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ESTIMATING ASIAN ECONOMIES' MISSING EXPORTS

Federico Ganz, Gonzalo Varela, and Kiyoshi Taniguchi

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ABSTRACT

Integration into global markets serves as a powerful catalyst for economic growth in developing economies, offering the potential to create high paying jobs and foster development. This paper uses the structural gravity model to quantify potential merchandise exports for Asian economies, identify destinations with significant untapped potential, and assess how factors such as cutting the time required to export can improve export performance. Our preliminary findings reveal that Asian economies, on average, have sustained missing exports equivalent to 6% of gross domestic product. While Asian economies perform relatively well internationally, there remains room for improvement to match top global standards.

Keywords: missing exports, gravity model, global financial crisis

JEL codes: F14, M31, M38, O24

I. Introduction

It is well established that integration into global markets is a powerful catalyst for economic growth in developing economies, offering the potential to create high paying jobs and foster development. The link between exports and positive development outcomes is supported by extensive literature. For instance, Wagner (2007) highlights the relationship between exports and productivity, while Aghion et al. (2018) explore the role of exports in driving innovation. Additionally, Munch and Skaksen (2008) demonstrate how export activities can enhance skills and capital premia. Despite this potential, many developing economies struggle to fully exploit their export capacity, often due to market failures or suboptimal policy choices.

A critical question arises: how can we determine an economy's "export potential," and where do the main opportunities lie regarding untapped export destinations? Addressing these questions is essential for guiding effective trade policies and export promotion strategies.¹ The structural gravity model offers a robust framework for this analysis. It is grounded in solid theoretical foundations, accommodates a diverse array of trade models, and demonstrates exceptional predictive power, making it a remarkable tool in empirical international trade analysis (Yotov et al. 2016). By applying this model, we aim to quantify merchandise potential exports for Asian economies, identify destinations with significant untapped potential, and assess how reducing the time required to export can improve export performance.

To facilitate the export potential analysis in Asia, we created economy-specific export potential simulators that allow the user to select from various models to estimate the difference between potential and observed exports ("missing exports"). These tools enable the user to visualize changes in potential and missing exports across time, their evolution by destination, and to assess the economy's performance with respect to a set of comparators.

This paper addresses two key questions regarding the merchandise export dynamics of Asian economies. First, we estimate the potential exports of Asian economies, which are defined as the expected level of exports based on the economy's characteristics. This analysis requires identifying key factors that influence export capacity, including gross domestic product (GDP), geographic variables such as distance to other economies, whether the economy is an island or landlocked, productive factor endowments, and trade policies. This research aims to pinpoint destinations with significant untapped export opportunities by quantifying this potential. This will enable policymakers to tailor their export promotion efforts more effectively, focusing on destinations with the highest growth potential.

The second objective is to estimate the impact of the time to export on international trade. This aspect of the research will measure how improvements in export times—such as reduced bureaucratic delays and streamlined customs processes—can influence export levels. By estimating the magnitude of these improvements in trade costs, the study will provide insights into how easing export procedures can enhance competitiveness and contribute to economic growth.

Our findings reveal that post-global financial crisis (GFC), Asian economies, on average, have sustained missing exports equivalent to 6% of GDP. Moreover, all economies in Central Asia, South Asia, and the Caucasus regions, except Kazakhstan, are underperforming relative to their potential exports. This study also shows that each additional day of export compliance time

¹ Export promotion can have significant returns on investment, as documented by J. Munch and Schaur (2018).

reduces exports by approximately 9% to 18%, underscoring the importance of streamlining export processes. Furthermore, an examination of updated Logistics Performance Index indicators shows that, while Asian economies perform relatively well internationally, there remains room for improvement to match top global standards. These insights provide a clear direction for policymakers to enhance trade logistics and capitalize on export opportunities.

The remainder of the paper is structured as follows: Section II provides a literature review, outlining key findings from previous studies and their methodologies and identifying research gaps that this paper aims to address. Section III presents the methodology, detailing the theoretical foundation of the gravity model and the econometric specifications employed in our analysis. Section IV describes the data and the sources. Section V estimates export potential and missing exports, exploring patterns across Asia and the Pacific, focusing on Central Asia, South Asia, and the Caucasus, culminating in a case study on Pakistan. In Section VI, we estimate the impact of time to export on trade, providing empirical evidence of its significance in influencing trade flows. Finally, Section VII concludes the paper, summarizing the findings.

II. Literature Review

A. Estimation of Potential Exports

Estimating export potential using the predicted trade flows from a gravity model is a widely accepted method in international trade literature. This approach leverages the fundamental principles of the gravity equation, akin to Newton’s law of gravitation, to explain bilateral trade flows based on the economic size and distance between trading partners. Table 1 presents a selection of recent studies that aim to quantify export potential in Asia using a gravity framework and the Poisson Pseudo Maximum Likelihood (PPML) estimation method.

Table 1. Selection of Recent Studies Using a Gravity Model to Estimate Merchandise Export Potential in Asia Using the Poisson Pseudo Maximum Likelihood Method	
Study	Description
Akepanidtaorn et al. (2022)	Estimation of Armenia’s merchandise export potential
Mulabdic and Yasar (2021)	Estimation of Türkiye’s merchandise export potential
Kumar et al. (2021)	Estimation of India’s export potential of climate-smart goods
Dadakas et al. (2020)	Estimation of United Arab Emirates’ merchandise export potential
Irshad et al. (2018)	Estimating Pakistan’s merchandise export potential with the People’s Republic of China

Source: Authors.

All the studies included in Table 1 use the typical gravity covariates as predictors for export potential, such as economy size, distance, language, and contiguity. However, the studies differ with respect to the inclusion of fixed effects. As explained in the methodology section, including importer–year and exporter–year fixed effects is recommended in the literature when the research is aimed at obtaining consistent estimates of the coefficients. However, as pointed out by Mulabdic and Yasar (2021), by definition, the inclusion of both of these fixed effects results in predicted exports equal to the observed exports at the economy level. In other words, no economy would have aggregate missing exports if we included exporter–year fixed effects.

However, this paper argues that including only importer–year fixed effects captures the destination multilateral resistance terms while avoiding the “perfect fit” problem. This adjustment is crucial given the documented shifts in the relationship between GDP growth and merchandise

trade growth following the GFC (Constantinescu et al. 2020). Excluding importer–year fixed effects leads to underestimating missing exports before the GFC and overestimating them post-GFC. Our approach refines the model’s predictive power and aligns it more closely with the evolving dynamics of global trade.

B. Impact of Time to Export on International Trade

Time to export is a critical unilateral and non-discriminatory trade policy variable significantly influencing an economy’s trade performance. Despite its importance, the impact of export times has yet to be sufficiently studied, primarily due to the difficulty in isolating this parameter using solely international trade data in the context of gravity models. This limitation has hindered the comprehensive understanding of how time-related factors affect trade flows, leading to a gap in the literature.

Addressing this challenge, Heid et al. (2021) developed a novel methodology to consistently estimate the effect of time to export on trade flows. Their approach provided insights into the relationship between time delays and export outcomes, demonstrating that reducing export times can enhance trade performance. They applied their method to a dataset of manufacturing trade (domestic and international) for 68 economies for the 2005–2012 period. They estimated that an additional day to comply with export requirements reduced manufacturing exports by 3.5% to 7%.

Building on their foundational work, we applied the same methodology to a novel database (ITPD-E) that includes domestic and international trade for all goods (manufacturing and non-manufacturing) for more than 200 economies. Our analysis included the impact of time to import, providing a more comprehensive understanding of how time-related variables influence trade dynamics across various sectors. By bridging this gap in the literature, we hope to contribute valuable insights that can inform policymakers and practitioners in enhancing trade efficiency.

III. Methodology

A. Theoretical Foundation of the Gravity Model

One of the most attractive features of the structural gravity equation is its generality: a large family of trade models results in the same gravity empirical specification. Eaton and Kortum (2002) and Anderson and Van Wincoop (2003) made a significant contribution in popularizing the structural gravity equation. The former derived the gravity equation from the supply side using a Ricardian framework (comparative advantages). In contrast, the latter derived it from the demand side, with constant elasticity of substitution demand preferences and goods differentiated by region of origin (Armington 1969).

As summarized by Yotov et al. (2016), the structural gravity system can be represented by the following equation system:

Equation 1. Structural gravity equation

$$X_{ij} = \frac{Y_i E_j}{Y} \left[\frac{t_{ij}}{\Pi_i P_j} \right]^{1-\sigma}$$

Equation 2. Outward multilateral resistance (exporter ease of market access)

$$\Pi_i^{1-\sigma} = \sum_j \left[\frac{t_{ij}}{P_j} \right]^{1-\sigma} \frac{E_j}{Y}$$

Equation 3. Inward multilateral resistance (importer ease of market access)

$$P_j^{1-\sigma} = \sum_i \left[\frac{t_{ij}}{\Pi_i} \right]^{1-\sigma} \frac{Y_i}{Y}$$

Where X_{ij} is the trade between economy i and economy j , Y_i is the nominal income in economy i , E_j is economy j 's aggregate expenditure, Y is global nominal income, t_{ij} are the bilateral trade costs between economies i and j , and σ is the Armington elasticity of substitution among different varieties.²

B. Econometric Specification

Assuming Equation 1 holds for every period t when including an error term, we can write:

Equation 4. Econometric specification of the gravity model

$$X_{ij,t} = \frac{Y_{i,t} E_{j,t}}{Y_t} \left[\frac{t_{ij,t}}{\Pi_{i,t} P_{j,t}} \right]^{1-\sigma} \varepsilon_{ij,t}$$

Log-linearizing and applying the exponential function to both sides of Equation 4:

Equation 5. Log-linear econometric specification of the gravity model

$$X_{ij,t} = \exp \left[\ln Y_{i,t} + \ln E_{j,t} - \ln Y_t + \underbrace{(1-\sigma) \ln t_{ij,t}}_{\text{Bilateral costs}} - \underbrace{(1-\sigma) \ln \Pi_{i,t}}_{\text{Multilateral cost } i} - \underbrace{(1-\sigma) \ln P_{j,t}}_{\text{Multilateral cost } j} + \varepsilon_{ij,t} \right]$$

The empirical trade literature usually estimates bilateral trade costs $(1-\sigma) \ln t_{ij,t}$ using a series of observable variables such as distance, contiguity, common colony, common language, regional trade agreements (RTAs), and bilateral tariffs. Estimating multilateral trade costs is more challenging since they are not directly observable. Anderson and Van Wincoop (2003) proposed using remoteness indexes, a function of bilateral distance and economy size.³ Alternatively, Olivero and Yotov (2012) proposed using importer–time and exporter–time fixed effects when working with panel data.⁴

Estimation of Potential Exports

To address our first question, we must obtain a prediction for the international trade flow ($\hat{X}_{ij,t}$), which we call “export potential,” that accounts for costs that are not under the control of the exporting economy i . For example, geographical variables such as distance, being an island, or being landlocked affect an economy's trade but are not subject to its policies. Therefore, it is

² If economy i is equal to economy j , then X_{ij} corresponds to domestic trade. If they are different, X_{ij} corresponds to international trade (export of economy i , import of economy j).

³ This approach has been criticized in the literature. See for example Head and Mayer (2014).

⁴ Appendix B shows the interpretation of coefficients in a gravity model.

sensible to include them as predictors in our regression. It is also reasonable to include variables that affect economy i 's importing counterparts' ease of market access since they also escape the exporter's control.

However, there are other variables whose inclusion is more contentious and depends on what we understand by "potential." For example, there are factor endowment variables with export predictive power, such as the exporter's average education levels and capital intensity, which are, in principle, susceptible to the exporter's policies, although not in the short run. Finally, trade policy variables such as RTAs and the tariff that the importing economy j charges on products coming from economy i are, at least to some extent, influenced by economy i 's trade policies. If we account for these variables, economies with poor trade policy (few RTAs signed and facing high tariffs in their products' destination) would have lower estimated "export potential" because it is underperforming in their trade policy.

Given that researchers might disagree on what variables should and should not be included as predictors, we propose five models that include different export predictive variables. We also iterated on the inclusion of fixed effects—no fixed effects, time fixed effects, and importer–year fixed effects—resulting in a total of 15 models that estimate potential exports.⁵

In the results section of this paper (Section V), we will comment on a particular model that we believe best represents the idea of potential exports. However, we will make available a series of simulators, one for each Asian economy, in which the user can select a preferred method of estimation between the 15 models available.

Equation 6. Export potential model

$$X_{ij,t} = \exp[\alpha \text{GRAV}_{ij} + \beta_1 \ln(\text{GDP})_{i,t} + \beta_2 \ln(\text{GDPpc})_{i,t} + \beta_3 \text{Rem}_{i,t} + \gamma \text{Geo}_i + \delta \text{End}_{i,t} + \beta_4 \text{RTA}_{ij,t} + \beta_5 \ln(1 + \tau)_{ij,t} + \mu_{j,t} + \varepsilon_{ij,t}] \quad \forall i \neq j$$

We implement Equation 6 in a panel setting with international merchandise trade data. Therefore, $X_{ij,t}$ corresponds to the nominal exports of goods from economy i to economy j , GRAV_{ij} is a vector of time-invariant control variables that include standard gravity covariates (distance, contiguity, language, common colony, time difference), $\ln(\text{GDP})_{i,t}$ is the natural logarithm of the exporting economy's GDP, $\ln(\text{GDPpc})_{i,t}$ is the natural logarithm of the exporting economy's per capita GDP, $\text{Rem}_{i,t}$ is a remoteness indicator of exporting economy i , Geo_i is a vector of time-invariant geographical characteristics of economy i (island, landlocked), $\text{End}_{i,t}$ is a vector of the exporting economy i 's factor endowments (capital per worker, arable land per capita, secondary and tertiary enrollment, age dependency ratio, mineral exporter), $\text{RTA}_{ij,t}$ is a dummy variable that indicates the existence of a trade agreement between economy i and economy j , $\ln(1 + \tau)_{ij,t}$ is the natural logarithm of one plus the average applied tariff (in %) by economy j to products from economy i , $\mu_{j,t}$ denotes the set of importer–year fixed effects, and $\varepsilon_{ij,t}$ is the remainder error term.⁶

⁵ When importer–year fixed effects are included, they absorb all economy characteristics, such as the importer's size, its geography, income level, and factor endowments.

⁶ When the model is estimated without importer–year fixed effects, then the same set of variables used for exporters is included for importers.

