulation on licensing and permits. Previous studies have shown the economic benefits of licensing and permits (see, e.g., Kleiner 2017). Our model's evidence on the positive impact of licensing and permits on international trade contributes to a long and controversial debate on these policy measures' effectiveness.

The positive effect is also observed from an exporter's viewpoint, which pinpoints a spillover effect of this kind of regulation from domestic markets to export markets. Also, communication and simplification of rules and procedures give importing and exporting firms high planning reliability, e.g., when governments regularly inform about new laws or lists of laws in current preparation. Moreover, simplifying processes and making these processes more efficient, e.g., using E-Government tools, relieve the companies' administrative burden and reduce the distortive effect of specific regulatory requirements on prices of goods and services to less economic welfare losses. However, for the sub-indicators *AdminBurden,* and *ProtectInc,* no significant trade effect can be observed. We, therefore, cannot assess the influence of administrative burdens on creating a business, or market entry barriers, limiting the number of competitors, and antitrust exemptions on bilateral trade. Nevertheless, previous empirical research has highlighted the detrimental effects of market entry barriers on productivity and participation in international trade (Bouis et al. 2016; Bourlès et al. 2013; Crafts 2006; Griffith and Harrison 2004) and on economic growth (Aghion et al. 2014; Freund and Bolaky 2008).

The third pillar of the aggregated PMR indicator are *Barriers to trade and investment*. Our model shows that a higher amount of *TradeInvest* in the importing and exporting countries impedes international trade measured both with TiVA and gross export data. *Barriers to trade and investment* are the most detrimental type of PMR. The coefficients of *TradeInvest* are the highest of all three sub-indicators, with values of -0.197 for the exporting country and -0.109 for the importing country (see column 4). *Barriers to trade and investment* is the only one of the three sub-indicators that captures the explicit direct effect of PMR on trade relationships between foreign and domestic firms. It encapsulates protective measures such as tariffs, FDI barriers, differential treatment of foreign suppliers, or barriers to trade facilitation that impose additional monetary and non-monetary costs on bilateral trade and restrictions to the flow of goods as services with foreign capital. The empirical evidence of the harmful effects of the importer's *TradeInvest* PMR is in line with international trade theory. Trade barriers reduce not only bilateral trade but also welfare. Deardorff (1996) describes barriers to trade and investment as *beggar-thy-neighbor policies,* leading to a prisoner's dilemma in international trade: Restricting trade by protective measures can lead to retaliation of trading partners who reciprocally raise trade barriers. The consequence might be trade wars in which every country is worse off (Deardorff 1996). A process of *beggar-thy-neighbor policies* has been observed

Table 7 Regression results focusing on regulation in BRICS countries

Variables	(1) TiVA (1. Lvl.)	(2) Gross Ex (1. Lvl.)	(3) TiVA (2. Lvl.)	(4) Gross Ex (2. Lvl.)
GDPi	2.376***	2.379***	2.779***	2.689***
GDPj	2.320***	2.343***	2.835***	2.747***
distance	−0.265**	−0.333**	−0.254**	−0.332***
common language	0.790***	0.833***	0.825***	0.849***
contiguity	1.376***	1.414***	1.330***	1.367***
RTA dummy	−0.526**	−0.421*	−0.479*	−0.376
WGIi	−0.051	−0.076	−0.067	−0.081
WGIj	−0.137	−0.134	−0.169	−0.158
$BRICS_i$	−3.233***	−3.352***	−3.531***	−3.685***
$BRICS_j$	−2.964***	−3.001***	−2.876***	−2.863***
PMR_i	−0.874***	−0.827***		
PMR_j	−1.060***	−0.974***		
$BRICS_i$*PMR_i	1.595***	1.591***		
$BRICS_j$*PMR_j	1.416***	1.390***		
$StateControl_i$			0.131	0.076
$StateControl_j$			0.242	0.166
$Entrepreneur_i$			−0.785***	−0.734***
$Entrepreneur_j$			−1.121***	−0.988***
$TradeInvest_i$			−0.518**	−0.400*
$TradeInvest_j$			−0.574***	−0.463**
$BRICS_i$*$StateControl_i$			−0.055	0.030
$BRICS_j$*$StateControl_j$			−0.440	−0.349
$BRICS_i$*$Entrepreneur_i$			0.891***	0.858***
$BRICS_j$*$Entrepreneur_j$			1.182***	1.080***
$BRICS_i$*$TradeInvest_i$			1.327***	1.207***
$BRICS_j$*$TradeInvest_j$			1.161***	1.055***
Fixed effects (FE)	Time FE	Time FE	Time FE	Time FE
Observations	4748	4748	4748	4748
R-squared	0.191	0.226	0.221	0.248

