> "Measurement of trade policy is perhaps one of the toughest issues faced in the evaluation of trade policy, especially in cases where non-tariff barriers are the primary trade policy instrument … Even when trade restriction measures are available, as is the case with import tariffs, the available information comes at a highly disaggregate level. Economic analysis of these restrictions' effects often requires the researcher to aggregate the information to a higher level (e.g., the industry, region or country) … economic analysis of the effect of these restrictions often requires the researcher to aggregate the information to a higher level (e.g., the industry, region, bilateral trade flow, or country) to map it to the level at which economic outcomes of interest are measured."
>
> Goldberg and Pavcnik (2016)

I. Introduction

Measuring the restrictiveness of a country's trade policy is important. Such measures are essential controls or determinants in empirical assessments of policy, and may be of intrinsic interest in the context of trade negotiations or economic rescue programs. But while the utility of such indicators is not in doubt, their availability is hampered by the need to aggregate across a panoply of heterogeneous restrictions. Some countries have tariff schedules with more than 5,000 individual tariff lines. Aggregating all these tariffs into a single empirical measure is challenging: tariff schedules are complicated; tariffs can be specific or *ad valorem*; tariffs for a given country differ by exporter; weighting individual goods is difficult since tariffs tend to deter and divert potential trade; and all this varies over time. Non-tariff barriers such as quotas, licenses, and regulatory requirements are perhaps even more complex and ubiquitous.

What to do? In theory, the correct way to proceed is to produce measures such as the "Trade Restriction Indices" (hereafter "TRIs") that have been developed and studied by Anderson and Neary (2005). TRIs use as a standard metric, the uniform tariff that would produce the same overall level of trade restrictiveness as the actual pattern of policies. That is, a TRI would hypothetically, if applied to each import, generate the same effect on economic welfare as the actual set of trade restrictions. Coughlin (2010) provides a primer on TRIs, and their usefulness for general equilibrium analysis, albeit often under a set of heroic assumptions. However, in practice TRIs are not widely available. In their absence, practitioners and researchers are forced to use other, admittedly less perfect, measures of aggregate trade restrictions.

Our work is motivated by the importance of aggregate measures of trade restrictions, and their absence.

A New Measure of Aggregate Trade Restrictions (MATR)

Our objective in this paper is to present a new way to quantify policy towards international trade at the aggregate level. In constructing our measure, we are guided by principles. A good measure should, if possible, be: a) simple, b) based on plausible, relevant policy inputs, which are c) quantitative and objective, d) timely and easily updateable, e) available for a large number of countries, for f) a substantial period of time, while covering both g) tariff and non-tariff barriers. In addition, a good measure should "smell right" and look reasonable, across economies (Hong Kong should look more liberal than Venezuela), across time (most trade should become more liberal over the last half of the twentieth century), and across alternative indicators (it should be strongly correlated with tariff rates and openness).

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Our Measure of Aggregate Trade Restrictions (hereafter "MATR") is based on data from the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (hereafter "AREAER"). Our measure is constructed combining information in the AREAER online database (available from 1999 onwards) with the narrative accounts of how restrictive official government policy is towards the international flow of goods and services, obtainable in printed versions of the AREAER country-year specific reports (from 1949 onwards).

MATR is simple, plausible, quantitative, easily updated, based solely on policy-relevant measures of trade policy, and (currently) covers an unbalanced panel of 157 countries annually between 1949 and 2019. MATR is strongly correlated with existing measures of openness and trade policy but is both more comprehensive—with greater country and time coverage—and more granular; it is also robust to minor methodological perturbations. In the first part of the paper, we present MATR as an empirically valuable, if theoretically *ad hoc,* complement to existing measures of trade restrictions.

The Economic Effects of Trade Restrictions

In the second part of the paper, we show that MATR is useful as a new measure of trade policy by using it to investigate the aftermath of trade restrictions. We use Jordà's (2005) local projection method to estimate the response of GDP and other economic outcomes (investment, productivity, employment, consumption, trade flows and inequality) to changes in MATR.

Consistent with much of the theoretical literature (e.g., Caliendo, Feenstra, Romalis and Taylor, 2017) and the empirical literature based on tariffs (e.g., Furceri et al. 2021), we find that trade restrictions are associated with large and persistent declines in GDP.[2] In particular, the results suggest that a one-standard deviation increase in the index (such as that introduced by Thailand in 2000) is associated with a reduction in the level of GDP by about 0.2 percent in the year of the change in MATR and by about 0.7 percent five years later. These effects are statistically significant and economically sizeable. The impact is almost twice the medium-term output effect of the one-standard deviation increase in tariff rates found in Furceri et al. (2021).

In line with theoretical predictions, we also find that there is complementarity between tariff and non-tariff restrictions; the effect of an increase in non-tariff restrictions is larger when tariffs are high. Further, the effect of an increase in trade restrictiveness is larger for countries that import a larger share of intermediate inputs, that is, economies that participate more in Global Value Chains (GVCs).

Our narrative source, however, does not provide enough information for us to separate trade policy actions implemented because of cyclical conditions (motivated by the objective to push output back to its normal trend) from those arising from more exogenous reasons. To address this, and in the same spirit of Romer and Romer (2010), we perform an extensive search of narrative records. We identify dates associated with major changes in MATR and look at the motivation behind such trade policy changes to identify those changes that can be deemed "exogenous". We examine official national documents, reports from international organizations (IMF, World Bank, OECD, WTO), policy papers and academic publications. The results based exogenous measures confirm that trade restrictions are harmful for economic activity.