Equation 7. Estimated potential exports

$$\hat{X}_{ij,t} = \exp[\hat{\alpha}\text{GRAV}_{ij} + \hat{\beta}_1 \ln(\text{GDP})_{i,t} + \hat{\beta}_2 \ln(\text{GDPpc})_{i,t} + \hat{\beta}_3 \text{Rem}_{i,t} + \hat{\gamma}\text{Geo}_i + \hat{\delta}\text{End}_{i,t} + \hat{\beta}_4 \text{RTA}_{ij,t} + \hat{\beta}_5 \ln(1 + \tau)_{ij,t} + \hat{\mu}_{j,t}]$$

To estimate Equation 7, we use the PPML estimator developed by Santos Silva and Tenreyro (2006).⁷ As explained by Yotov et al. (2016), this method avoids the problem presented by the existence of zero trade flows in the data and the loss of information associated with the logarithmic transformation in Equation 5.

Finally, missing exports are defined as the difference between observed and potential exports:

Equation 8. Estimated missing exports

$$X_{ij,t}^{\text{Miss}} = \hat{X}_{ij,t} - X_{ij,t}$$

Impact of Time to Export on Trade

To address the second question proposed in this paper, we must estimate the impact of time to export on trade. The time to export is the time it takes to comply with border and documentary requirements in the exporting economy.⁸

To achieve this while including the importer–year and exporter–year fixed effects that account for the multilateral resistance terms, we apply the identification strategy developed by Heid et al. (2021) to a panel dataset with international and domestic trade. This strategy relies on the fact that while trade policies that affect time to export may be unilateral and non-discriminatory, they apply only to international and not to domestic transactions.

Equation 9. Econometric specification to identify the effects of time to export

$$X_{ij,t} = \exp[\gamma \text{GRAV}_{ij,t} + \beta_1 I_{ij} + \beta_2 \text{RTA}_{ij,t} + \beta_3 \ln(1 + \tau)_{ij,t} + \beta_4 \text{TTE}_{i,t} + \beta_5 \text{TTI}_{i,t} + \eta_{i,t} + \mu_{j,t} + \varepsilon_{ij,t}]$$

We will implement Equation 9 in a panel setting with domestic and international trade data on merchandise. Therefore, $X_{ij,t}$ represents both exports ($i \neq j$) and domestic transactions ($i = j$), I_{ij} is a dummy variable that indicates if the trade is international (value of 1 when $i \neq j$), $\text{RTA}_{ij,t}$ is a dummy variable that indicates the existence of a trade agreement between economy i and economy j , $\ln(1 + \tau)_{ij,t}$ is the natural logarithm of one plus the average applied tariff by economy j to products from economy i , $\text{TTE}_{i,t}$ corresponds to the total time to export (the sum of the time needed to comply with border and documentary requirements when exporting), $\text{TTI}_{i,t}$ corresponds to the total time to import (the sum of the time needed to comply with border and documentary requirements when importing), $\eta_{i,t}$ denotes the set of exporter–year fixed effects, $\mu_{j,t}$ denotes the set of importer–year fixed effects, and $\varepsilon_{ij,t}$ is the remainder error term.

To estimate Equation 9, we will use the PPML estimator developed by Santos Silva and Tenreyro (2006). This allows us to solve the null trade flows challenge discussed in the previous section

⁷ All PPML estimations are executed using the `ppmlhdfc` Stata package by Correia et al. (2020).

⁸ Time to export is a unilateral and non-discriminatory variable, in the sense that if economy reduces its time burden on exports, that impacts trade with all international destinations.

and to deal with the heteroscedasticity of trade data, which makes estimated coefficients biased and inconsistent when estimated using OLS.⁹

Another challenge when estimating Equation 9 is the potential endogeneity of trade policy (RTA and tariffs), given that unobservable trade costs might be correlated with trade policy. Following Agnosteva et al. (2014) and Egger and Nigai (2015), we estimate the model using pair fixed effects instead of the standard gravity covariates.

Equation 10. Econometric specification to identify the effects of time to export with pair fixed effects

$$X_{ij,t} = \exp[\beta_1 RTA_{ij,t} + \beta_2 \ln(1 + \tau)_{ij,t} + \beta_3 TTE_{i,t} + \beta_4 TTI_{j,t} + \eta_{i,t} + \mu_{j,t} + \rho_{ij} + \varepsilon_{ij,t}]$$

Finally, as noted by Treffer (2004) and Cheng and Wall (2005), trade flows' response to trade policy is not instantaneous, and this is particularly problematic when using fixed effects models on data pooled over consecutive years. Following previous studies, we use panel data with intervals instead of data pooled over successive years to overcome this challenge.¹⁰

IV. Data and Sources

A. Potential Exports Estimation Dataset

We construct an unbalanced annual panel dataset for 143 economies covering 1988 to 2022 to estimate export potentials and missing exports.¹¹

International trade flows

- $X_{ij,t}$: international trade flows of merchandise in million current US dollars. Data on international trade flows come from BACI-CEPII for 1995–2022 and the International Trade and Production Database for Estimation (ITPD-E) for 1988–1994.¹²

Gravity covariates

- $\ln(\text{Dis})_{ij,t}$: natural logarithm of the population-weighted distance between i 's and j 's largest cities, in thousand kilometers (km) (harmonic mean).¹³
- Con_{ij} : indicator variable that takes the value of 1 if i and j share a border in 2021 (contiguous).
- Lan_{ij} : indicator variable that takes the value of 1 if i and j share a common language in 2021.
- Col_{ij} : indicator variable that takes the value of 1 if i and j share a common colonizer post-1945.

⁹ See Santos Silva and Tenreyro (2006).

¹⁰ See Treffer (2004), Anderson and Yotov (2016), and Baier and Bergstrand (2007).

¹¹ The sample of economies accounts for 97% of the world's population. Economies were excluded for lack of data or for having populations smaller than one million. The list of included economies and their classification by region and income group is included in Appendix A.

¹² See Gaulier and Zignago (2010) for BACI data. See Borchert et al. (2021) and Borchert et al. (2022) for International Trade and Production Database for Estimation (ITPD-E) data.

¹³ Given that each city's population changes over time, this distance measure is not time-invariant, although annual variations are minor.

The source for all gravity variables is CEPII (Conte et al. 2022).

Size

- $\ln(\text{GDP})_{i,t}$: natural logarithm of economy i 's GDP, in billion current US dollars. Source: World Development Indicators (WDI) (World Bank 2024).

Income per capita

- $\ln(\text{GDPpc})_{i,t}$: natural logarithm of economy i 's GDP per capita, in thousand current US dollars. Source: WDI.

Remoteness

- $\text{Rem}_{i,t}$: economy i 's remoteness index, calculated as the weighted average distance to importers in 1,000km, using the share in world income in year t as weights. Sources: CEPII (distance) and WDI (GDP).

Geography

- Island_i : indicator variable that takes the value of 1 if economy i is an island. Source: ITPD-E.
- Landlocked_i : indicator variable that takes the value of 1 if economy i is landlocked. Source: ITPD-E.

Endowments

- $\text{Land}_{i,t}$: economy i 's arable land per capita, in hectares per person. Source: WDI. Missing values were linearly interpolated when possible.
- $\text{EduSec}_{i,t}$: economy i 's secondary gross school enrollment, in %. Source: WDI. Missing values were linearly interpolated when possible.
- $\text{EduTer}_{i,t}$: economy i 's tertiary gross school enrollment, in %. Source: WDI. Missing values were linearly interpolated when possible.
- $\text{Age}_{i,t}$: economy i 's age dependency ratio, in % of the working age population. Source: WDI.
- $\ln(K/L)_{i,t}$: natural logarithm of economy i 's capital stock per worker, in million 2017 US dollars. Source: PWT (Feenstra et al. 2015). Post-2019 values were imputed using GDP per capita.
- MinRich_i : indicator variable that takes the value of 1 if economy i 's average rents from coal, mineral, gas, and oil during 1970–2021 were larger than 10% of GDP. Source: WDI.

Trade variables

- $\text{RTA}_{ij,t}$: indicator variable that takes the value of 1 if i and j share a trade agreement. Source: Mario Larch's Regional Trade Agreements Database (P. Egger and Larch 2008).
- $\ln(1 + \tau)_{ij,t}$: natural logarithm of one plus the trade-weighted average of effectively applied tariffs by economy j to exports of economy i , in %. Source: WITS–TRAINS database (World Bank 2024b).

B. Impact of Time to Export on Trade International Dataset¹⁴

We construct an unbalanced panel dataset for 143 economies from 2014 to 2019 to estimate export potentials and missing exports. The starting year (2014) corresponds to the first year we have data on time to exports using the Doing Business 2015–2020 methodology (World Bank 2020). The last year (2019) corresponds to the last year we have data for time to export and for domestic trade.¹⁵ Gravity and trade policy variables are the same as those in the potential export estimation. Below, you will find a description of the variables that were not previously described.

Domestic and international trade flows

- $X_{ij,t}$: international and domestic trade flows of merchandise in million current US dollars. Data on international trade flows come from BACI-CEPII. Data for domestic trade flows from ITPD-E.¹⁶
- I_{ij} : indicator variable that takes the value of 1 if $i \neq j$ (international trade).
- $TTE_{i,t}$: total time to export of economy i in days. Corresponds to the sum of border and documentary compliance time. Source: Doing Business Report within WDI.
- $TTI_{j,t}$: total time to import of economy j in days. Corresponds to the sum of border and documentary compliance time. Source: Doing Business Report within WDI.

¹⁴ The World Bank is currently updating its measurements of logistics performance indicators (LPI). Before 2023, the LPI was solely based on survey data collected from logistics professionals who worked outside the economy that is being ranked. Recently, the World Bank has started measuring the speed of trade around the world, using large datasets on movements of containers, air cargo, and parcel shipments via postal services. So far, there are only cross section data for 2022 on these measurements, which is why we rely on the Doing Business indicators instead.

¹⁵ As previously explained, we used intervals (2014, 2017, and 2019) to mitigate the critique associated with the lags of trade policy on trade flows.

¹⁶ See Gaulier and Zignago (2010), Borchert et al. (2021), and Borchert et al. (2022).

C. Descriptive Statistics

Table 2 provides the descriptive statistics for the covariates included in both exercises.

Table 2. Descriptive Statistics					
	N	Mean	Standard Deviation	Min	Max
<i>Gravity covariates</i>					
Ln(distance)	620,671	1.711	0.796	−3.772	2.979
Contiguous	620,178	0.024	0.152	0	1
Common colony	620,178	0.081	0.273	0	1
Common language	620,178	0.122	0.328	0	1
<i>Size</i>					
Ln(GDP)	620,974	3.837	2.104	−2.427	10.16
<i>Income per capita</i>					
Ln(GDP pc)	621,542	1.287	1.617	−3.228	4.689
<i>Remoteness</i>					
Ln(remoteness)	620,428	2.064	0.214	1.636	2.628
<i>Geography</i>					
Island	620,107	0.087	0.282	0	1
Landlocked	620,107	0.214	0.410	0	1
<i>Endowments</i>					
Mineral rich	623,795	0.163	0.369	0	1
Ln(K/L)	623,220	−2.648	1.412	−6.859	0.261
Arable land pc	623,795	0.251	0.259	0.0001	2.195
Secondary enroll.	623,795	74.11	32.93	3.988	199.6
Tertiary enroll.	623,795	32.79	27.59	0	157.1
Age dep. ratio	623,795	62.81	19.16	16.17	116.9
<i>Trade variables</i>					
RTA	623,795	0.211	0.408	0	1
Ln(1+tariffs)	541,885	1.573	1.132	0	6.364
<i>Time to export estimation</i>					
Intl. trade	628,256	0.993	0.084	0	1
Time to export	124,451	4.236	4.989	0	34.54
Time to import	124,451	5.739	7.189	0	55.42

GDP=gross domestic product, K/L=capital stock per worker, Ln=natural logarithm, pc=per capita, RTA=regional trade agreement.

Source: Authors' calculations.

V. Estimating Export Potential and Missing Exports

We estimate Equation 6 using the PPML estimator developed by Santos Silva and Tenreyro (2006). Table 3 provides the estimation output for the model with importer–year fixed effects on a dataset that includes over half a million observations at the dyad–year level.¹⁷

The estimated coefficients align closely with existing literature on international trade. The significant negative relationship between distance and trade is well documented, with coefficients ranging from −0.7 to −0.8; greater distances generally increase transportation costs, reducing trade volumes. Similarly, the positive coefficients for contiguity (0.3 to 0.4) and common colonial ties (0.4 to 0.5) are consistent with prior findings. Geographic proximity enhances trade by

¹⁷ In Appendix C we present the results for the models without importer–year fixed effects.

lowering transportation costs and fostering familiarity, while shared colonial histories can establish robust trade networks.

The strong positive correlation between exporter GDP (0.8 to 0.9) and trade volume is a foundational concept in gravity models. Larger economies typically possess greater production capacities and can exploit economies of scale, resulting in higher exports. Interestingly, the positive effect of remoteness (0.9 to 1.1) on exports may seem counterintuitive. Still, it can be understood in the context of remote economies seeking to boost their export potential through trade partnerships, often due to limited domestic markets.

Additionally, the negative impact of being an island nation (-0.2 to -0.3) supports the literature suggesting that geographic isolation restricts trade opportunities. The positive coefficient associated with natural resources (0.17 to 0.20) indicates that such endowments enhance export potential. In contrast, the positive correlation with secondary education enrollment (0.0032 to 0.0036) underscores the idea that a more educated workforce can improve productivity and competitiveness, thereby boosting exports.

Moreover, the negative relationship between tariffs (-0.19 to -0.24) and export potential aligns with trade theory, which posits that higher tariffs create trade barriers, reducing export volumes. Finally, although the estimated coefficient for RTAs is positive (0.05 to 0.06), it is not statistically significant. This may be because part of the effect of RTAs on trade operates through tariff reductions, which are captured by the tariff coefficient.