in the recent decade between the US and China. Unfortunately, our data did not yet capture the effects of this trade conflict. In January 2018, the US started a trade war with China by imposing tariffs on solar panels and washing machines as retaliation for China's protectionist, mercantilist economic system (Kwan 2020). In response, China imposed tariffs on US goods. The conflict escalated further, and Chinese tech companies such as Huawei faced significant barriers to their business in the United States (Kwan 2020). Along with the direct effects of these *beggar-thy-neighbor policies*, economists such as Paul Krugman highlight the problem of 'uncertainty' and found evidence for the inverse impact of tariffs from the trade war on the US economy: The trade deficit has actually widened since the advent of the trade war while

manufacturing production in the United States was shrinking (Krugman 2019) A prolonged trade war can have detrimental effects on both countries' economies and the world economy. In addition, Mao and Görg (2020) have shown negative spillover effects on third countries through links in GVC in their empirical analysis of the trade war between China and the US.

Our model also provides evidence for this retaliation mechanism. *TradeInvest PMR* in the exporting country also has significant negative effects on bilateral trade, even though these policies directly target only imports. However, as explained above, they also affect domestic firms' exports resulting from retaliatory protective measures such as tariffs, quotas, or other market impediments from their exports' destinations.

Countries like the United States under the Trump administration established trade barriers and restricted imports to increase the domestic production of goods and services. They aim to spur domestic growth, as firms have to fill the gap of fewer imports. However, the protectionist country misses out on opportunities to realize economies of scale and scope that are only possible by cooperation with firms in other countries (Krugman 1987). Besides this, when we stick to the example of the US-China trade war, the US cannot benefit from lower labor costs in China (comparative cost advantage). However, in the protectionist setting, the firms' productivity in the exporting country declines, and trade decreases.

To shed more light on the *TradeInvest* variable*s,* we focus on the two sub-pillars, *ExplicitBarrier* and *OtherBarrier,* in Table 6. The model does not reveal significant results for *ExplicitBarrier* (including tariffs and barriers to FDIs). However, the second pillar of barriers to trade and investment, *OtherBarrier* (including barriers to trade facilitation and differential treatment of foreign suppliers,) proves to be significant and negative for both importer and exporter, which follows the well-known theoretical arguments of trade economists such as Baldwin (1970) and is in line with empirical research in recent years (e.g., Fontagné, Mimouni, and Pasteels 2005; Disdier et al. 2008; Ardakani et al. 2009). However, as noted earlier, regulations such as non-tariff barriers to trade (e.g., environmental standards) can be essential to ensure domestic policy objectives as defined by the legitimated policymakers are met (Hillman 1991).

4.3 Hypothesis 3

We now turn to the third hypothesis to test whether PMR has a more negative effect in BRICS countries. Thus, reducing PMR might increase trade in GVC more than in OECD countries. The gravity model has been further extended by two dummy variables, $BRICS_i$ and $BRICS_j$ ($BRICS_{ij}$ hereafter), that carry the information whether the exporting *country i* or importing *country j* is either Brazil, Russia, India, China, or South Africa and two interaction terms of $BRICS_{ij}$ and PMR_{ij}. Our findings from model 3 are presented in Table 7. In this model, we only included time-fixed effects because country-fixed effects would be a nearly perfect predictor of the $BRICS_{ij}$ dummy variables, leading to a significant bias in our results. Therefore, the goodness-of-fit with an R-squared of 0.19 indicates that the third model explains less data

variance than in the previous models.[4] Due to this different specification, the coefficients are not comparable with the previous models.

First, we look at the gravity model variables, which are significant and fit our expectations for the importing and exporting country. However, the control dummy for regional trade agreements shows counterintuitive results and is negative while being significant in our specification. We attribute this effect to the negative correlation of $BRICS_{ij}$ and the *RTA dummy,* which stems from the fact that BRICS countries tend to have significantly less trade agreements than the OECD countries (see e.g., WTO 2018). Besides, we speculate that the *RTA dummy* might absorb some of the multilateral resistance terms information on monetary and non-monetary trade.