[2] See Furceri et al. (2020) for a discussion on the output-effect of tariffs from earlier literature. For example, Eichengreen (1981) show that tariffs increase output and employment in the short run but could lead to decline in production in the long run. Ostry and Rose (1992) find no theoretical presumption about the effects of tariffs on output, with the impact depending on a host of factors.

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II. An Introduction to MATR

MATR aggregates the multitude of ways that countries restrict the international trade of goods and services. The underlying variables cover tariffs, non-tariff barriers, and restrictions on requiring, obtaining, and using foreign exchange for current transactions. More precisely, MATR is based on the IMF's AREAER binary variables related to: (i) exchange measures; (ii) arrangements for payments and receipts; (iii) imports and imports payments; (iv) exports and exports proceeds; and (v) payment and proceeds from invisible transfers and current transfers.[3] Each of these categories is further decomposed into sub-categories. The simplest version of MATR is the unweighted sum of up to 22 possible variables.

II. Exchange measures	II.A. Restrictions and/or multiple currency practices
	II.B. Exchange measures imposed for security reasons
IV. Restrictions to payments	IV.A. Prescription of currency requirements
	IV.B. Payments arrangements
	IV.C. Administration of control
	IV.D. Payment arrears
	IV.F. Controls on exports and imports of banknotes
VII. Import Restrictions	VII.A. Foreign exchange budget
	VII.B. Financing requirements for imports
	VII.C. Documentation requirements for release of forex for imports
	VII.D. Import licenses and other nontariff measures
	VII.E. Import taxes and/or tariffs
	VII.F. State Import Monopoly
VIII. Export Restrictions	VIII.A. Repatriation requirements
	VIII.B. Financing requirements
	VIII.C. Documentation requirements
	VIII.D. Export licenses

[3] The AREAER draws together information from a number of sources, including official IMF staff visits to its member. The individual country chapters include information related to restrictions on current international payments and transfers and multiple currency practices subject to the IMF's jurisdiction, in accordance with Article VIII of the IMF's Articles of Agreement, or maintained under Article XIV. The report also provides information on the structure and determination of exchange rates, monetary frameworks, arrangements for payments and receipts, procedures for resident and nonresident accounts, the operation of foreign exchange markets, controls on international trade and capital transactions, and measures implemented in the financial sector, including prudential measures. In addition, it lists exchange measures imposed by member countries for security reasons, including those reported to the IMF in compliance with IMF Executive Board decisions.

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	VIII.E. Export taxes
IX. Payments and X. Proceeds for Invisibles Restrictions	IX.A. Payments for Invisibles, Transfers & Current Transfers
	X.A. Repatriation requirements on Proceeds
	X.A.1. Surrender Requirements on Proceeds
	X.B. Restrictions on use of funds

The IMF's AREAER yearly reports are freely available online from 1949. We constructed the dataset using the narrative record included in the yearly reports, complemented with information available in the AREAER online database; details are in Appendix 1.[4] We score each sub-indicator of MATR as one if a restriction is present in a particular country for a particular year, and zero otherwise. As a result, MATR potentially varies between 0 and 22, with a higher score indicating more restrictions (in practice MATR varies between 2 and 21).

We believe that sections VII (Import Restrictions) and VIII (Export Restrictions) are likely the most important of the 22 variables, but we do not restrict ourselves solely to them, because of evidence that other instruments have been used in practice for protectionism.[5] Below, we demonstrate the insensitivity of MATR to the exact choice of underlying fundamentals. Perhaps more importantly, we provide the underlying fundamentals in the raw data set, so that users can choose for themselves.

MATR has several desirable properties. This simple measure is based on sensible, plausible, trade policy inputs from a transparent, accessible, reliable source. Each of the underlying fundamentals is quantitative, based on clear criteria, and the fundamentals include a host of non-tariff barriers as well as tariffs. Normalization issues are avoided since the measure is an aggregate of binary components. MATR is available for a large, unbalanced panel of most economies from 1949 through 2019, and it is regularly updated.[6,7] The coverage increases from about 30 economies in 1949 to more than 100 in 1973, and over 150 by 2000, as shown in Figure 1 (regional analogues are presented in Appendix 1, Figure A1.1).

Admittedly, MATR is an *ad hoc* measure, without a clear theoretical interpretation. It is an intrinsically aggregate measure rather than a weighted average of disaggregated microdata (as for aggregate tariffs). Moreover, it codes the *existence* of restrictions, not their intensity or efficacy. In this respect, the measure is similar to the Chinn and Ito (2008) index for capital controls. That said, and as shown in the next section, MATR is strongly correlated with existing measures that capture the intensity of trade restrictions, as well as with *de facto* measures of their consequences, such as trade openness.

[4] Each variable is, in principle, absolute, not relative; unity merely reflects the presence of a trade barrier (and zero its absence), not how the country*year observation compares with current best practice. In this, our measure differs from, e.g., Cerdeiro and Nam (2018).

[5] The 1997 AREAER (p 1) states that the "Import and Import Payments" section of the data base describes the nature and extend of exchange and trade restrictions on imports.

[6] Cerdeiro and Nam (2018) deplore the fact that measures of trade policy rarely extend far back in time.

[7] MATR is also essentially unaffected by missing granular data since the latter can be filled in using *AREAER* entries on annual changes to fundamentals.