Table 3. Models to Estimate Export Potential with Importer–Year Fixed Effects					
Estimated Using the Poisson Pseudo Maximum Likelihood Estimator					
	Model 1	Model 2	Model 3	Model 4	Model 5
<i>Gravity covariates</i>					
Ln(distance)	−0.717*** (0.0317)	−0.784*** (0.0287)	−0.814*** (0.0279)	−0.745*** (0.0345)	−0.803*** (0.0308)
Contiguous	0.374*** (0.0799)	0.411*** (0.0872)	0.338*** (0.0826)	0.370*** (0.0793)	0.401*** (0.0851)
Common colony	0.511*** (0.134)	0.463*** (0.136)	0.454*** (0.139)	0.521*** (0.139)	0.472*** (0.142)
Common language	0.0349 (0.0684)	0.0440 (0.0742)	0.00807 (0.0697)	−0.00386 (0.0684)	0.0204 (0.0745)
<i>Size</i>					
Ln(exporter GDP)	0.871*** (0.0172)	0.849*** (0.0169)	0.856*** (0.0210)	0.862*** (0.0193)	0.854*** (0.0140)
<i>Income per capita</i>					
Ln(exporter GDP pc)	0.0757** (0.0365)	0.106*** (0.0360)	0.0506 (0.0328)	0.0345 (0.0358)	
<i>Remoteness</i>					
Ln(exporter remoteness)	0.952*** (0.142)	1.027*** (0.147)	1.140*** (0.139)	0.900*** (0.134)	0.916*** (0.120)
<i>Geography</i>					
Exporter island	−0.225*** (0.0645)	−0.238*** (0.0643)	−0.324*** (0.0640)		
Exporter landlocked	0.0754 (0.0751)	0.0262 (0.0765)	0.00639 (0.0727)		
<i>Endowments</i>					
Exporter mineral rich	0.170** (0.0694)	0.204*** (0.0713)			
Ln(exporter K/L)	−0.175*** (0.0525)	−0.182*** (0.0515)		−0.0393 (0.0546)	
Exporter arable land pc	−0.325*** (0.0819)	−0.275*** (0.0858)			
Exporter secondary enroll.	0.00364*** (0.00124)	0.00322** (0.00126)			
Exporter tertiary enroll.	0.00144 (0.00113)	0.00147 (0.00120)			
Exporter age dep. ratio	−0.0176*** (0.00240)	−0.0166*** (0.00239)			
<i>Trade variables</i>					
RTA	0.0505 (0.0600)			0.0655 (0.0630)	
Ln(1+tariffs)	−0.238*** (0.0307)			−0.194*** (0.0341)	
Observations	533,815	610,279	610,279	534,361	610,833
Importer–year fixed effects	YES	YES	YES	YES	YES
Pseudo r-squared	0.921	0.920	0.915	0.914	0.913

GDP=gross domestic product, K/L=capital stock per worker, Ln=natural logarithm, pc=per capita, RTA=regional trade agreement.

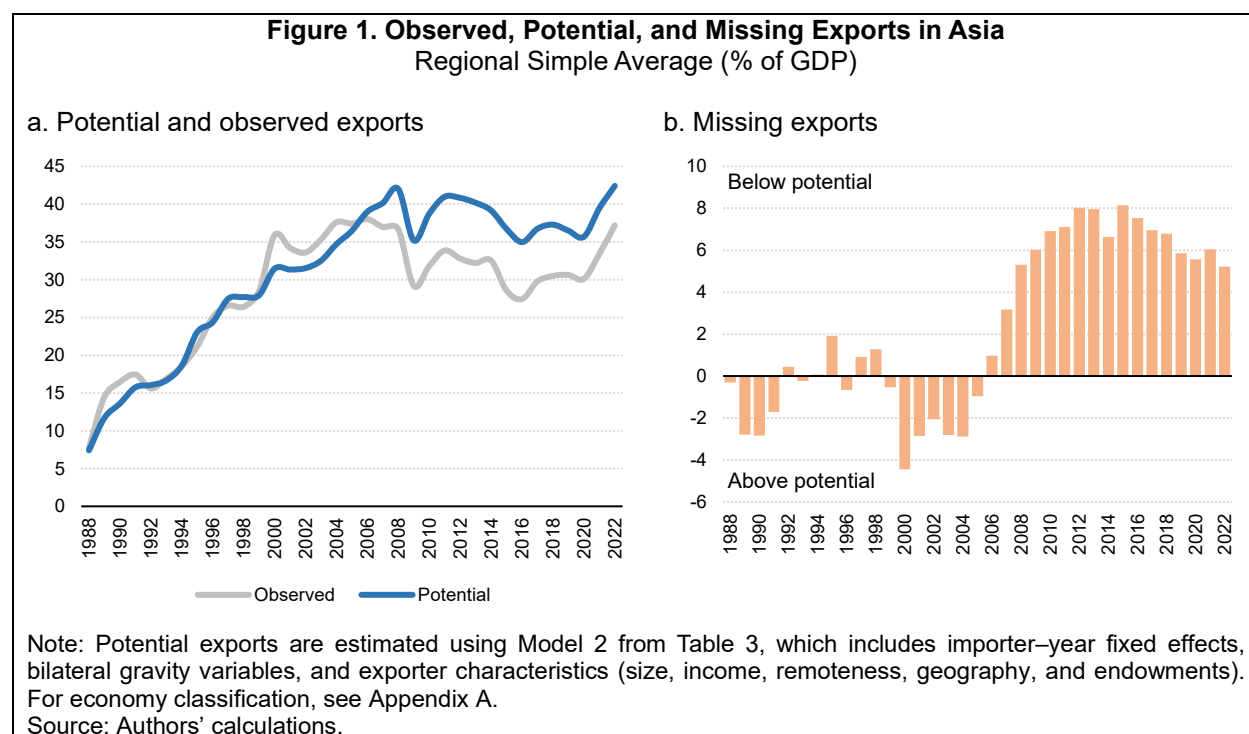
Standard errors are reported in parentheses and are robust to symmetric two-way clustering at the importer–exporter level. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors' calculations.

A. Patterns of Export Potential for Asia and the Pacific by Region

This section presents the results of our potential exports and missing export estimates for Asia and its subregions. Potential exports were estimated using Model 2 from Table 3, which incorporates importer–year fixed effects, bilateral gravity variables, and exporter characteristics such as size, income, remoteness, geography, and factor endowments. Missing exports were calculated as the difference between predicted exports and observed exports (Equation 8).

Potential exports in Asia experienced significant growth, rising from less than 10% of GDP in 1988 to more than 40% by 2007, just before the GFC (Figure 1, Panel a). However, post-GFC, the ratio of potential exports to GDP interrupted its upward trend and fluctuated between 35% and 40%. This change in the trend aligns with broader international trade literature, which often identifies the GFC as a turning point in the relationship between GDP growth and trade growth (Constantinescu et al. 2020). Observed exports tracked potential exports until the GFC, keeping missing exports close to –1% of GDP (small overperformance). However, post-GFC observed exports dropped more than potential exports, opening a gap of approximately 6% of GDP that has remained relatively stable over time (Figure 1, Panel b).



Most Asian regions exhibit a common pattern for potential exports as a share of GDP: an upward trend until the GFC, followed by stagnation (Figure 2). Four regions have underperformed their export potential—Central, South, Caucasus, and West—while two have outperformed it: Southeast and East (Figure 3).

Potential exports rose from 2000 until the GFC in the Central region but then slightly declined. Observed exports have been in a downward trend over the past two decades, resulting in missing exports that shifted from negative (indicating overperformance) to positive (indicating underperformance), currently standing at around 10% of GDP. In the South region, which includes

Pakistan, potential exports increased from approximately 20% of GDP in 2000 to nearly 30% in 2008, then stagnated, oscillating between 25% and 30%. Observed exports, however, showed a downward trajectory, dropping from 17% to 10% of GDP, leading to positive and growing missing exports. The Caucasus region saw potential exports rise from about 40% in 2000 to almost 55% in 2008, followed by a decline that stabilized at around 45%. In contrast, observed exports have fluctuated around 25%, with missing exports peaking in 2012 at approximately 28%, but now closer to historical levels of 15%. The West region experienced potential exports increasing from slightly over 30% to nearly 50%, while observed exports generally oscillated around 30%. Consequently, missing exports increased significantly, reaching 16% in 2022.

The Southeast region displayed a different trajectory, with potential exports showing a slight increase until 2008, from 38% to 48% of GDP, before stagnating at around 45%. Observed exports have consistently been higher, fluctuating between 55% and 65%, which resulted in missing exports oscillating between –25% and –10% of GDP (overperformance). The East region, encompassing major economies like the People’s Republic of China (the PRC) and Japan, initially saw observed exports closely track potential exports until 2013. Post-2013, observed exports seem to have decoupled from potential exports: while the latter decreased slightly, observed exports grew, leading to increasingly negative missing exports (indicating overperformance), currently at around 12% of GDP.

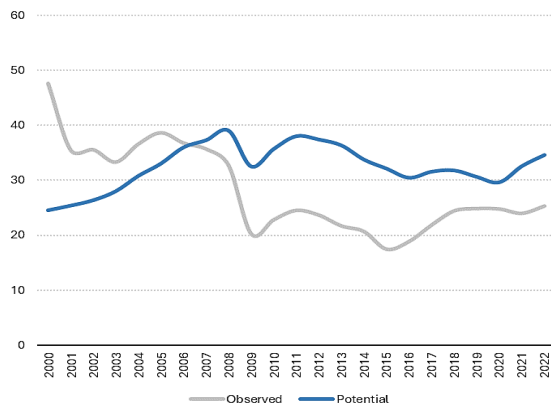
Southeast Asian economies are among the top performers in the world in terms of missing exports as a share of GDP, while some South Asian and Middle Eastern economies are among the worst performers (Figure 4). Cambodia, Malaysia, Singapore, Thailand, and Viet Nam have among the lowest average missing exports in the world, exporting over 20% of GDP above predicted. On the other hand, Nepal, Lebanon, and Armenia are among the worst performers, exporting roughly 30% of GDP below their potential.

Economies like Pakistan do not have significant missing exports compared to their GDP. However, the value of missing exports is large when compared to their current export efforts. For example, for the 2010–2022 period, Pakistan had, on average, 11% of GDP in missing exports. Given Pakistan’s observed exports, if Pakistan matched its potential, exports would more than double (Figure 5).

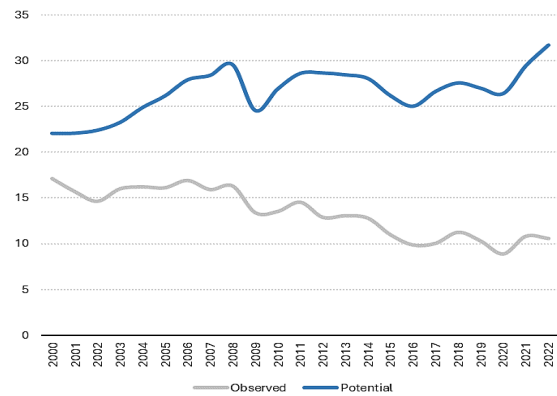
Three economies stand out in terms of improvement in missing exports since 2010: Cambodia, Mongolia, and Viet Nam (Figure 6). Mongolia’s performance is particularly impressive: based on massive exports to the PRC (destination for approximately three-quarters of all Mongolian exports), it managed to cut missing exports from 15% of GDP in 2010 to –30% in 2022 (45 percentage points). Armenia and Myanmar have also cut missing exports, although they are still underperforming by nearly 20% of GDP. Finally, Nepal and Lebanon are among the worst performers, with high and growing missing exports.

Figure 2. Potential and Observed Exports by Asian Region
Regional Simple Average (% of GDP)

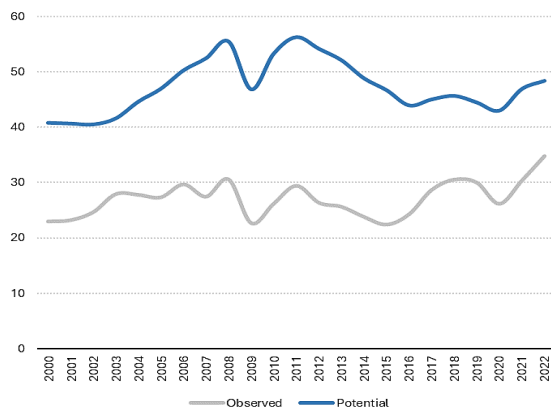
a. Central



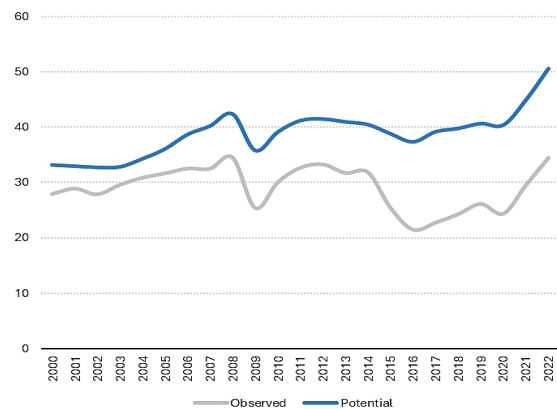
b. South



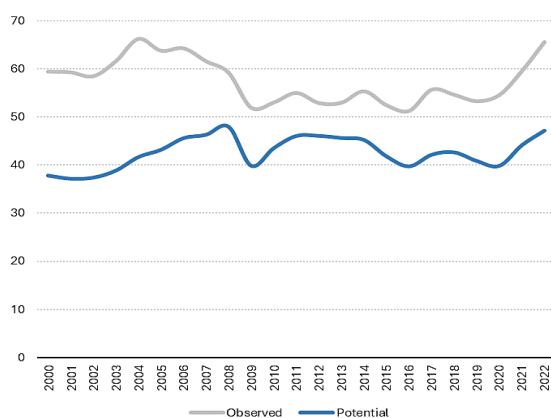
c. Caucasus



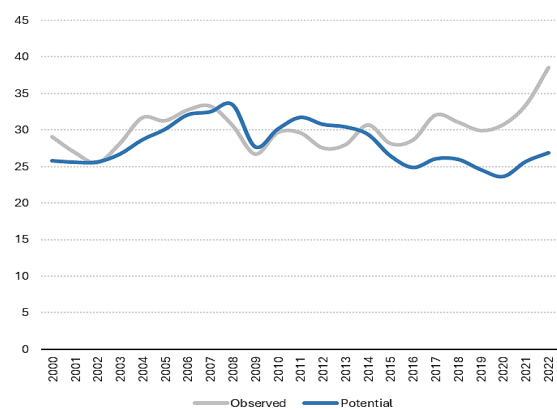
d. West



e. Southeast



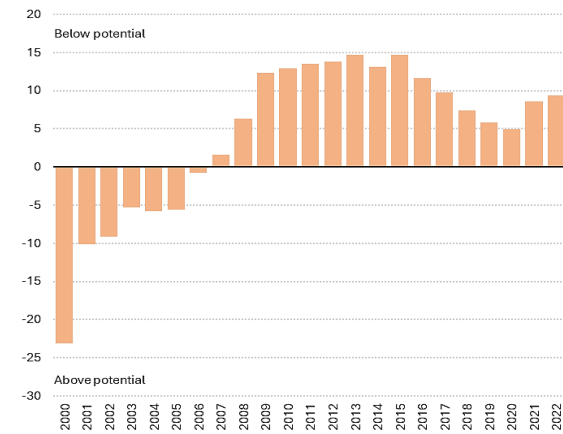
f. East



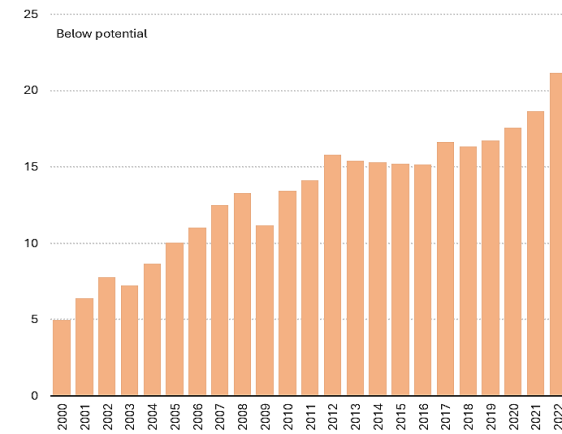
Note: Potential exports are estimated using Model 2 from Table 3, which includes importer–year fixed effects, bilateral gravity variables, and exporter characteristics (size, income, remoteness, geography, and endowments). For economy classification, see Appendix A.
Source: Authors' calculations.