Turning to the variables of interest, the $BRICS_{ij}$ dummies for both exporting and importing country, we observe them to be significant and strongly negative, with a value of −3.233 for exporters and −2.964 for importers. At this stage of understanding, we assume that the dummy variables for BRICS countries also capture the effects of institutions (WGI_{ij}) on trade. These variables were not found to be significant in model 3. We assume this is a consequence of the extremely low *WGI* values of BRICS countries. Compared to the OECD countries, BRICS countries rank very low in institutional quality. The high negative correlation (−0.66) between the BRICS variables and institutional quality supports the notion that the $BRICS_{ij}$ variable absorbs the effects of the WGI_{ij} variable.

Furthermore, the negative betas for the BRICS dummies indicate that ceteris paribus, a country's exports as measured by TiVA, is 96.06% less if the BRICS country is the exporter. These results have to be interpreted cautiously since the role of BRICS countries in global trade has significantly changed during this study's observation period. According to our data, the share of the value-added exports of BRICS countries in total global trade between OECD and BRICS countries has increased from 8.35% in 2000 to 22.25% in 2015, underlying the emerging nature of this country cluster.

We now turn to the main variables of interest, the *PMR* indicator, and the interaction term between the *PMR* and *BRICS* variables for countries *i* and *j*. In summary, the model is consistent with previous results from the other models: Both PMR values for importers (−0.874) and exporters (−1.060) are significant and negative.

However, if we turn to the interaction terms of $BRICS_{ij}$ and PMR_{ij}, we observe a significant and positive value for the exporter (1.595) and the importer (1.416). This is an essential finding in understanding the different roles of PMR in developed and emerging countries. Moreover, these positive effects of the economy-wide PMR in BRICS countries are larger than the negative effects of PMR for the entire sample,

[4] With the introduction of the country-level dummy variables *BRICSij* and the exclusion of country-level fixed effects, a potential trade-off between multicollinearity and omitted variable bias occurred. Based on specific measures on these issues (e.g., an F-test), we have concluded that the potential bias of omitted variable bias is less serious than the potential bias of multicollinearity. With more data on PMR available in the near future, the risk of omitted variable bias can be decrease by introducing more country-cluster variables (such as the dummy variables *BRICSij)* to account for the omitted country-level fixed effects. Since we still included time-fixed effects and the two BRICS dummies as well as the interaction term to account for a fixed effect of BRICS countries and non-BRICS countries (in addition to the time-fixed effects to control for effects attributed to the specific years of the observations), we account for unobserved effects to a certain degree in model three.

including OECD and BRICS countries. Consequently, our model provides evidence that PMR has an overall positive impact on trade measured with TiVA in the BRICS countries. These results are robust when using gross exports as a dependent variable.

Overall, the findings suggest that the regulation of competition in emerging countries has different effects on trade and economic performance. The economic policy of BRICS countries is shaped by more state-oriented capitalism, including more restrictive at-the-border regulations (e.g., tariffs) and behind-the-border trade restrictions (Stephen and Parízek 2019). The economy-wide PMR indicator is at a high level across all BRICS countries. Nonetheless, economic profiles and regulatory frameworks in BRICS countries are very heterogeneous, and BRICS countries are far from being a unified, homogenous block.

As previously shown, all BRICS countries were ranked as the top six countries having the highest PMR values, along with the OECD country Turkey in the sample. According to the data, India is the most regulated country in the sample by far, with an overall PMR value of 3.09 (the average for 2010 is 1.61). Previous literature supports this notion, and India has retained a very high level of tariffs even compared to other emerging countries, with an average tariff rate of 32.7% in 2000, compared to tariffs in the lower single digits for the US or EU in the same year (Sally 2009). However, other BRICS countries' tariff regimes do not stand much behind, with 16.6% in Brazil, 16.2% in China, 11.1% in Russia, and 6.9% in South Africa, significantly higher than in OECD countries (Sally 2009).

For additional insight into the effects of PMR in BRICS countries, we again disaggregated the economy-wide PMR indicator to the three sub-indicators in columns 3 (TiVA) and 4 (gross exports). The control variables are mostly in line with expectations. Consistent with the previous estimation, the dummy variables $BRICS_{ij}$ are significant and negative.