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MATR is just one particularly simple way to aggregate the 22 underlying fundamentals. While we find simplicity attractive, it is not particularly important. Below, we consider both broader and more narrow sets of fundamentals, and we use both factor and principal component analysis to weigh the fundamentals differently; each of these variants is provided in the MATR database which we will make available.

Whether MATR is useful or not remains to be seen; we now try to make the case that MATR is a useful complement to existing measures.

A Graphical Portrait

We now present a broad-brush picture of MATR.

Figure 2 scatters MATR against the size of the economy in 2016, as measured by the natural logarithm of real GDP (measured in USD, from the Penn World Table). The data are a cloud; there is no strong relationship between our new measure of trade restrictions and the sheer size of the economy. In the lower-right of Figure 2 are large open economies such as the United States and Germany. Large but relatively closed economies like India and China are in the top right. Small open economies like Hong Kong are towards the bottom.

Figures 3-6 examine the time-series characteristics of MATR. Figure 3 shows the development of MATR for advanced economies (AEs) and emerging market and developing economies (EMDEs). Both groups began in comparable situations, started to liberalize in the early 1970s, and have done little since the early 2000s; the liberalizations were more dramatic for AEs than EMDEs. Figure 4 presents the evolution of MATR across regions. Not surprisingly, European countries are typically characterized by the lowest restrictions, and Africans by the highest trade. MATR moves little over a typical year for most countries. Its stability is manifest in Figure 5, which scatters MATR values across four decades.[8]

Figure 6 plots the evolution of MATR for eighteen economies. The levels of MATR seem eminently sensible. For instance, in the top-left panel, MATR for the United States remains low throughout the period, while for China the opposite is true. Indonesia imposes more trade restrictions than the United Kingdom; Russia has more restrictions than Canada and Germany. India and South Africa have numerous restrictions throughout. The panels also show a few dramatic cases of MATR changes; particularly noticeable are increases in Venezuelan restrictions to trade, and the reductions for the United Kingdom and Hong Kong.

Thus far, we have only provided an intrinsic description of MATR's properties. Figure 7 broadens the exploration by providing scatterplots of MATR against four key variables, in each case using data from 1996. Richer countries tend to have fewer trade restrictions, as shown by the scatter of MATR against log real GDP per capita in the top-left panel. Reassuringly, the relationship is strongly negative. Smaller countries tend to be more open and have fewer restrictions, as reflected in the upward-sloping scatter of MATR against log population in the top-right graph.

What of traditional measures of trade restrictiveness? Tariff rates are an imperfect measure of protectionism, because of well-known measurement problems as well as NTBs. Nevertheless, tariffs remain an important measure of protectionism, in part because they are available for many countries and periods. As shown in the

[8] Figure A1.2 presents a histogram of the net changes in MATR between 1976 and 2016 for the 106 economies with data in both years. The histogram is clustered between zero and five, since MATR usually moves little on net even over 40 years.

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lower-left panel of Figure 7, MATR is strongly correlated with the World Bank's tariff rate measure.[9] Another widely used measure is *de facto* trade openness, the ratio of exports and imports to output. There are many determinants of openness beyond protectionism; remote, landlocked, thinly populated countries with idiosyncratic languages tend to trade less. Nevertheless, MATR is negatively correlated with openness, as shown in the lower-right panel. Statistical analogues to the figures are reported in Table 1, when MATR is regressed against these variables, along with income, size, and year effects.

The image of MATR that emerges from the graphical evidence seems sensible. There is no clear relationship between economic mass and trade restrictions; trade policy restrictions move only slowly over time, and the differences between countries are more systematic than those within a country over time. Richer and smaller countries have systematically lower values of MATR, as do more open countries, and those with lower tariff rates. One does not want to over-interpret these simple scatterplots, since each is a simple bivariate cross-sectional relationship, taking no account of other factors.[10] But collectively they provide reassurance.

Sensitivity Analysis

The most straightforward version of MATR is a sum of up to 22 binary dummy variables, each weighted equally. There are alternative ways to use the fundamentals from *AREAER*, and we now briefly consider some.

One tack is to aggregate the underlying AREAER variables in a more sophisticated way. We use standard factor analysis to extract the first principal factor from the 22 fundamentals; this allows for different weights (not necessarily all positive, let alone equal) to be applied to the underlying variables. The factor analysis works relatively well in the sense that the scatter-plot is steep (the first eigenvalue is 6.16, while the second and third are .72 and .64), and the loadings for the first factor are positive for 21 of the 22 fundamentals. We also generate a closely related variant, the first principal component, following Chinn and Ito (2008) on capital account restrictions.[11,12] Both measures are strongly correlated with the baseline version of MATR (Figure A1.3).

[9] That is, the mean weighted applied tariff rate for all products, available from the *World Development Indicators*.

[10] Nevertheless, the visual impressions of Figure 4—and of other results elsewhere—stand up to more rigorous statistical inspection. This is clear from Table 1, which provides estimates when MATR is regressed on the variables of interest (such as the tariff rate or trade openness), controlling for year fixed effects as well as log size and income.

[11] Since this is a three-way panel (countries, years, and fundamentals), we cannot use dynamic factor models. Dynamic factor analysis country-by-country does not seem sensible, since we only have 21 time-series observations. Factors and principal components extracted from the cross-section, year by year, yield basically the same factors as ours.