Figure 3. Missing Exports by Asian Region
Regional Simple Average (% of GDP)

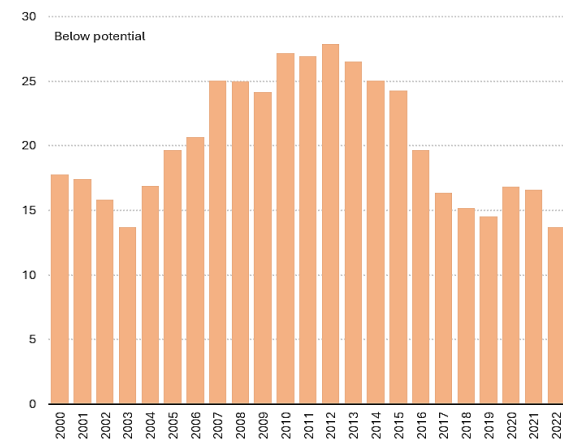
a. Central



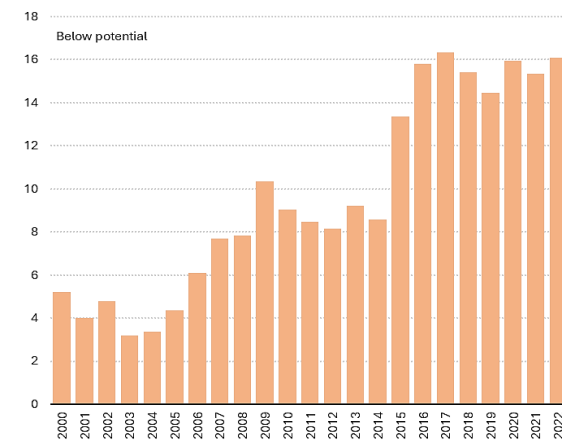
b. South



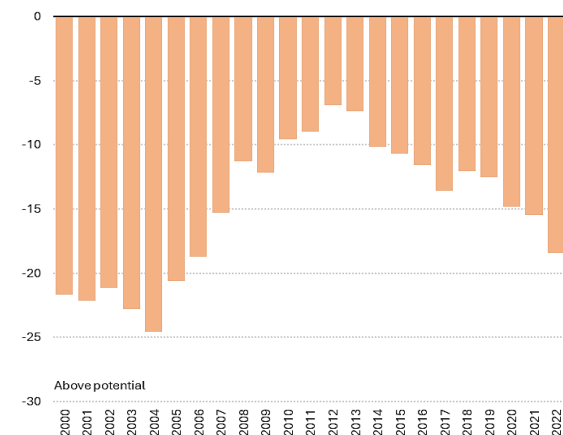
c. Caucasus



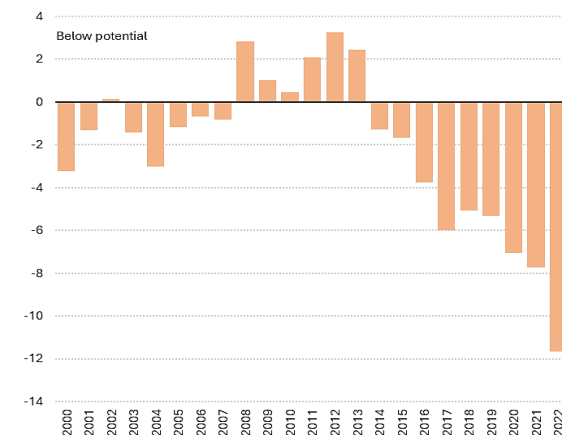
d. West



e. Southeast



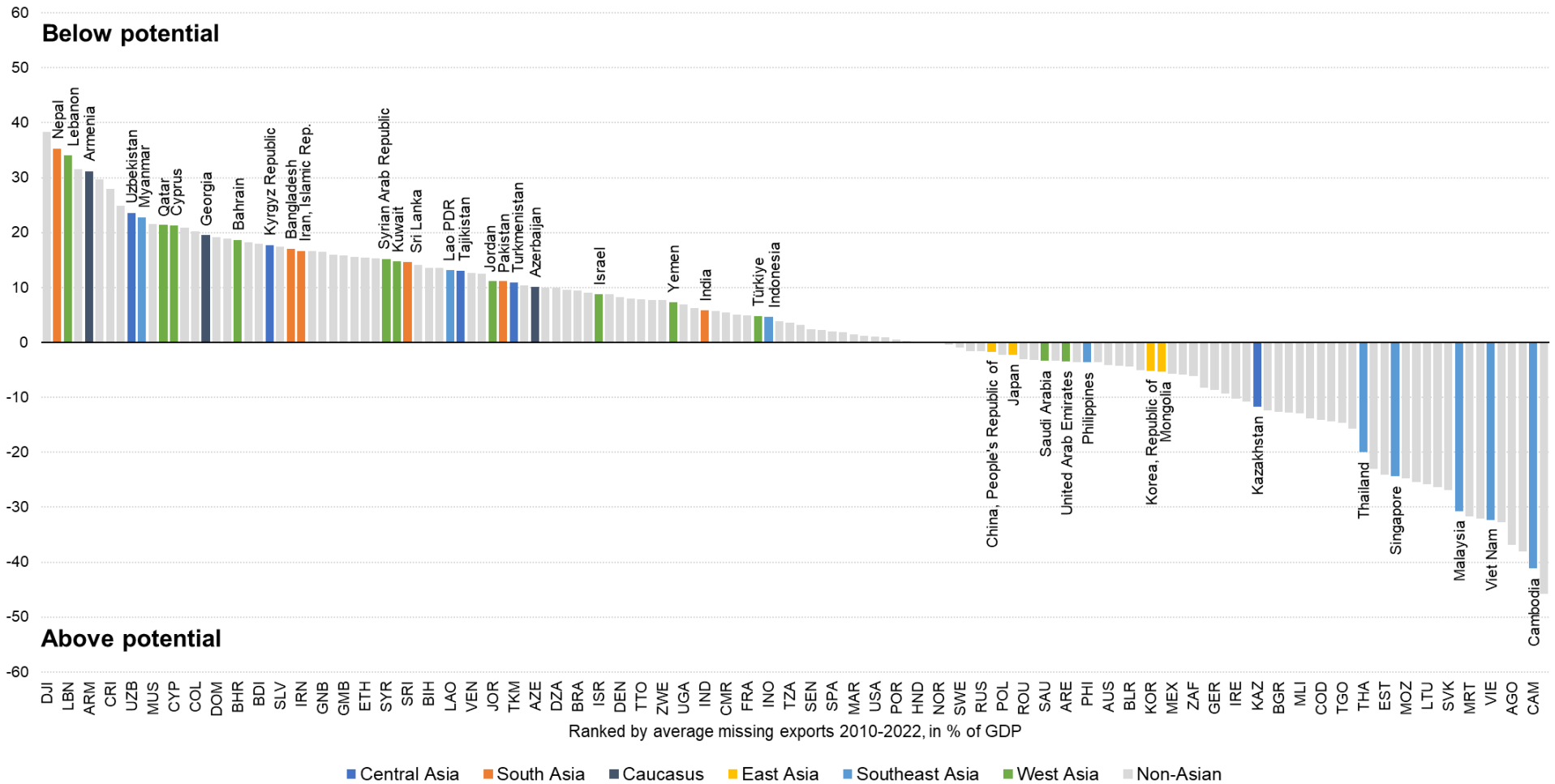
f. East



Note: Potential exports are estimated using Model 2 from Table 3, which includes importer–year fixed effects, bilateral gravity variables, and exporter characteristics (size, income, remoteness, geography, and endowments). For economy classification, see Appendix A.

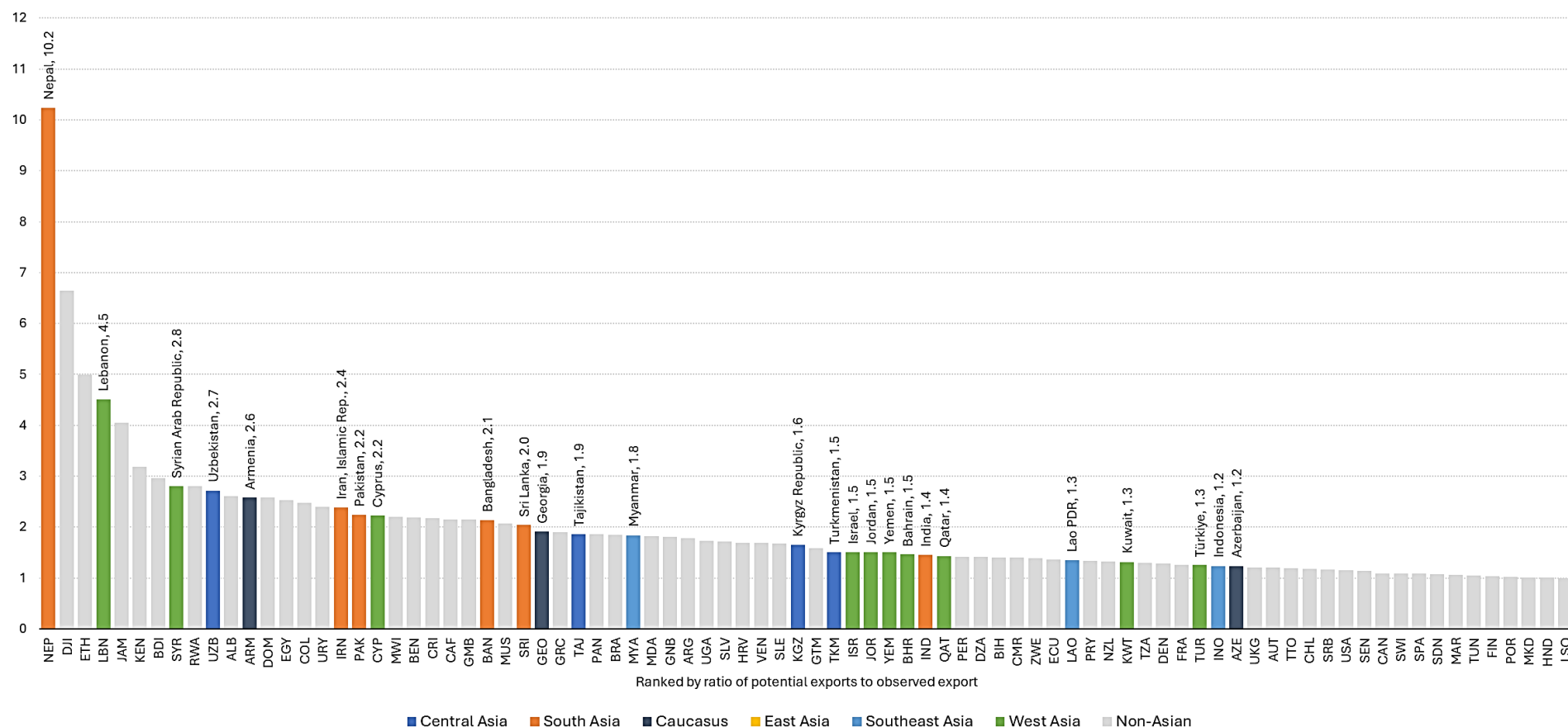
Source: Authors' calculations.

Figure 4. Missing Exports by Economy
Average 2010–2022 (% of GDP)



Note: Potential exports are estimated using Model 2 from Table 3, which includes importer–year fixed effects, bilateral gravity variables, and exporter characteristics (size, income, remoteness, geography, and endowments). For economy classification, see Appendix A. Due to limited space, some economy codes corresponding to each bar are not displayed. Source: Authors' calculations.

Figure 5. Ratio of Potential Exports to Observed Exports by Economy
Economies with Positive Missing Exports on Average During 2010–2022

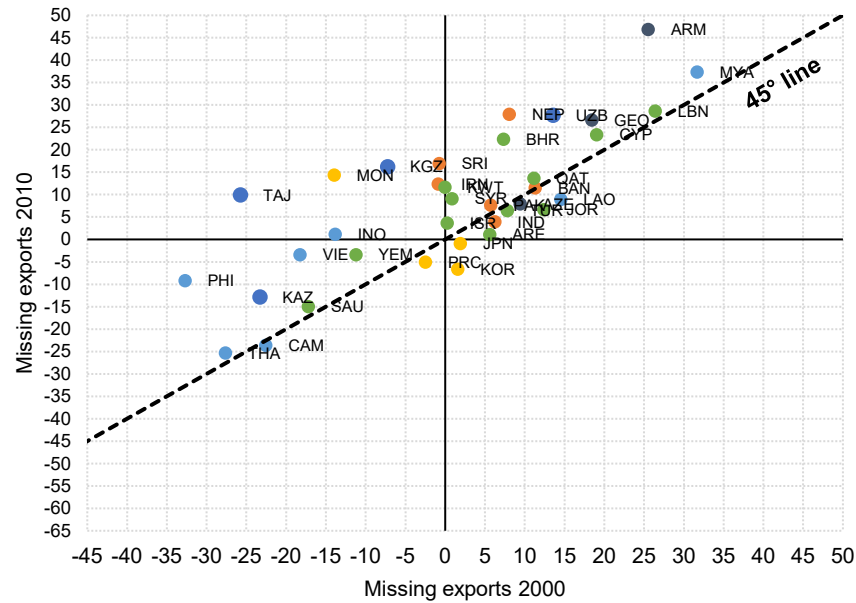


Note: Potential exports are estimated using Model 2 from Table 3, which includes importer–year fixed effects, bilateral gravity variables, and exporter characteristics (size, income, remoteness, geography, and endowments). For economy classification, see Appendix A.