Barriers to trade and investment appeared to be exceptionally high in BRICS countries. Therefore, we first focus on the role of the *TradeInvest* variable, comprising barriers to trade and investment such as tariffs or FDIs. Once again, we see a significant and negative effect of *TradeInvest* for both exporters and importers in the OECD and BRICS countries. We obtain positive values again when we focus on the interaction term of the *BRICS* and *TradeInvest* variables. For the BRICS exporter, the positive value is suggested to be slightly higher (1.327) than for the importing BRICS country (1.161). This effect is also larger than the single PMR variable *TradeInvest,* which in sum implies a positive impact of barriers to trade and investment on the trade of BRICS countries.

The results of model 3 provide evidence for the positive effects of import substitution for emerging countries. In recent decades, all BRICS countries implemented different policies for import substitution, such as tariffs and export subsidies. The concept of import substitution as an economic policy for developing countries was introduced by Prebisch (1950) in the 1950s. Many development economists have since then embraced protectionist policies that aim to establish domestic capacity and improve the competitiveness of developing countries until they attain a certain level of industrial development (Edwards 1993).

Our results further contribute to the arguments for the potential positive effects of import substitution policies in emerging countries. However, these results have to be

interpreted cautiously, as we only considered the years 2010 and 2015 in this analysis. Within this period, the PMR value for barriers to trade and investment in BRICS countries significantly decreased from 2.12 to 1.77. In 2015, it was still far above the OECD average of 0.54. Further data has to be analyzed to provide more evidence on the potentially positive effects of barriers in trade and investment for the trade of emerging countries such as the BRICS.

Meanwhile, emerging countries will presumably advance to further stages of development ceteris paribus. We, therefore, might also expect a further decline of PMR values in these countries along with rather detrimental effects of PMR on trade, such as we have found for the entire panel of countries (compare model 1).

*StateContr*ol appears to be not significant for both importers and exporters. The same applies to the interaction terms $BRICS_{ij}$*$StateControl_{ij}$. We assume that this effect is absorbed by the variable $BRICS_{ij}$, which is likely to capture the state-oriented capitalism of the countries in the BRICS cluster. The sub-indicator *Entrepreneur* capturing the impact of barriers to entrepreneurship is negative for both importers and exporters from BRICS and OECD countries. In the initial model specification in model 1, only the importer $Entrepreneur_i$ was significant and, in contrast, positive.

Turning to the interaction between *BRICS* and *Entrepreneur*, the results suggest a significant and positive effect that exceeds the negative effects reported for the entire sample. This indicates that a supportive PMR framework, not just the reduction of PMR, enhances exporters' and importers' business activity in the BRICS countries. However, it has to be noted that small and mid-sized enterprises (SMEs) that are mostly affected by barriers to entrepreneurship contribute less to national employment and value-added in the BRICS countries (Marchese and Thompson 2014). Hence, further analysis of BRICS' SMEs and their role in international trade is necessary to assess these counterintuitive results. In addition, indirect effects from FDIs have to be considered, as studies have found that under high barriers to entrepreneurship, such as entry restrictions, FDIs increasingly crowd out domestic investments (Munemo 2014).

5 Conclusion and policy implications

This paper outlined the dynamic development of international trade research and shifting paradigms to the Global Value Chain (GVC) framework. The global economy is increasingly fragmented, and policymakers must account for this dynamically shifting structure by adjusting their regulatory measures. This seems particularly important for emerging countries that seek to upgrade in GVC.

We analyzed the role of Product Market Regulation (PMR) for trade in GVC. Furthermore, we shed light on the different trade effects of regulation in the industrialized OECD countries and the emerging BRICS countries. Based on a comprehensive dataset of PMR indicators and more accurate value-added trade data, we constructed gravity specifications to test three hypotheses.