[12] A different way to proceed is to use different sets of underlying AREAER fundamentals. Some of MATR's components are more distant from the underlying objective of measuring trade restrictions; this suggests using only a more restricted set of fundamentals. But AREAER also provides indicators that we do not use, allowing for the more liberal use of fundamentals. We try both directions. Variant 1 is a restrictive version of MATR with only the sum of the eleven trade related variables (AREAER variables for both import restrictions [VII.A through VII.F], and export restrictions [VIII.A through VIII.E]). This is a relatively coarse variable, ranging in principle from 0-11. But we also create more inclusive measures than MATR. Variant 4 is the least restrictive and adds in 27 more fundamentals, using all the sub indicators of the main subcomponents (if there are any).Variants 3 and 4 are intermediate between Variant 1 and variant 4. In Figure A1.3, MATR is scattered against all six of these variants; it is highly correlated with each. This also shows up in more rigorous statistical analysis; Table 2 reports results when MATR and its variants are regressed against income, size, and year effects.

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III. Is MATR Useful?

Our measure is strongly correlated with existing measures of trade restrictions. To repeat, as portrayed in Figure 7, MATR is correlated with both tariff rates and openness (also apparent in Table 1). We provide more comparisons in Figure 8, which is a series of scatterplots of MATR (always on the y-axis) against alternative measures of aggregate trade restrictions. Each of the graphs is a cross-country scatterplot (most of the alternatives are not available in panel form over any substantive span of time); statistical analogues are again recorded in Table 1.[13] We consider six alternative measures:

1. Novy's (2012) measure of *Trade Costs*, a "comprehensive all-inclusive measure … providing an alternative measure of trade facilitation performance," used by the UN's ESCAP in conjunction with the World Bank, with export weights,[14]
2. The World Economic Forum's 2016 Index of *Trade Enablement*, which "assesses performance of 136 economies on domestic and foreign market access; border administration; transport and digital infrastructure; transport services; and operating environment",[15]
3. Quinn's measure of *Current Account Financial Openness* "… an indicator of how compliant a government is with its obligations under the IMF's Article VIII to free from government restrictions the proceeds from international trade of goods and services..."[16]
4. A TRI produced by the World Bank (2009), using methodology from Kee et al. (2009),[17]
5. A similar World Bank TRI produced using only tariffs, for 2009, and
6. A similar World Bank TRI for the service sector.[18]

In each case, the correlation between alternative indicators and MATR is correctly signed; Table 1 indicates that it is also significantly different from zero except for some of the TRI measures (which may be the result of the small sample size).

The closest variable to MATR that is available for a long period of time is the sub-component "Trade Freedom" of the Heritage Foundation's *Index of Economic Freedom*, discussed further in Appendix 3. Trade Freedom, "a composite measure of the absence of tariff and non-tariff barriers," is available for approximately the same countries as MATR, but with less time coverage; MATR begins in 1949, Trade Freedom in 1995. Like MATR, Trade Freedom is a measure of trade policy arising from both tariffs and NTBs. Its methodology is unclear, which may explain why it has not been used widely in the academic literature. But Trade Freedom and MATR are similarly motivated, so it is natural to compare the two measures. Reassuringly, Figure 9 shows that MATR and trade freedom are strongly (negatively) correlated at both the beginning and end of the sample, as well as two years in between. More trade restrictions are strongly correlated with less trade freedom. And since both

[13] Novy's trade costs and Quinn's measure of current account and financial openness are available over long time spans.

[14] Further details are available at https://www.unescap.org/resources/escap-world-bank-trade-cost-database.

[15] http://reports.weforum.org/global-enabling-trade-report-2016/files/2016/11/GETR16_Global_FINAL_with-language-links.pdf; further details available at http://reports.weforum.org/global-enabling-trade-report-2016/downloads-page/. This measure is available for 2012, 2014, and 2016.

[16] More at http://faculty.msb.edu/quinnd/data/capital%20_financial_current_Master_1950_2012_public.xlsx .

[17] Further details are available at https://datacatalog.worldbank.org/dataset/overall-trade-restrictiveness-indices-and-import-demand-elasticities.

[18] Further details are available at http://iresearch.worldbank.org/servicetrade/default.htm.

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MATR and trade freedom are likely to be imperfect measures of the underlying concept, each can serve as an instrumental variable for the other.

A final comparison of interest is with the celebrated Chinn-Ito (2008) measure of financial openness. Like MATR, the fundamentals of the Chinn-Ito "kaopen" measure stem from *AREAER*; but kaopen seeks to measure the international mobility of *capital*, where MATR's focus is on international flows of *goods and services*. Also, where MATR simply sums the (up to 22) underlying AREAER fundamentals, kaopen is the first principal component of (transformations of) the underlying four variables (controls over current or capital account transactions, multiple exchange rates, and export surrender requirements). Figure 10 presents four scatter plots (for the same years as Figure 9) of MATR against kaopen. The series are substantially different, but strongly negatively related; countries more open to capital flows à la Chinn-Ito have fewer trade restrictions, as measured in MATR.

Potential Applications

Why does the world need another, admittedly imperfect, aggregate measure of trade policy? The short answer is that such measures are used, and there aren't enough of them. Since more imperfect measures are better than fewer, we propose MATR as a helpful addition to the literature, especially given its substantial coverage over time. In this section, we provide some explicit examples of where MATR might have been useful in the past.