Source: Authors' calculations.

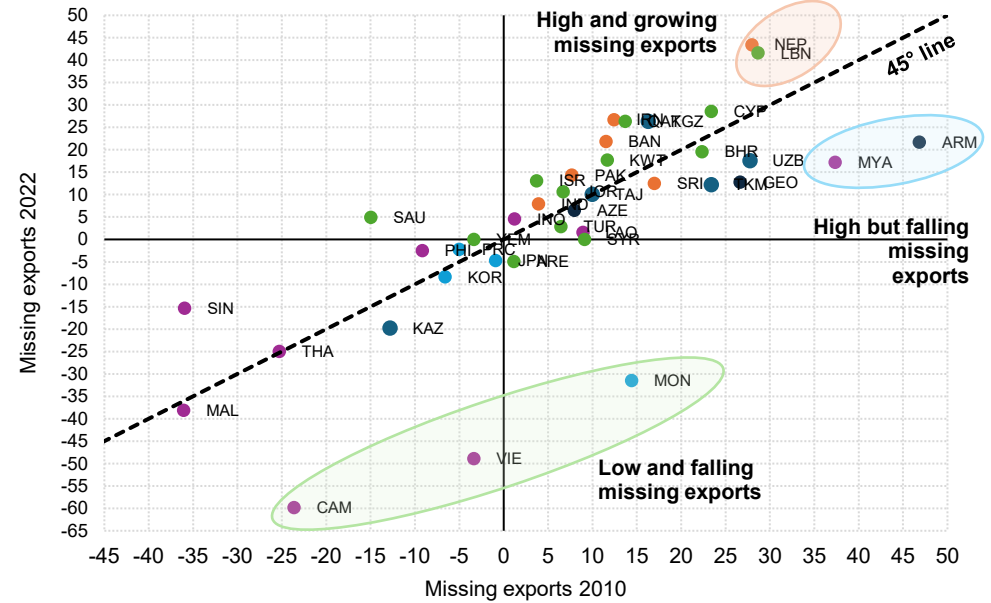
Figure 6. Recent Evolution of Missing Exports in Asia
(% of GDP)

a. 2000 vs. 2010



● Central ● South ● Caucasus ● East ● Southeast ● West

b. 2010 vs. 2022



● Central ● South ● Caucasus ● East ● Southeast ● West

Note: Potential exports are estimated using Model 2 from Table 3, which includes importer–year fixed effects, bilateral gravity variables, and exporter characteristics (size, income, remoteness, geography, and endowments). For economy classification, see Appendix A.
Source: Authors' calculations.

B. Focus on Central Asia, South Asia, and the Caucasus

Except for Kazakhstan, all economies in Central Asia, South Asia, and the Caucasus regions are underperforming relative to their potential exports (Figure 7). However, the trend of missing exports varies substantially. These significant variations in levels and especially trends highlight the need for tailored policy interventions to maximize export growth and economic development in each economy.

In Central Asia, the Kyrgyz Republic has the highest percentage of missing exports in recent years, reaching close to 30% of GDP in 2022, indicating substantial untapped export potential (Figure 7, Panel a). Uzbekistan and Tajikistan also exhibit positive missing exports, suggesting significant opportunities for increasing exports. Conversely, Kazakhstan displays negative missing exports, dropping to around 20% of GDP in 2022. However, as we will show in the next section, this aggregate measure does not imply that Kazakhstan has fully realized its potential with all potential partners. In particular, it is underperforming in its exports to the US.

In South Asia, Nepal has experienced a dramatic increase in missing exports since 2000, reaching nearly 50% of GDP by 2022 (more than 10 times its current export levels), which highlights the significant opportunities for expanding its export sector (Figure 7, Panel b). Iran and Bangladesh also show considerable missing exports, though to a lesser extent than Nepal, suggesting room for export growth. Pakistan exhibits relatively modest missing exports, indicating their export levels are closer to their potential when measured as a share of GDP. Sri Lanka shows a slight negative trend, suggesting it may be exporting close to or above its potential.

In the Caucasus region, Armenia's missing exports peaked around 2010, reaching nearly 50% of GDP, before declining to around 30% by 2022, indicating significant export potential, though the gap has been reducing (Figure 7, Panel c). Georgia maintains a relatively steady level of missing exports, around 20% of GDP, suggesting consistent opportunities for export growth. Azerbaijan exhibits a downward trend, with missing exports decreasing to around 10% by 2022, indicating it is closer to its export potential compared to Armenia and Georgia.

While aggregate data provides broad strokes of how the economy performs on the export front, destination data is crucial for effectively orienting trade policy and export promotion efforts. By identifying specific markets where economies are underperforming, policymakers can tailor strategies to target these gaps, enhancing trade relationships and optimizing resource allocation. This granular insight enables more precise interventions, such as negotiating trade agreements, reducing trade barriers, and providing targeted support to exporters, ultimately maximizing an economy's export potential and contributing to sustainable economic growth.¹⁸

Except for Kazakhstan, Central Asian economies have the largest untapped export potential in the EU, followed by the US and, to a lesser extent, the PRC (Figure 8). Kazakhstan's overperformance is based on large exports to the EU that exceed predictions by almost 10% of GDP. The Kyrgyz Republic, Tajikistan, and Uzbekistan show significant gaps in potential exports to the EU, the US, and the PRC, while Turkmenistan has missing exports with the EU and the US but is overperforming with the PRC.

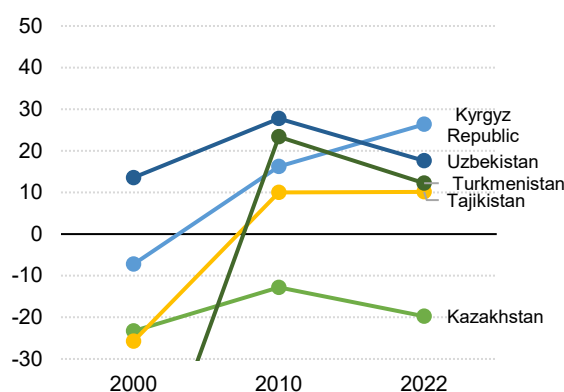
¹⁸ The potential export simulators built for this paper are granular at the economy of destination. Here we present data aggregated by destination groups.

For South Asian economies, the largest untapped market is the PRC, while there is also room for export growth with the EU and the US. Bangladesh has substantial missing exports with the PRC and other South Asian economies, while Iran displays significant gaps in exports to the EU and the US. Nepal shows pronounced missing exports across the board, while Pakistan has more modest gaps, primarily with the EU and the US, indicating that their export levels are closer to their potential.

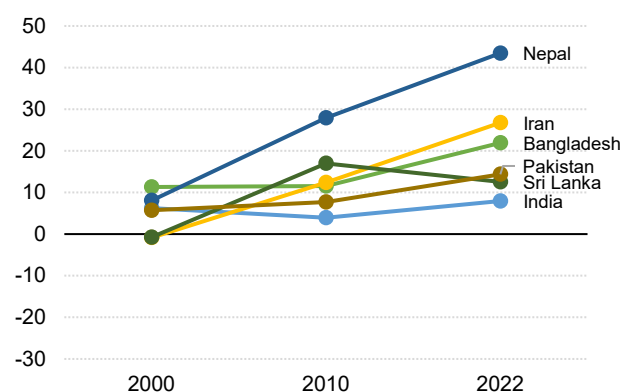
In the Caucasus region, the EU is the primary destination with the largest untapped potential for Armenia and Georgia. At the same time, Azerbaijan's exports to the EU exceed predicted levels by nearly 20% of GDP. Moreover, all three economies have considerable room to improve their export performance towards the US and, to a lesser extent, the PRC.

Figure 7. Missing Exports by Economy
(% of GDP)

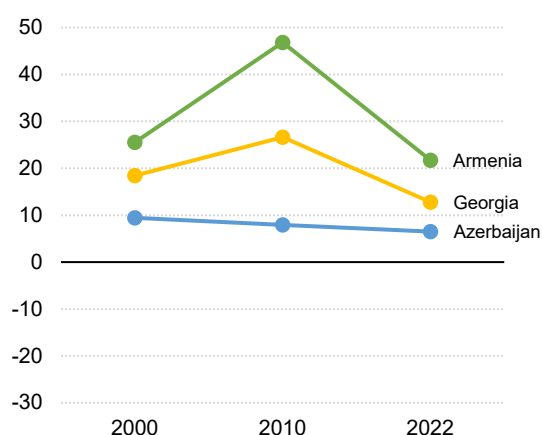
a. Central



b. South



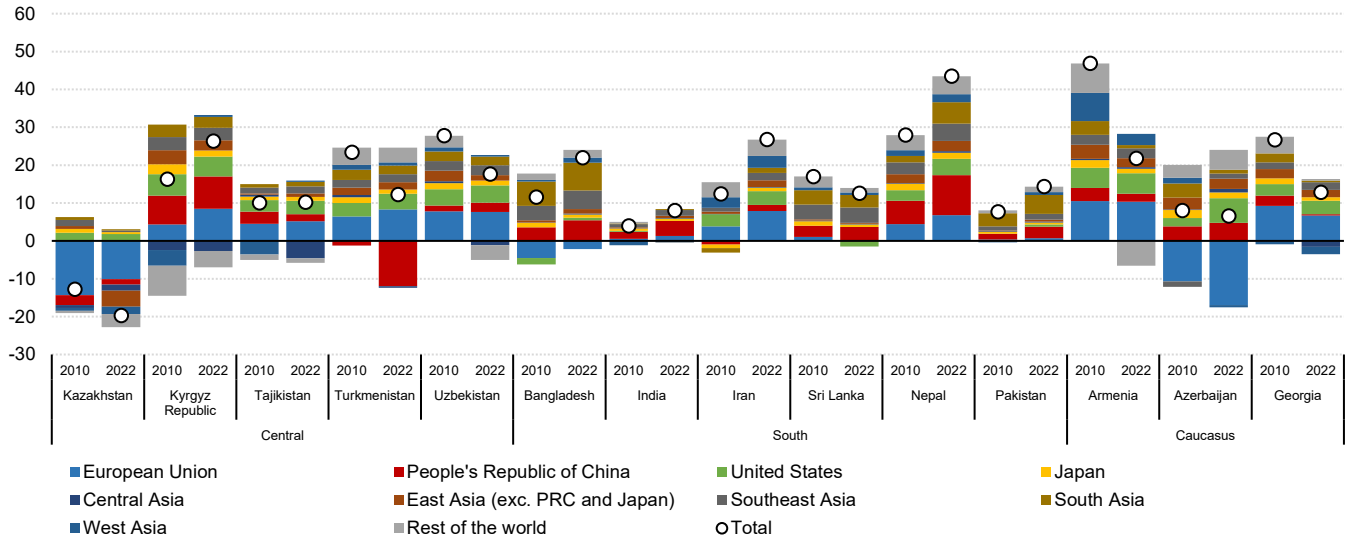
c. Caucasus



Note: Potential exports are estimated using Model 2 from Table 3, which includes importer–year fixed effects, bilateral gravity variables, and exporter characteristics (size, income, remoteness, geography, and endowments). Panel a. vertical axis was truncated for illustration reasons (Turkmenistan 2000: –73 %).

Source: Authors' calculations.

Figure 8. Missing Exports by Exporting Economy and Destination
(% of GDP)



Note: Potential exports are estimated using Model 2 from Table 3, which includes importer–year fixed effects, bilateral gravity variables, and exporter characteristics (size, income, remoteness, geography, and endowments). For economy classification, see Appendix A.

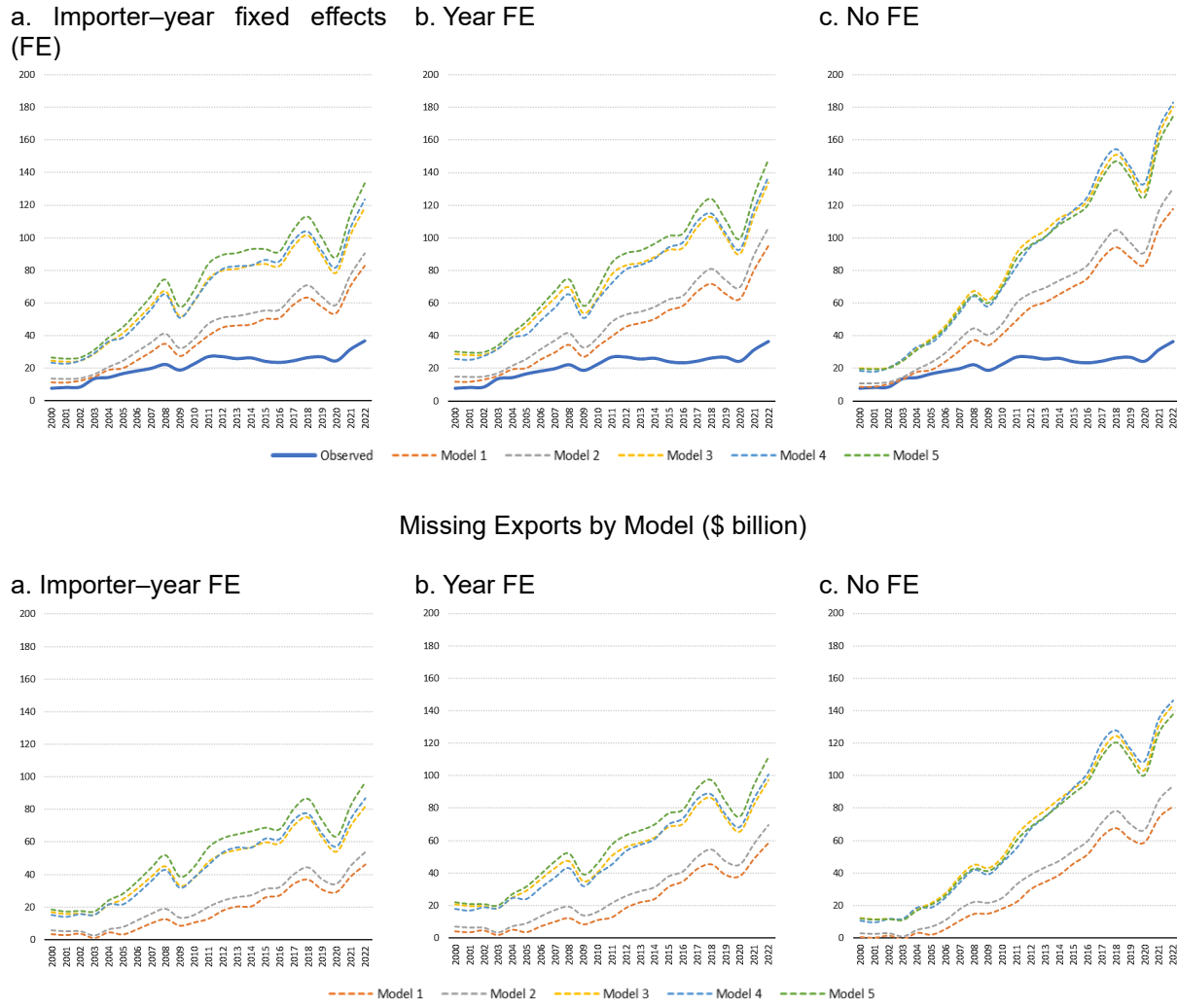
Source: Authors' calculations.