The analysis leads to the following conclusions and policy implications: We showed that a high degree of PMR in both the importer and exporter countries has

an overall negative effect on international trade. This may be considered a further validation of previously conducted empirical studies. Furthermore, the analysis revealed that PMR's deteriorating effect stems mainly from barriers to trade and investment (e.g., tariffs or other at-the-border trade barriers). These findings have important implications for the globally rising protectionist trends. In recent years, we observed *beggar-thy-neighbor policies* of the United States under the Trump and Biden administration and China, triggering a trade war, which ultimately leads to a prisoner's dilemma in which every party is worse off. However, the sole analysis of trade effects of regulation in BRICS countries leads to an additional insight: Here, our evidence suggests an overall positive impact of PMR on trade. Particularly barriers to trade and investment appear to have positive outcomes for the BRICS. These results provide crucial arguments for a long-lasting debate among development economists, who embrace import substitution as an economic policy tool for upgrading developing economies in GVC (Edwards 1993). These findings also demonstrate the ineffectiveness of the current economic policy in the late 2010 and early 2020s of the US. According to our model's results, the recent tariff hikes by the US to decrease the trade deficit with China (and the retaliation measure from China) is expected to have the opposite effect, and exports from China might actually increase. Future empirical research has to confirm these assumptions with the emergence of new data. Most importantly, the results indicate that regulation has different effects and roles in countries characterized by state-oriented capitalism. Hence, trade organizations and policymakers need to account for and consider these differences. Further research should follow up on these initial results.

Additionally, the data analysis implies that emerging countries such as the BRICS group will benefit from further integration into the global economy through participation in GVC. However, the inclusion of the Russian Federation in this group presents a challenge to this assumption. Since the country's annexation of Crimea in 2014, the subsequent involvement in the conflict in the Easter Ukraine and most importantly, the Russian invasion of Ukraine in 2022, Russia's economic development and trade policy has been heavily impacted by economic sanctions being imposed by Western countries, which likely have significant impact on Russia's trade and investment flows. Furthermore, Russia's economic model is heavily dependent on natural resource exports, particularly oil and gas. This dependence on natural resource exports has led to volatility in the country's economy, with the price of oil and gas having a significant impact on the country's economic performance. In light of these factors, it is questionable whether Russia will be able to advance to further stages of development.Thus, policymakers could reconsider the inclusion of Russia in the BRICS group, given its outlier status and unique set of economic and geopolitical challenges, and potentially diminishing role in GVC. This could potentially lead to the group being reconstituted as BICS or a different acronym altogether.

Last but not least, the disentanglement of the economy-wide PMR indicator led to another insight into the positive trade effects of barriers to entrepreneurship. A closer look into the sub-indicator revealed that this is driven by licensing and permits regulations. In economic literature, the effects of policies such as occupational licensing are still controversial. Our results thus contribute further arguments to that debate.

Naturally, our models and results come with a few limitations. First, we firmly acknowledge that regulation is highly heterogeneous. Hence, the analysis of data and multiple levels of regulation will often produce different results, which also explains the mixed evidence of previous studies on the matter. Second, the PMR indicator used in this study is based on survey data that is only available every five years. Thus, the indicator underlies a response bias, among others. However, national governments and international organizations (e.g., the EU) have extensively used the indicators to support economic policy (Vitale et al. 2020). Third, our results regarding the BRICS countries must be interpreted cautiously. For this country cluster, PMR data has only been collected since 2008. Therefore, the third model has significantly fewer observations for PMR in BRICS countries. Thus, the explanatory power of the variance in the data is significantly smaller in comparison to the other models, which also results in a lower R-squared. Nevertheless, future research will also benefit from a growing PMR database for the BRICS countries and other country clusters to then account for potentially omitted country-level fixed effects.

Besides, further research could examine the different trade effects of regulation in an increasing number of developing economies. Future studies could also consider the position of a country in the Global Value Chain. The theoretical and empirical literature suggests that economic policy and regulation play a crucial role for the position and upgrading in GVC to export products of a higher value-added (Gereffi 1999; Marel 2015). Therefore, it could be hypothesized that there are differences in the trade effects of different types of regulation in countries highly embedded in GVC but which mainly trade intermediate products and services with low value-added, as these goods cross borders more frequently and are subject to more and different regulations (see, e.g., Marel 2015; Timmer et al. 2014). Lastly, having a diverse dataset of industrialized and emerging countries, it might be interesting to analyze the influence of regulatory harmonization in trade in GVC. Particularly concerning further advances in ICTs, the geographical distance between countries might play less of a role in trade, but the distance of regulatory frameworks (or the degree of digitization) might gain importance.

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