In a well-cited paper, Ilzetzki, Mendoza and Végh (2010) compare estimated fiscal multipliers across a variety of different environments, including stage of development, exchange rate regime, public indebtedness, and openness to trade. They find that fiscal multipliers are smaller for open as opposed to closed economies, using two definitions of the latter. The first involves splitting the sample according to the trade/GDP ratio, though the authors acknowledge that low openness may be due to factors other than trade policy. The authors also split the sample by national tariff rates. MATR might have been useful in exactly such circumstances.

In an influential paper, Rodrik (1998) investigated openness as a determinant of government size, without distinguishing between natural and artificial barriers to international trade. Similarly, Alesina and Wacziarg (1998), another well-cited paper, links government size and openness through the channel of country size, but without distinguishing artificial and natural trade barriers. Both papers might have benefited from MATR.

In a completely different literature, two well-known papers Hall and Jones (1999) and Sachs and Warner (1995) use the same measure of policy-driven trade openness as a key determinant of income levels and growth respectively. This measure has been criticized by Rodriguez and Rodrik (2000), who focus on the growth impact of policy-induced trade barriers.[19] Yet again, MATR might have helped.

A number of papers simultaneously employ separate measures of the international mobility of a) goods and services, and b) capital, often as control variables. For the latter, it is now common to use the policy-based

[19] Rodríguez and Rodrik ask (p264) "… Do countries with lower policy-induced barriers to international trade grow faster, once other relevant country characteristics are controlled for? We take this to be the central question of policy relevance in this area… Note that this question differs from an alternative one we could have asked: Does international trade raise growth rates of income?" In his comment on the paper, Hsieh writes (p325) "Their main point is that the empirical evidence that purportedly shows a negative correlation between trade barriers and growth typically relies on measures that are either measures of macroeconomic imbalances or bad institutions and are not actually measures of trade barriers."

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measure of capital mobility estimated by Chinn and Ito (2008). However, for the former, it is almost as common to use openness, the ratio of exports and imports to aggregate output. For instance, in modelling capital flows, Fratzscher (2012) uses the Chinn-Ito (2008) measure of capital mobility, and openness to measure trade. Openness is also used as a control along with the Chinn-Ito index in a well-cited paper on growth by Eichengreen, Park and Shin (2012). In yet another well-cited paper, Milesi-Ferretti and Tille (2011) use trade openness along with the Chinn-Ito index. But while the Chinn-Ito measure relies on the presence of liberal/restrictive *policies* towards capital flows, *openness* is driven by other factors as well; more on this below. One of our objectives in this paper is to produce an analogue to the Chinn-Ito measure of capital mobility; simple to use and broad in both scope and span, if also *ad hoc*.

The problem of measuring the state of aggregate trade restrictions is similar to that of measuring the exchange rate regime. There are a number of different systems for measuring how flexibly an exchange rate moves, and there is often conflict between different schemes; Rose (2011) provides details. It is striking how many more measures of exchange rate regimes there are compared with measures of mobility of trade in goods and services.

IV. The Effect of MATR on Economic Activity

We now examine the periods after changes in MATR, to see if the dynamics of aggregate output are different following changes in trade policy. Since our contribution lies in the MATR series, we deliberately choose a well-known plain-vanilla methodology.

Empirical Methodology

To examine the short run dynamics of output following changes in trade barriers, we follow the local projection method proposed by Jordà (2005); this methodology has also been used by many others, including Auerbach and Gorodnichenko (2013), Romer and Romer (2018), and Alesina et al. (2019). This procedure does not impose the dynamic restrictions embedded in vector autoregression specifications and is particularly suited to estimating nonlinearities in the dynamic response. The first regression we estimate is:

$$y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta^k \Delta R_{i,t} + \sum_{j=0}^{2} \vartheta_j^k \Delta R_{i,t-j} + \sum_{j=0}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k, \quad (1)$$

where:

- *i* denotes the economy and *t* denotes the year,
- *k* denotes the horizon being considered (in years after the change in trade barriers),
- *y* is the log of output,
- $\{\alpha\}$ are country fixed effects, included to account for differences in countries' average economic performance,
- $\{\gamma\}$ are time fixed effects, included to control for economic developments facing all countries in a given year, and
- ΔR denotes the change in MATR, increasing with restrictions,
- $\{\vartheta\}$ and $\{\theta\}$ are nuisance coefficients, and
- $\{\varepsilon\}$ are residuals that represent all other output determinants.

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For the main results, we use the aggregate MATR index, denoted *R*. We also report separate results for sub-indices, as well as alternative aggregations as robustness checks.

The coefficient β^k denotes the "impact" of changes in trade barriers on output at a given horizon *k*. In the baseline we do not take a stance on the drivers of trade barriers; that is, we do not distinguish between changes in trade restrictions that can be considered exogenous to economic activity in the short-to-medium run, and endogenous changes. The latter might occur as part of broader reform, or because of a cyclical motivation to push output back to trend during recessions. Below, we also investigate the sensitivity of our results by focusing on major episodes of liberalization and tightening of trade barriers, since these can be considered more exogenous.

We estimate equation (1) for an unbalanced sample of 157 countries from 1949 to 2019, using ordinary least squares (OLS) for k = 0,…,5. Impulse response functions are computed using the estimated coefficients β^k, and the confidence bands associated with the estimated impulse-response functions are obtained using their estimated standard errors. We also apply Driscoll and Kraay (1998) standard errors to account for cross-sectional and time dependence in the error term ε_t^k. Throughout, we consider alternative specification choices, and provide details of these, and the associated results, in Appendix 4.