C. Case Study: Pakistan

In this section, we study the evolution of Pakistan's potential and missing exports as an example of the consequences of model selection on estimations. While model selection has quantitative implications on missing export estimations in Pakistan, all models give the same qualitative result: potential exports have grown constantly, widening the gap with the stagnating exports (Figure 9). Depending on the model selected, current missing exports are between \$46 billion (Model 1 with importer–year fixed effects, Panel a) and \$146 billion (Model 4 without fixed effects, Panel c).¹⁹

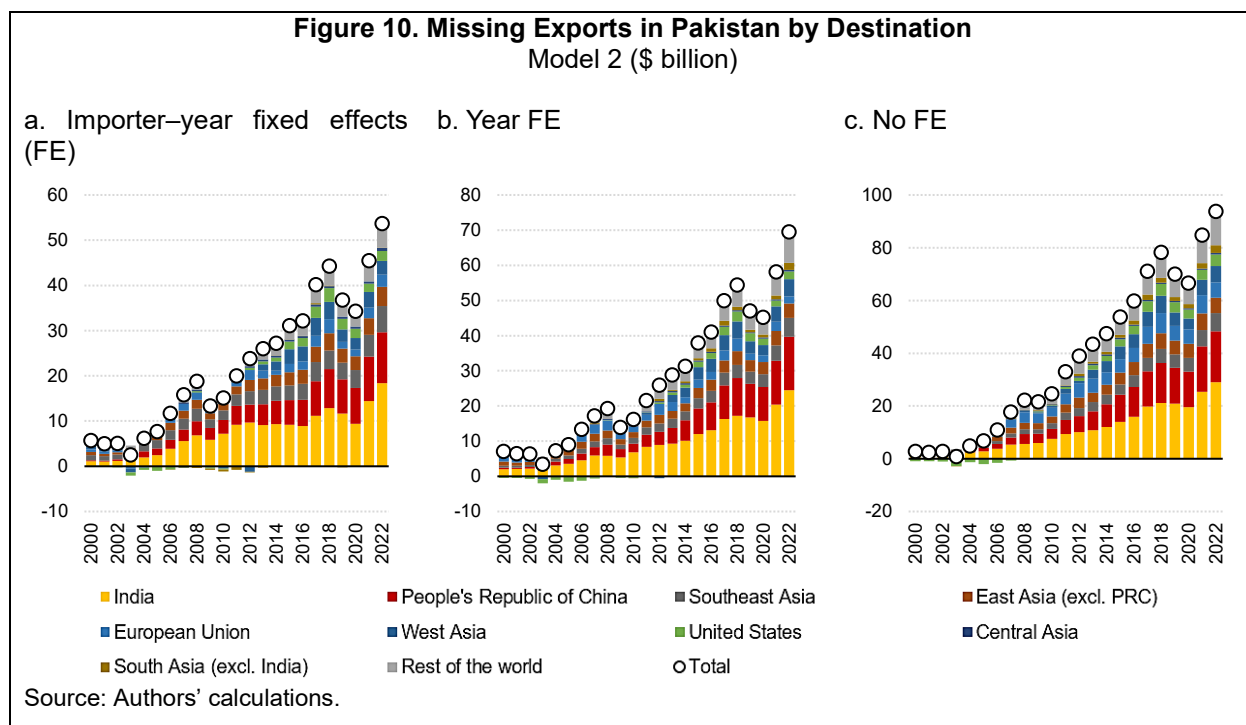
¹⁹ As mentioned previously, our preference is for Model 2 with importer fixed effects, which estimates \$54 billion of missing exports as of 2022.

Figure 9. Missing Exports in Pakistan
Observed and Potential Exports by Model (\$ billion)



Source: Authors' calculations.

The analysis of missing exports in Pakistan by destination across different models consistently shows that South Asia holds the largest trade potential for Pakistan, followed closely by the PRC (Figure 10). All three specifications—importer–year fixed effects, year fixed effects, and no fixed effects—show a significant and growing gap between South Asia and the PRC. In particular, the importer–year fixed effects model indicates that potential exports to other South Asian economies could reach nearly \$20 billion by 2022, while potential exports to the PRC approach \$11 billion. Similar trends are observed in the other models, underscoring the substantial untapped export potential in these markets. Other regions, such as the EU, Southeast Asia, and the US, also show notable gaps, but to a lesser extent. This alignment across models reinforces the robustness of the finding that enhancing trade relations with South Asia and the PRC could significantly boost Pakistan's export performance.



VI. Estimating the Impact of the Time to Export on International Trade

In this section, we present the results of our estimation of the impact of the time to export on international trade using the methodologies mentioned in Section III. Table 4 provides the estimation outputs using the PPML estimator, including two specifications: one with bilateral fixed effects and one without.

The coefficients for most control variables, such as the log of distance, common colony, common language, and tariffs, align with the existing literature. The primary coefficient of interest is on the “time to export” variable. The estimated coefficient for time to export is -0.09 in the specification without bilateral fixed effects and -0.18 in the specification with bilateral fixed effects. These coefficients are significant at 5% and 10%, respectively. Since this coefficient is a semi-elasticity, a value of -0.09 implies that an extra day of compliance time to export reduces exports by approximately 9%, while a value of -0.18 implies a reduction of 18% in exports. This finding highlights the substantial negative impact of delays in the export process on international trade flows.²⁰

The time to import variable also shows a significant negative impact on trade, although the estimated value varies more between both models. The model without bilateral fixed effects estimates a -0.28 semi-elasticity, while the model with fixed effects estimates a -0.05 semi-elasticity. These results emphasize the critical role of efficient import processes in facilitating international trade.

²⁰ Our estimates are slightly higher than Heid et al. (2021), who applied the methodology on a narrower dataset.

Table 4. Impact of Time to Export on International Trade		
Estimated Using Poisson Pseudo Maximum Likelihood Estimator		
	Panel 2014–2019	Bilateral Fixed Effects with intervals
Intl. trade	–0.948*** (0.189)	
Ln(distance)	–0.623*** (0.0367)	
Contiguous	0.377*** (0.0844)	
Common colony	0.733*** (0.151)	
Common language	0.189** (0.0770)	
RTA	–0.0409 (0.0870)	0.0287 (0.126)
Ln(1+tariffs)	–0.232*** (0.0481)	–0.359*** (0.101)
Time to export	–0.0853** (0.0361)	–0.178* (0.101)
Time to import	–0.0521*** (0.0166)	–0.283*** (0.0391)
Exporter–Year FEs	YES	YES
Importer–Year FEs	YES	YES
Bilateral FEs	NO	YES
Observations	114,828	55,776
Pseudo R-squared	0.965	0.995

FE=fixed effects, Ln=natural logarithm, RTA=regional trade agreements.

Standard errors are reported in parentheses and are robust to symmetric two-way clustering at the importer–exporter level. *** p<0.01, ** p<0.05, * p<0.1.

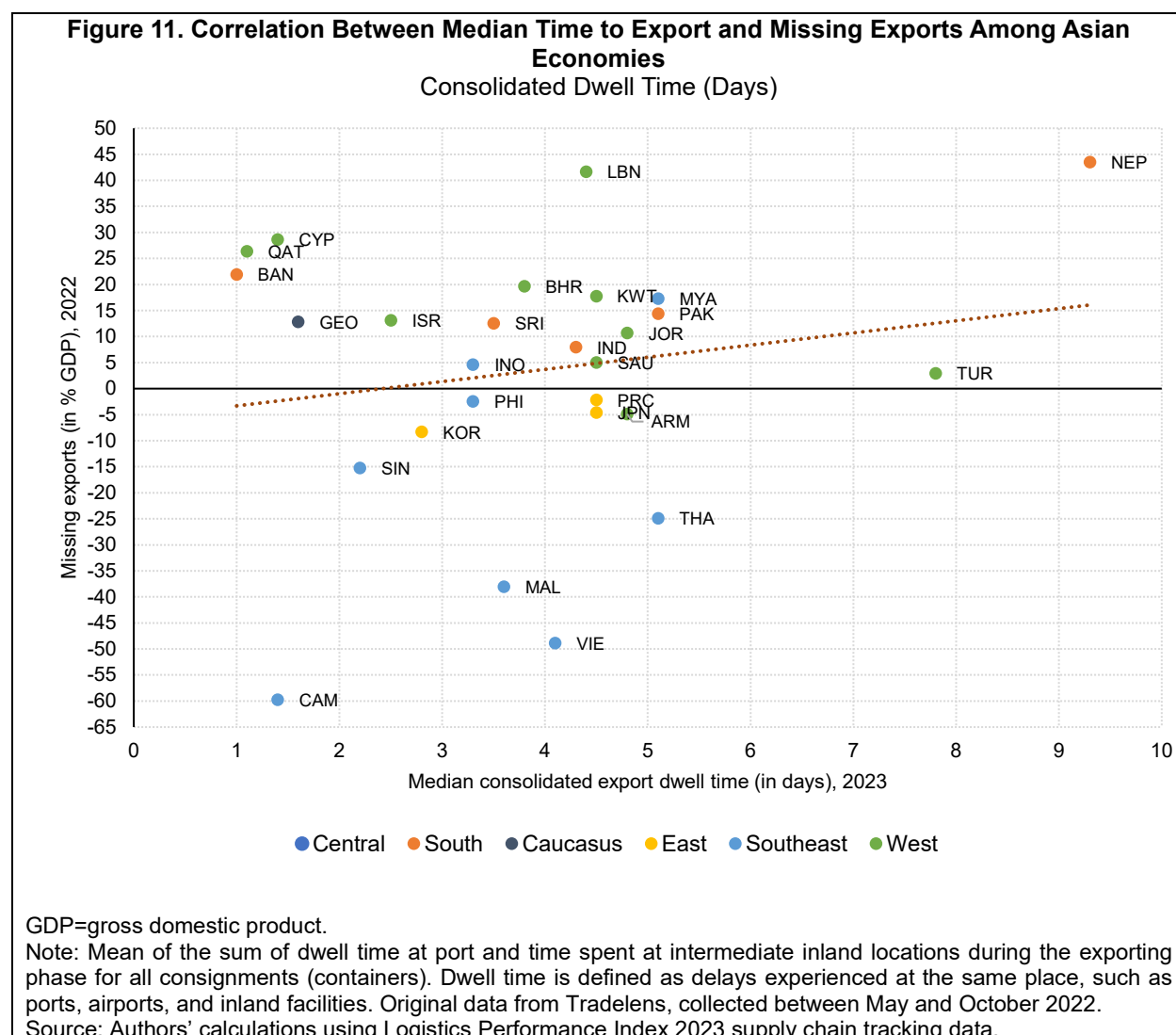
Source: Authors' calculations.

While we do not have updated data for the specific variables used in the regression analysis on time to export and import (2019 is the last year), we have access to updated proxy variables from the logistics performance indicators (LPI).²¹ These indicators provide valuable insights into the efficiency and performance of trade logistics. Using the LPI data, we can assess how far Asian economies are from the top performers in international trade-related logistics. This approach allows us to approximate the current state of trade logistics in these economies and identify areas for improvement.

There is a weak but positive correlation between the median time to export and missing exports (in % of GDP) for Asian economies (Figure 11). Economies with higher median dwell times, such as Nepal and Lebanon, tend to have higher missing exports. Conversely, economies with lower dwell times, such as Singapore, the Republic of Korea, and Viet Nam, exhibit negative missing export levels. This relationship highlights the critical impact of logistical efficiency on export

²¹ World Bank (2023). Arvis et al. (2024) present a new dataset built for the LPI that uses microdata for containers and provides valuable insights into the current cross-economy logistical performance.

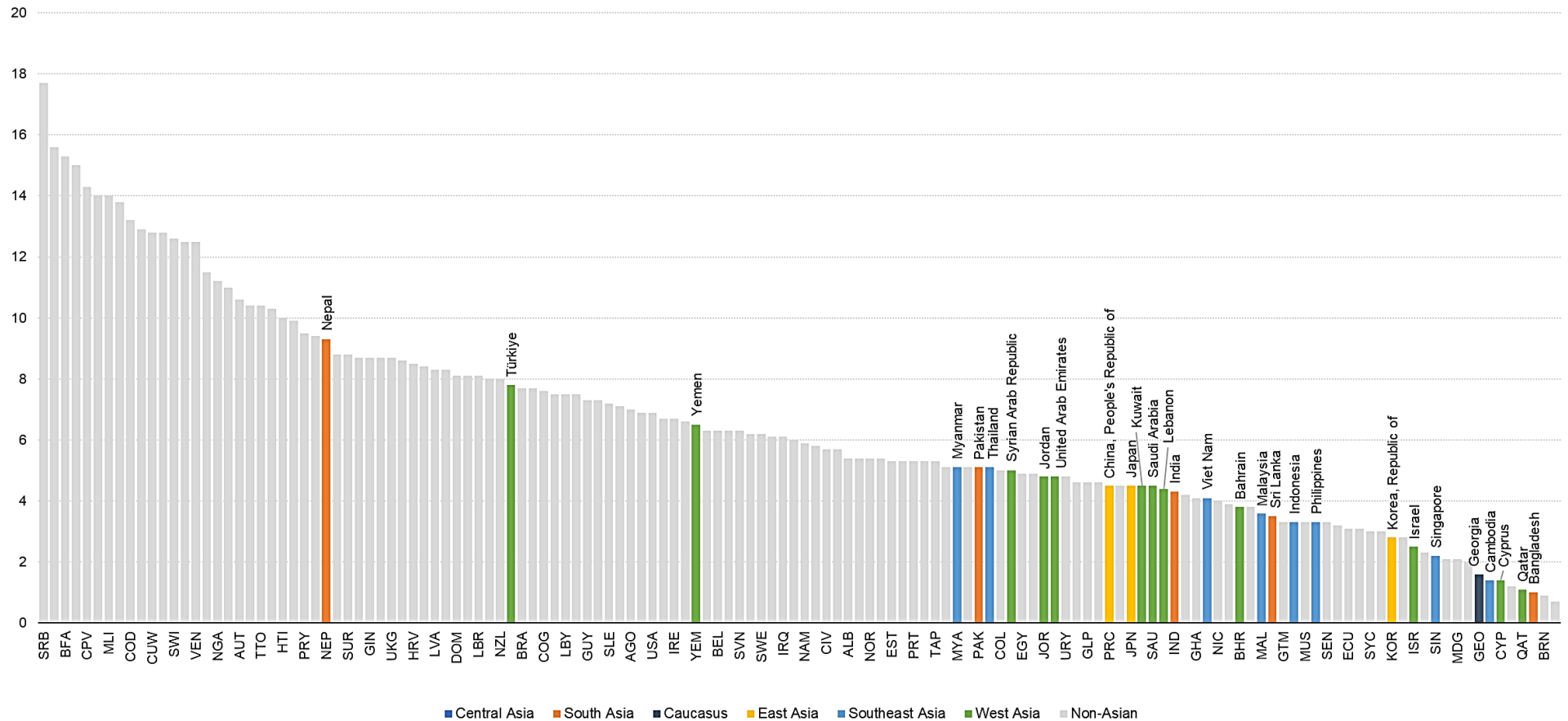
performance. Notably, Nepal stands out with the highest dwell time and the most significant missing exports, underscoring the importance of reducing export delays to enhance this economy's trade potential.