Data Sources

Appendix 2 provides a summary of our other data sources. Annual series for GDP, labor productivity (defined as the ratio of GDP to employment), employment, investment, consumption are taken from the Penn World Table (PWT10.0). Exports, imports and the trade balance are taken from World Economic Outlook (April 2021). The Gini coefficient, a measure of inequality, is taken from the Standardized World Income Inequality Database (SWIID). Series on the level of regulation in product and financial markets, and job protection legislation, are taken from Alesina et al. (2019). Measures of Global Value Chains (GVC) comes from UNCTAD EORA database. Tariffs are taken from Furceri et al. (2021). The classification of countries in income groups (advanced vs. emerging and developing economies) and regions (Africa, Asia-Pacific, Europe, MENA and the Americas) follows that of the IMF World Economic Outlook.

Results

Table 3 presents the results obtained estimating equation (1) for each horizon *k*, from 0 to 5. The lagged output coefficients {*θ*}, as expected, sum close to 1, suggesting that the level of GDP is non-stationary and that the country fixed effects *de facto* capture average national growth rates.[20] The country fixed effects are jointly statistically significant; so are the time fixed effects, reflecting the importance of global shocks as well as the fact that some changes in trade restrictions are determined by multi-country trade agreements.

The coefficients of interest are {*β*}; these are presented in Figure 11, the evolution of (log) output following a one-standard deviation in MATR.[21] Time is on the x-axis; the solid line portrays the average estimated response, and its 90 percent confidence interval is included. The results suggest that such an increase in MATR (comparable to that of Thailand in 2000) is associated with an immediate reduction in output by 0.2

[20] Panel cointegration tests reject the null hypothesis that the estimated residual of equation (1) is non-stationary.
[21] Equivalent to 0.82 changes in the index.

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percent, and by 0.7 percent five years after. This effect is highly significant in both statistical and economic terms. To put it in perspective, it is almost twice the medium-term output effect of one-standard deviation increase in tariff rates found in Furceri et al. (2021). It is also economically plausible, close in magnitude to simulation results from a sectoral, computable, general equilibrium model with input-output linkages (Caliendo, Feenstra, Romalis and Taylor, 2017) based on the same magnitude of reduction in trade restrictions (IMF 2021 provide more details).

To check the robustness of these associations, we performed a number of sensitivity tests across alternative samples and specifications, and present the results in Appendix 4, which presents a number of analogues of Figure 11. For instance, we divided our observations into those from advanced and emerging economies; reassuringly, the results for the different groups suggest that effect of reducing trade barriers is statistically significant in both AEs and EMDEs, albeit larger in the second group.[22] To get a sense of the components of MATR driving the results for AEs and EMDEs, we run the regressions on the different components of trade restrictions: invisibles, exports, imports, payments and exchange measures. The results in AEs seem to be driven mainly by export and import restrictions (latter statistically significant), while those for EMDEs seem to be driven mainly by restrictions related to invisibles, exports, imports, and payments (all statistically significant).

Potential Channels of Influence

We now explore informally some of the channels through which trade restrictions might affect output, in the hope that patterns might emerge to stimulate future research. We re-estimate (1) using as alternative dependent variables: (i) labor productivity; (ii) employment; (iii) inequality; (iv) the trade balance; (v) investment; (vi) consumption; (vii) exports and (viii) imports. The results are reported in Figure 12 in graphics constructed analogously to Figure 11.

The results suggest that one key channel is the statistically and economically significant decrease in labor productivity, which declines by about 1.5 percent after five years. This result confirms the standard view that protectionism can lead to a meaningful reduction in the efficiency with which labor is used, and thus output. An increase in trade barriers is also associated with lower investment, consistent with the idea that firms face less

[22] We have also reduced the sample in a number of ways, and again, present the results in Appendix 4 (Figure A4.2). In particular, we changed the sample through dropping: (i) series with gaps and less than 20 consecutive years of data; (ii) high inflation (>100%) episodes; (iii) small countries (population < one million); (iv) outliers (those with output residuals in the bottom and top percentiles of the distribution)[22]; (v) years before 1980; (vi) episodes with large changes in MATR change (corresponding to the 99th percentile of the distribution); (vii) observations from the Americas; and (viii) observations from Asia and Sub-Saharan Africa. Our results persist through all these perturbations.

We also consider three perturbations to the methodology of (1). First, we expand the set of controls by including contemporaneous changes in the trade balance and the real exchange rate; this is equivalent to considering shocks to MATR that are orthogonal to contemporaneous shocks in these variables. Second, we restrict MATR to enter (1) only with a lag; that is, we exclude a contemporaneous effect of MATR on GDP. As discussed above, an important issue in estimating the causal economic effects of MATR is the contemporaneous relation between economic activity and MATR: our baseline specification (1) does not distinguish between changes in trade barriers that can be considered exogenous to economic activity in the short run, from those endogenous that are correlated with contemporaneous shocks to economic activity or that are motivated by short-term economic objectives. Another way to address endogeneity is to include a measure of expectations on contemporaneous growth as a control (Corsetti et al. 2012; Duval and Furceri 2018). We also implement this by including the IMF WEO GDP growth forecasts made in October of the same projecting year (e.g., the growth forecast for 2018 made in October of 2018). Happily our results remain robust to these alternative specifications. While these are only imperfect ways to address endogeneity, they provide some reassurance of the main findings.