Finally, Asian economies exhibit competitive performance in median time to export compared to other regions (Figure 12).²² Economies like Bangladesh, Singapore, and Qatar are among the top performers, with significantly lower export dwell times. However, considerable variation remains within Asia. Pakistan, for instance, has a relatively high median dwell time, indicating substantial room for improvement. If our estimates are correct, if Pakistan reduced its export times to Bangladesh's levels (from 5 to 1 day), it could boost exports by 36% (semi-elasticity of -0.09) to 76% (semi-elasticity of -0.18). On a broader scale, while Asian economies generally rank well, further enhancements in export logistics could boost their trade efficiency even more, aligning them closer with the leading global benchmarks.

²² Median time to import is shown in Appendix D.

Figure 12. Median Time to Export
Consolidated Dwell Time (Days)



Note: Mean of the sum of dwell time at port and time spent at intermediate inland locations during the exporting phase for all consignments (containers). Original data from Tradelens, collected between May 2022 and October 2022. Due to limited space, some economy codes corresponding to each bar are not displayed.
Source: Authors' calculations using Logistics Performance Index 2023 supply chain tracking data.

VII. Conclusion

This paper investigates the export potential of Asian economies, focusing on the impact of time to export and import on international trade.

Using a structural gravity model and the PPML estimation method, we identified significant gaps in export performance across various destinations. The study estimated potential and missing exports using a model incorporating importer–year fixed effects, bilateral gravity variables, and exporter characteristics. In general, Asia experienced a significant growth in potential exports, which rose from less than 10% of GDP in 1988 to more than 40% by 2010. However, this upward trend was disrupted post-GFC, and potential exports have since fluctuated between 35% and 40% of GDP. Observed exports tracked closely with potential exports until the GFC, after which observed exports declined more sharply, leading to a gap of about 6% of GDP that has persisted.

Regional analysis shows a common pattern of upward potential exports until the GFC, followed by stagnation. Central, South, and West Asia, along with the Caucasus region, underperformed relative to their export potential, while Southeast and East Asia outperformed theirs. For instance, in Central Asia, potential exports rose until the GFC but have since slightly declined, with observed exports on a downward trend, resulting in missing exports of around 10% of GDP. South Asia saw similar trends, with potential exports stagnating post-GFC and observed exports declining. In contrast, Southeast Asia and East Asia saw observed exports exceeding potential exports, with economies like Cambodia, Viet Nam, Malaysia, Thailand, and Singapore exporting significantly above their predicted levels. Conversely, Nepal, Lebanon, and Armenia underperformed considerably. The study highlights the need for tailored policy interventions to maximize export growth, emphasizing that granular destination data is crucial for effectively orienting trade policies and export promotion efforts.

In estimating the impact of the time to export on trade, our results reaffirm existing literature, showing that delays significantly hinder export performance. The semi-elasticity of the time to export coefficient suggests that each additional day of export compliance time reduces exports by approximately 9% to 18%, emphasizing the critical role of reducing export times in enhancing trade flows. Similarly, the time to import also exhibits a significant negative impact on trade, further corroborating the need for comprehensive logistical improvements to foster integration.

In conclusion, this study underscores the critical importance of improving export and import logistics to unlock the full trade potential of Asian economies. By addressing logistical bottlenecks and focusing export promotion strategies on strategic markets, policymakers can significantly enhance their economies' export performance, fostering economic growth and integration into the global economy.

APPENDIX

A. Economy List

Table A1 presents the 143 economies included in the gravity model estimations. The economies are sorted by Asian Region (UN classification). The first 40 economies are the Asian economies for which we produced potential and missing export simulators.

Table A1. Economy List						
#	Code	Economy	Region	Asian region	Income	Population
<i>Asian Economies</i>						
1	KAZ	Kazakhstan	ECA	Central	UMI	20
2	KGZ	Kyrgyz Republic	ECA	Central	LMI	7
3	TAJ	Tajikistan	ECA	Central	LMI	10
4	TKM	Turkmenistan	ECA	Central	UMI	6
5	UZB	Uzbekistan	ECA	Central	LMI	36
6	BAN	Bangladesh	SA	South	LMI	171
7	IND	India	SA	South	LMI	1,417
8	IRN	Iran	MENA	South	LMI	89
9	SRI	Sri Lanka	SA	South	LMI	22
10	NEP	Nepal	SA	South	LMI	31
11	PAK	Pakistan	SA	South	LMI	236
12	ARM	Armenia	ECA	Caucasus	UMI	3
13	AZE	Azerbaijan	ECA	Caucasus	UMI	10
14	GEO	Georgia	ECA	Caucasus	UMI	4
15	PRC	People's Republic of China	EAP	Eastern	UMI	1,412
16	HKG	Hong Kong, China	EAP	Eastern	HI	7
17	JPN	Japan	EAP	Eastern	HI	125
18	KOR	Republic of Korea	EAP	Eastern	HI	52
19	MON	Mongolia	EAP	Eastern	LMI	3
20	INO	Indonesia	EAP	Southeast	UMI	276
21	CAM	Cambodia	EAP	Southeast	LMI	17
22	LAO	Lao People's Democratic Republic	EAP	Southeast	LMI	8
23	MYA	Myanmar	EAP	Southeast	LMI	54
24	MAL	Malaysia	EAP	Southeast	UMI	34
25	PHI	Philippines	EAP	Southeast	LMI	116
26	SIN	Singapore	EAP	Southeast	HI	6
27	THA	Thailand	EAP	Southeast	UMI	72
28	VIE	Viet Nam	EAP	Southeast	LMI	98
29	ARE	United Arab Emirates	MENA	West	HI	9
30	BHR	Bahrain	MENA	West	HI	1
31	CYP	Cyprus	ECA	West	HI	1
32	ISR	Israel	MENA	West	HI	10
33	JOR	Jordan	MENA	West	LMI	11
34	KWT	Kuwait	MENA	West	HI	4
35	LBN	Lebanon	MENA	West	LMI	5
36	QAT	Qatar	MENA	West	HI	3
37	SAU	Saudi Arabia	MENA	West	HI	36
38	SYR	Syrian Arab Republic	MENA	West	LI	22
39	TUR	Türkiye	ECA	West	UMI	85
40	YEM	Yemen	MENA	West	LI	34

Continued on the next page

Table A1. Economy List						
#	Code	Economy	Region	Asian region	Income	Population
<i>Non-Asian Economies</i>						
41	AGO	Angola	SSA		LMI	36
42	ALB	Albania	ECA		UMI	3
43	ARG	Argentina	LAC		UMI	46
44	AUS	Australia	EAP		HI	26
45	AUT	Austria	ECA		HI	9
46	BDI	Burundi	SSA		LI	13
47	BEL	Belgium	ECA		HI	12
48	BEN	Benin	SSA		LMI	13
49	BFA	Burkina Faso	SSA		LI	23
50	BGR	Bulgaria	ECA		UMI	6
51	BIH	Bosnia and Herzegovina	ECA		UMI	3
52	BLR	Belarus	ECA		UMI	9
53	BRA	Brazil	LAC		UMI	215
54	BWA	Botswana	SSA		UMI	3
55	CAF	Central African Republic	SSA		LI	6
56	CAN	Canada	NA		HI	39
57	SWI	Switzerland	ECA		HI	9
58	CHL	Chile	LAC		HI	20
59	CIV	Côte d'Ivoire	SSA		LMI	28
60	CMR	Cameroon	SSA		LMI	28
61	COD	Congo, Dem. Rep.	SSA		LI	99
62	COG	Congo, Rep.	SSA		LMI	6
63	COL	Colombia	LAC		UMI	52
64	CRI	Costa Rica	LAC		UMI	5
65	CZE	Czechia	ECA		HI	11
66	GER	Germany	ECA		HI	84
67	DJI	Djibouti	MENA		LMI	1
68	DEN	Denmark	ECA		HI	6
69	DOM	Dominican Republic	LAC		UMI	11
70	DZA	Algeria	MENA		LMI	45
71	ECU	Ecuador	LAC		UMI	18
72	EGY	Egypt	MENA		LMI	111
73	SPA	Spain	ECA		HI	48
74	EST	Estonia	ECA		HI	1
75	ETH	Ethiopia	SSA		LI	123
76	FIN	Finland	ECA		HI	6
77	FRA	France	ECA		HI	68
78	GAB	Gabon	SSA		UMI	2
79	UKG	United Kingdom	ECA		HI	67
80	GHA	Ghana	SSA		LMI	33
81	GIN	Guinea	SSA		LMI	14
82	GMB	Gambia	SSA		LI	3
83	GNB	Guinea-Bissau	SSA		LI	2
84	GNQ	Equatorial Guinea	SSA		UMI	2
85	GRC	Greece	ECA		HI	10
86	GTM	Guatemala	LAC		UMI	17
87	HND	Honduras	LAC		LMI	10
88	HRV	Croatia	ECA		HI	4

Continued on the next page

Table A1. Economy List						
#	Code	Economy	Region	Asian region	Income	Population
89	HUN	Hungary	ECA		HI	10
90	IRE	Ireland	ECA		HI	5
91	ITA	Italy	ECA		HI	59
92	JAM	Jamaica	LAC		UMI	3
93	KEN	Kenya	SSA		LMI	54
94	LBR	Liberia	SSA		LI	5
95	LSO	Lesotho	SSA		LMI	2
96	LTU	Lithuania	ECA		HI	3
97	LVA	Latvia	ECA		HI	2
98	MAR	Morocco	MENA		LMI	37
99	MDA	Moldova	ECA		UMI	3
100	MDG	Madagascar	SSA		LI	30
101	MEX	Mexico	LAC		UMI	128
102	MKD	North Macedonia	ECA		UMI	2
103	MLI	Mali	SSA		LI	23
104	MOZ	Mozambique	SSA		LI	33
105	MRT	Mauritania	SSA		LMI	5
106	MUS	Mauritius	SSA		UMI	1
107	MWI	Malawi	SSA		LI	20
108	NAM	Namibia	SSA		UMI	3
109	NER	Niger	SSA		LI	26
110	NGA	Nigeria	SSA		LMI	219
111	NIC	Nicaragua	LAC		LMI	7
112	NET	Netherlands	ECA		HI	18
113	NOR	Norway	ECA		HI	5
114	NZL	New Zealand	EAP		HI	5
115	PAN	Panama	LAC		HI	4
116	PER	Peru	LAC		UMI	34
117	POL	Poland	ECA		HI	37
118	POR	Portugal	ECA		HI	10
119	PRY	Paraguay	LAC		UMI	7
120	ROU	Romania	ECA		HI	19
121	RUS	Russian Federation	ECA		UMI	144
122	RWA	Rwanda	SSA		LI	14
123	SDN	Sudan	SSA		LI	47
124	SEN	Senegal	SSA		LMI	17
125	SLE	Sierra Leone	SSA		LI	9
126	SLV	El Salvador	LAC		UMI	6
127	SRB	Serbia	ECA		UMI	7
128	SVK	Slovak Republic	ECA		HI	5
129	SVN	Slovenia	ECA		HI	2
130	SWE	Sweden	ECA		HI	10
131	SWZ	Eswatini	SSA		LMI	1
132	TCD	Chad	SSA		LI	18
133	TGO	Togo	SSA		LI	9
134	TTO	Trinidad and Tobago	LAC		HI	2
135	TUN	Tunisia	MENA		LMI	12
136	TZA	Tanzania	SSA		LMI	65
137	UGA	Uganda	SSA		LI	47

Continued on the next page

Table A1. Economy List						
#	Code	Economy	Region	Asian region	Income	Population
138	UKR	Ukraine	ECA		LMI	38
139	URY	Uruguay	LAC		HI	3
140	USA	United States	NA		HI	333
141	VEN	Venezuela	LAC		N/A	28
142	ZAF	South Africa	SSA		UMI	60
143	ZWE	Zimbabwe	SSA		LMI	16
<p>Regions: EAP=East Asia and Pacific, ECA=Europe and Central Asia, LAC=Latin America and Caribbean, MENA=Middle East and North Africa, NA=North America, SA=South Asia, SSA=Sub-Saharan Africa. Income: LI=low income, LMI=low middle income, UMI=upper middle income, HI=high income.</p> <p>Note: Region corresponds to the World Bank regional classification; Asian region to the <u>UN classification</u> (with exception of Caucasus, which was added by the authors); Income to the <u>World Bank income classification</u> according to the gross national income per capita, Atlas method (current US\$) FY2023; Population: total population in millions, 2022 (source: WDI). Asian economies excluded from the analysis due to insufficient data: Iraq; Afghanistan; Democratic People's Republic of Korea; West Bank and Gaza; Oman; Timor-Leste; Bhutan; Macau, China; Maldives; and Brunei Darussalam.</p> <p>Source: Authors' compilation.</p>						

B. Interpretation of Coefficients in a Gravity Model²³

Variables expressed in logarithms. The coefficient should be interpreted as the elasticity of trade to the original variable. For example, $\hat{\beta}_{\text{Dist}} = -1$ implies that a 1% increase in distance decreases expected trade by 1%.