Finally, we re-estimate (1) but using the six different variants of MATR presented in Appendix 1(Figure A1.3); the results are presented again presented in Appendix 4 (Figure A4.3). Our key result – of a persistent, economically, and statistically significant decline in output after trade is restricted – does not depend on the precise measurement of MATR.

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competition from abroad and have therefore less incentive to invest. Unsurprisingly, both imports and exports fall with an increase in protectionism. Another predictable result is that increases trade barriers lower consumption, by around 1 percent after five years; this result is unsurprising, given the decline in income. While the reduced-form approach does not allow for a full-fledged analysis of the welfare effects of trade restrictions, the broad characteristics indicate that trade restrictions resemble shocks to the productivity of the tradeables sector.

Finally, the results also suggest that increases in trade restrictions are associated with a reduction in inequality. This result mirrors the view that trade liberalization does come with potentially adverse distributional consequences, as resource reallocation associated with reforms generates both winners and losers, with the already better-off well positioned to benefit more.

Components of MATR and Alternative Aggregations

Are specific trade restrictions more harmful than others? To address this question, we repeated the analysis to consider separately the five main components of MATR: (i) exchange measures; (ii) payment restrictions; (iii) import restrictions; (iv) export restrictions; and (v) payment for invisibles. The results, reported in Figure 13, suggest that increases in any component is associated with a decline in output. The effects are not statistically different across components.

Non-linearities

Theory suggests two important elements of heterogeneity in the effects of trade restrictions (Caliendo, Feenstra, Romalis and Taylor, 2017): (i) there is complementarity between tariff and non-tariff restrictions—that is, the effect of an increase in non-tariff restrictions is larger in situation when tariffs are higher; and (ii) the effect of an increase in trade restriction is larger for countries that are imports a larger share of intermediate inputs—that is, if the country participates more in Global Value Chains (GVCs).

To test these hypotheses, we modify equation (1) to allow the response to vary across according to a given country's characteristics—the level of tariff and the degree of GVC participation. The specification we estimate is:

$$y_{i,t+k} = \alpha_i^k + \gamma_t^k + F(z_{it})\left[\beta^{1k}\Delta R_{i,t} + \sum_{j=0}^{2}\vartheta_j^{1k}\Delta R_{i,t-j} + \sum_{j=0}^{2}\theta_j^{1k}y_{i,t-j}\right] + (1 - F(z_{it}))[\beta^{2k}\Delta R_{i,t} + \sum_{j=0}^{2}\vartheta_j^{2k}\Delta R_{i,t-j} + \sum_{j=0}^{2}\theta_j^{2k}y_{i,t-j}] + \varepsilon_t^k, \quad (2)$$

$$\text{with } F(z_{it}) = \frac{exp^{-z_{it}}}{(exp^{-z_{it}})}; \text{ and } z_{it} = \frac{(x_{it} - \bar{x})}{sd\,(x_i)}$$

where *z* is the variable measuring a given country characteristics (*x,* tariff rate and GVC participation), normalized to have zero mean and a unit variance. The weights assigned to each regime vary between 0 and 1 according to the weighting function $F(.)$, so that $F(z_{it})$ can be interpreted as the probability of being in a given state. The coefficients β^{1k} and β^{2k} capture the output impact of trade barriers at horizon *k* in cases of very low *z* ($F(z_{it}) \approx 1$ when *z* goes to minus infinity) or high *z* ($1 - F(z_{it}) \approx 1$ when z goes to plus infinity), respectively.[23] This approach

[23] $F(z_{it})$=0.5 is the cutoff between low and high *z*. The approach is similar to considering a dummy variable that takes value 1 when the z is below zero, or the underlying country characteristics (*x*) below average ($\bar{x}$)—that is, $F(z_{it})$>=0.5, and zero otherwise. The difference is that instead of considering two discrete values (0 and 1), the smooth transition approaches allow the regimes to continuously vary between 0 and 1.

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is equivalent to the smooth transition autoregressive model developed by Granger and Terävistra (1993), and has two advantages. First, it permits a direct test of whether the effect of reforms varies across different country characteristics. Second, compared with estimating structural vector autoregressions for each regime, it allows the effect of trade barriers to change smoothly between states by considering a continuum of states to compute the impulse response functions, thus making the response more stable and precise.

We estimate equation (2) with OLS, with standard errors clustered at the country level. The time and country sample used to estimate equation (2) is typically reduced compared to equation (1) because of limited data availability regarding the national characteristics, *z*, being considered (see Appendix 1). Still, the results obtained by estimating equation (2) confirm the theoretical predictions (analogues to Figure 11 are contained in Appendix 4). The decline in output following a one-standard deviation increase in MATR (excluding the tariff component) is larger when tariffs are high than when tariff rates are low (Figure A4.4), so there seem to be complementarity effects of protectionism; non-tariff barriers hurt more when tariffs are higher. Second, the effect of MATR is larger for countries with high GVC participation, as shown in Figure A4.5.[24]

Large and Plausibly Exogenous Episodes of Trade Policy Change

As one final robustness check, we focus on both large and plausibly exogenous episodes of trade policy change. We follow the spirit of Romer and Romer (2010), and search for exogenous MATR shocks not intended to offset the output gap or return growth to trend.