Indicator variables. To calculate the % change in bilateral trade, the following formula can be used: $100 \times (e^{\hat{\beta}} - 1)$. For example, $\hat{\beta}_{\text{RTA}} = 0.76$ implies that, on average, signing a trade agreement increases bilateral trade by 114%.

Other variables. The coefficient should be interpreted as a semi-elasticity of trade to the original variable. For example, $\hat{\beta}_{\text{Land}} = -0.6$ implies that an additional hectare of arable land per capita reduces exports by 0.6%.

²³ Based on Yotov et al. (2016).

C. Predicted Exports: Models Without Importer–Year Fixed Effects

Table A2. Models to Estimate Export Potential with Year Fixed Effects					
Estimated Using the Poisson Pseudo Maximum Likelihood Estimator					
	Model 1	Model 2	Model 3	Model 4	Model 5
<i>Gravity covariates</i>					
Ln(distance)	−0.729*** (0.0356)	−0.775*** (0.0345)	−0.838*** (0.0316)	−0.762*** (0.0433)	−0.830*** (0.0411)
Contiguous	0.369*** (0.0998)	0.403*** (0.112)	0.273*** (0.102)	0.354*** (0.101)	0.352*** (0.115)
Common colony	0.533*** (0.142)	0.516*** (0.145)	0.589*** (0.158)	0.667*** (0.170)	0.562*** (0.185)
Common language	0.158** (0.0772)	0.171** (0.0835)	0.123 (0.0774)	0.116 (0.0765)	0.160* (0.0823)
<i>Size</i>					
Ln(exports GDP)	0.873*** (0.0190)	0.852*** (0.0204)	0.872*** (0.0238)	0.880*** (0.0217)	0.866*** (0.0172)
Ln(importer GDP)	0.797*** (0.0189)	0.782*** (0.0200)	0.819*** (0.0219)	0.828*** (0.0202)	0.840*** (0.0206)
<i>Income per capita</i>					
Ln(exports GDP pc)	0.0526 (0.0360)	0.0872** (0.0356)	0.0150 (0.0386)	0.00881 (0.0355)	
Ln(importer GDP pc)	−0.0224 (0.0384)	0.0508 (0.0383)	0.113*** (0.0282)	−0.0595 (0.0398)	
<i>Remoteness</i>					
Ln(exports remoteness)	0.945*** (0.155)	1.007*** (0.163)	1.194*** (0.145)	0.999*** (0.142)	1.063*** (0.135)
Ln(importer remoteness)	0.900*** (0.114)	0.839*** (0.123)	1.085*** (0.130)	1.029*** (0.127)	0.793*** (0.122)
<i>Geography</i>					
Exporter island	−0.203*** (0.0779)	−0.215*** (0.0822)	−0.291*** (0.0821)		
Importer island	−0.160** (0.0762)	−0.132* (0.0768)	−0.268*** (0.0855)		
Exporter landlocked	0.0311 (0.0873)	−0.0141 (0.0907)	−0.00648 (0.0842)		
Importer landlocked	−0.173** (0.0703)	−0.177** (0.0738)	−0.123 (0.0846)		
<i>Endowments</i>					
Exporter mineral rich	0.103 (0.0760)	0.166** (0.0784)			
Importer mineral rich	−0.217*** (0.0604)	−0.386*** (0.0605)			
Ln(exports K/L)	−0.162*** (0.0565)	−0.180*** (0.0574)		−0.0444 (0.0588)	
Ln(importer K/L)	0.0384 (0.0488)	0.0567 (0.0501)		0.0974* (0.0530)	
Exporter arable land pc	−0.302*** (0.109)	−0.259** (0.117)			
Importer arable land pc	−0.0720 (0.0671)	−0.0817 (0.0740)			
Exporter secondary enroll.	0.00348*** (0.00132)	0.00323** (0.00133)			
Importer secondary enroll.	−0.00497*** (0.00151)	−0.00442*** (0.00148)			

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Table A2. Models to Estimate Export Potential with Year Fixed Effects					
Estimated Using the Poisson Pseudo Maximum Likelihood Estimator					
	Model 1	Model 2	Model 3	Model 4	Model 5
Exporter tertiary enroll.	0.000768 (0.00132)	0.000967 (0.00139)			
Importer tertiary enroll.	0.00376*** (0.00123)	0.00350** (0.00143)			
Exporter age dep. ratio	−0.0185*** (0.00265)	−0.0175*** (0.00272)			
Importer age dep. ratio	−0.0124*** (0.00202)	−0.0128*** (0.00209)			
<i>Trade variables</i>					
RTA	−0.0446 (0.0682)			−0.00657 (0.0671)	
Ln(1+tariffs)	−0.250*** (0.0284)			−0.229*** (0.0297)	
Observations	533,815	612,932	612,932	534,361	613,494
Importer–year FE	NO	NO	NO	NO	NO
Year FE	YES	YES	YES	YES	YES
Pseudo R-squared	0.907	0.904	0.896	0.896	0.892

FE=fixed effects, GDP=gross domestic product, K/L=capital stock per worker, Ln=natural logarithm, pc=per capita, RTA=regional trade agreement.

Standard errors are reported in parentheses and are robust to symmetric two-way clustering at the importer–exporter level. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors' calculations.

Table A3. Models to Estimate Export Potential Without Fixed Effects					
Estimated Using the Poisson Pseudo Maximum Likelihood Estimator					
	Model 1	Model 2	Model 3	Model 4	Model 5
<i>Gravity covariates</i>					
Ln(distance)	−0.738*** (0.0335)	−0.769*** (0.0320)	−0.804*** (0.0310)	−0.758*** (0.0408)	−0.800*** (0.0371)
Contiguous	0.377*** (0.107)	0.402*** (0.117)	0.348*** (0.110)	0.378*** (0.105)	0.388*** (0.117)
Common colony	0.370** (0.149)	0.363** (0.152)	0.472*** (0.174)	0.549*** (0.183)	0.492*** (0.188)
Common language	0.159* (0.0821)	0.171** (0.0868)	0.168** (0.0790)	0.139* (0.0778)	0.173** (0.0841)
<i>Size</i>					
Ln(exports GDP)	0.835*** (0.0180)	0.818*** (0.0193)	0.843*** (0.0226)	0.854*** (0.0204)	0.839*** (0.0150)
Ln(importer GDP)	0.763*** (0.0178)	0.753*** (0.0185)	0.792*** (0.0211)	0.804*** (0.0194)	0.814*** (0.0186)
<i>Income per capita</i>					
Ln(exports GDP pc)	0.0872** (0.0363)	0.115*** (0.0367)	−0.0234 (0.0394)	0.0642* (0.0351)	
Ln(importer GDP pc)	0.0239 (0.0384)	0.0833** (0.0392)	0.0739*** (0.0269)	0.0124 (0.0372)	
<i>Remoteness</i>					
Ln(exports remoteness)	0.627*** (0.151)	0.700*** (0.156)	0.840*** (0.146)	0.715*** (0.146)	0.869*** (0.129)
Ln(importer remoteness)	0.596*** (0.0958)	0.548*** (0.101)	0.731*** (0.117)	0.753*** (0.122)	0.595*** (0.113)
<i>Geography</i>					
Exporter island	−0.0996 (0.0840)	−0.104 (0.0894)	−0.175** (0.0875)		
Importer island	−0.0571 (0.0713)	−0.0283 (0.0712)	−0.150** (0.0766)		
Exporter landlocked	−0.0970 (0.0838)	−0.128 (0.0864)	−0.0958 (0.0813)		
Importer landlocked	−0.286*** (0.0697)	−0.282*** (0.0723)	−0.206** (0.0802)		
<i>Endowments</i>					
Exporter mineral rich	−0.0707 (0.0792)	0.00247 (0.0806)			
Importer mineral rich	−0.406*** (0.0592)	−0.539*** (0.0592)			
Ln(exports K/L)	−0.184*** (0.0567)	−0.198*** (0.0573)		−0.160*** (0.0545)	
Ln(importer K/L)	0.0101 (0.0452)	0.0304 (0.0461)		−0.0311 (0.0445)	
Exporter arable land pc	−0.124 (0.102)	−0.0861 (0.106)			
Importer arable land pc	0.0974 (0.0714)	0.0860 (0.0755)			
Exporter secondary enroll.	0.00219* (0.00129)	0.00189 (0.00129)			
Importer secondary enroll.	−0.00603*** (0.00166)	−0.00561*** (0.00164)			
Exporter tertiary enroll.	−0.00249* (0.00131)	−0.00223* (0.00131)			

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Table A3. Models to Estimate Export Potential Without Fixed Effects					
Estimated Using the Poisson Pseudo Maximum Likelihood Estimator					
	Model 1	Model 2	Model 3	Model 4	Model 5
Importer tertiary enroll.	0.000318 (0.00109)	0.000299 (0.00119)			
Exporter age dep. ratio	-0.0218*** (0.00263)	-0.0207*** (0.00270)			
Importer age dep. ratio	-0.0168*** (0.00183)	-0.0168*** (0.00189)			
<i>Trade variables</i>					
RTA	-0.0882 (0.0678)			-0.0356 (0.0661)	
Ln(1+tariffs)	-0.224*** (0.0286)			-0.202*** (0.0297)	
Observations	533,815	612,932	612,932	534,361	613,494
Importer–Year FE	NO	NO	NO	NO	NO
Year FE	NO	NO	NO	NO	NO
Pseudo R-squared	0.902	0.900	0.888	0.889	0.886

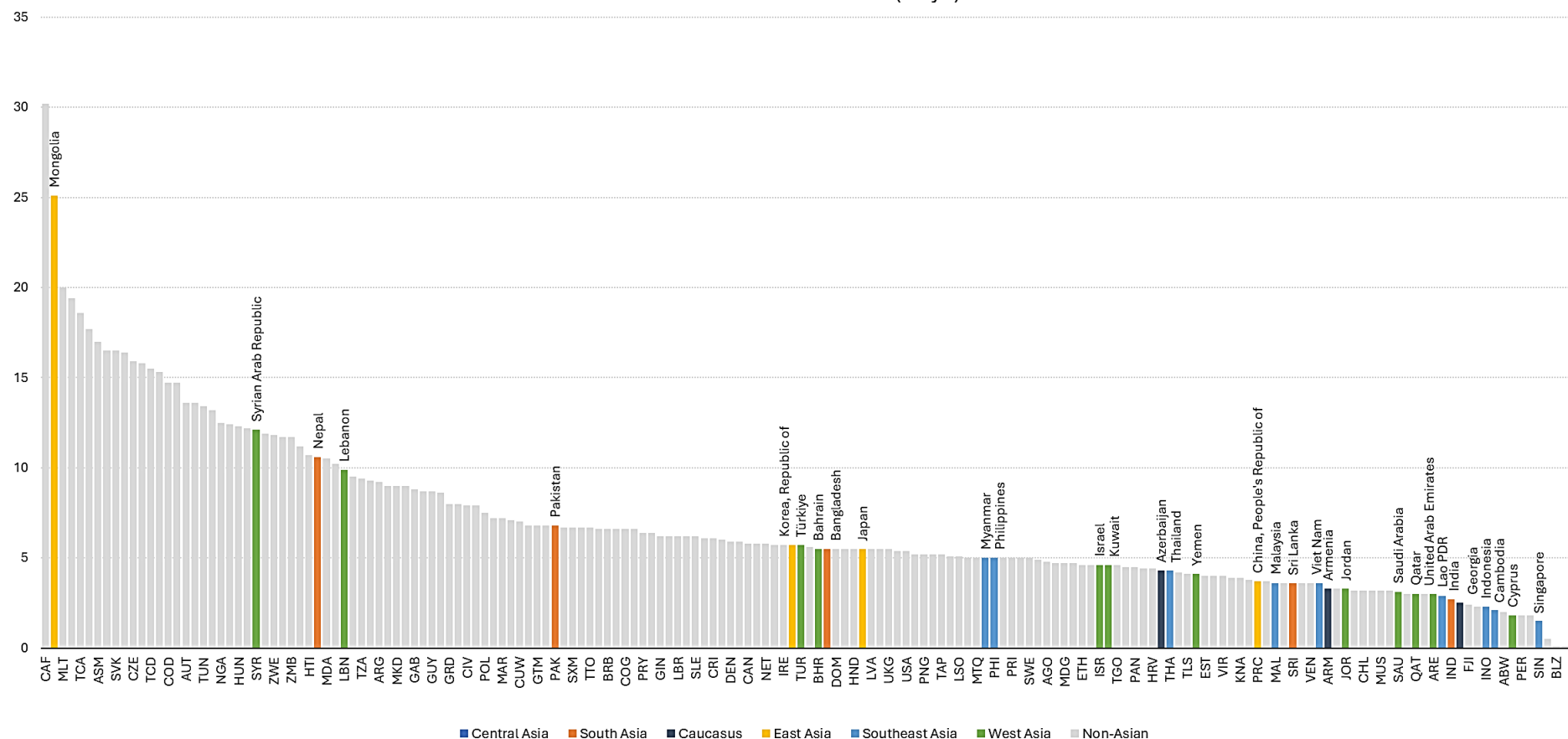
GDP=gross domestic product, K/L=capital stock per worker, Ln=natural logarithm, pc=per capita, RTA=regional trade agreement.

Standard errors are reported in parentheses and are robust to symmetric two-way clustering at the importer–exporter level. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors' calculations.

D. Median Time to Import

Appendix Figure. Median Time to Import
Consolidated Dwell Time (Days)



Note: Median of the sum of dwell time at port and time spent at intermediate inland locations during the importing phase for all consignments (containers). Dwell time is defined as delays experienced at the same place, such as ports, airports, and inland facilities. Original data from Tradelens, collected between May 2022 and October 2022. Due to limited space, some economy codes corresponding to each bar are not displayed.

Source: Authors' calculations using Logistic Performance Index 2023 supply chain tracking data.

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Estimating Asian Economies' Missing Exports

This paper uses the structural gravity model to quantify potential merchandise potential exports for Asian economies, identify destinations with significant untapped potential, and assess how factors such as cutting the time required to export can improve export performance. Preliminary findings reveal that Asian economies, on average, have sustained missing exports equivalent to 6% of gross domestic product. While Asian economies perform relatively well internationally, there remains room for improvement to match top global standards.

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