The first step in identifying such episodes is to look at large changes in MATR. We follow the literature's approach to infer major episodes of stock market liberalization (Henry 2007) and capital account liberalization (Furceri and Loungani 2018; Furceri, Loungani and Ostry 2019). We identify episodes in which changes in MATR exceed their average by at least two standard deviations, using all observations (in practice, this is where MATR changes by more than 1.64). This criterion identifies a large but manageable number of 385 episodes, 123 of increased restrictions and 262 of liberalization; the majority of these occurred between 1989 and 2008. We narrow our focus to these, ignoring the many minor episodes of MATR changes that make the narrative identification difficult. This reduces measurement error associated with the timing of minor and potential gradual changes in MATR. It also reduces the possibility of reverse causality, as large changes are unlikely to be driven by normal business cycle conditions.[25]

Of course, these major changes could be determined by significant economic shocks and crisis and therefore might still be endogenous. Therefore, as a second step, we restrict our selection to those episodes that were not preceded or succeeded by economic and financial crises in a one-year interval. This results in 162 episodes, listed in Appendix 1 (Table A1.4).

We redo our analysis by replacing the change in MATR in equation (1) with a discrete variable which takes value 1 for a major trade restriction, -1 for a major liberalization and 0 otherwise. The results, presented in Figure 14, are similar to but smaller than those of the baseline Figure 11. The analysis confirms that major

[24] These results are robust to alternative non-linear specifications, such as including in equation (1) either a) an interaction term between change in MATR and the level of tariff (GVC participation), or b) interactions between change in MATR and dummies that denote alternatively quartiles of distribution of the country's characteristics.

[25] Indeed, we run Granger causality tests between large episodes and growth, and do not find that past GDP growth helps to predict major changes in trade restrictions—the p-value for the test of the null hypothesis that GDP growth Granger cause large changes in MATR is about 0.76.

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trade restrictions are associated with significant output declines, of around 0.35 percent 5 years after the restriction.

While closer to being exogenous, these major MATR changes could be driven by the desire of policy makers to bring growth to trend. To address this issue, we perform extensive search of narrative records. We searched through official national documents, international institutions reports (such as IMF, WTO or World Bank), AREAER reports, trade institutes and think-tanks (such as FREIT[26], TRALAC[27], SICE[28], ECIPE[29]), policy papers, publications and other online sources, looking for the absence of any discussion of counter-acting shocks or of any desire to close an output gap. This approach produces a smaller list of 58 episodes, 7 increase in restrictions and 51 liberalizations (see Table A1.5 of Appendix 1, for the list of episodes and the associated narrative records). Looking closely, most of these "exogenous" episodes are associated with ideological and/or political changes. For instance, one occurred in Austria 1995, when the Austrian Independence Treaty was signed. Others occurred as part of major trade agreements among countries to strengthen economic and political linkages, such as those associated with the EU or WTO memberships. Still others were motivated by the desire to increase long-run growth, such as the increase in restriction associated with the import substitution strategy implemented by Costa Rica in 1966.

One final concern is that these episodes could still be part of broader reform packages aimed at improving long-term output. To address this issue, we further restrict the set of episodes to exclude those occurred during an IMF stabilization program and those associated with other major changes in product, domestic and external finance, and labor market reforms—dates for these reform indicators are taken from Alesina et al. 2020—(Table A.1.6).[30]

The results obtained by re-estimating equation (1) with the "exogenous" changes in MATR identified with the narrative approach and excluding structural reforms are presented in Figure 15 and 16. The results confirm that trade restrictions have statistically significant negative effects on output, with output falling by almost 0.4 percent 5 years after.

V. Summary and Conclusion

In this paper, we propose a new Measure of Aggregate Trade Restrictions, MATR. This simple measure has a number of desirable properties: it is based on sensible, plausible, trade policy inputs with a transparent, accessible, reliable source. Each of the underlying fundamentals is quantitative, based on clear criteria, and include both tariffs and a host of non-tariff barriers. MATR covers an unbalanced sample of 157 countries annually between 1949 and 2019, is strongly correlated with existing measures of openness and trade policy, and is more comprehensive than existing measures. Using MATR, as well as a narrative approach to identify the motivation behind changes in MATR, we show that trade restrictions are harmful for the economy and lead to significant contractions in output.

[26] Forum for Research in Empirical International Trade.

[27] Trade Law Center.

[28] Foreign Trade Information Center. Organization of American States.

[29] European Center for International Political Economy.

[30] The episodes are listed in Appendix 1, Table A1.6.

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Our work could be extended further in at least three dimensions. We have only considered impediments to the international flow of goods and services; future scholars may also want to consider FDI. Another thing for other researchers to contemplate is lagged values. In measuring capital mobility, Chinn and Ito (2008) use moving averages of current plus lagged values; we only consider contemporaneous values. Finally, we have developed MATR without a rigorous theoretical model which would be necessary to understand the general equilibrium and welfare consequences of trade restrictions more deeply.

We emphasize that MATR is not a perfect measure of artificial trade impediments. Most obviously, it is theoretically *ad hoc.* It diverges from the literature in that it is an aggregate measure of trade restrictions composed only from aggregate data, not a weighted average of disaggregated data. For all these reasons, MATR certainly does not displace any existing measures of aggregate trade restrictions; rather, we think of it as a complementary measure. There is no perfect (or even, perhaps, good) measure of aggregate trade restrictions; we think that adding another, admittedly imperfect, such measure is a worthwhile contribution, and an appropriate place to pass the torch to others.

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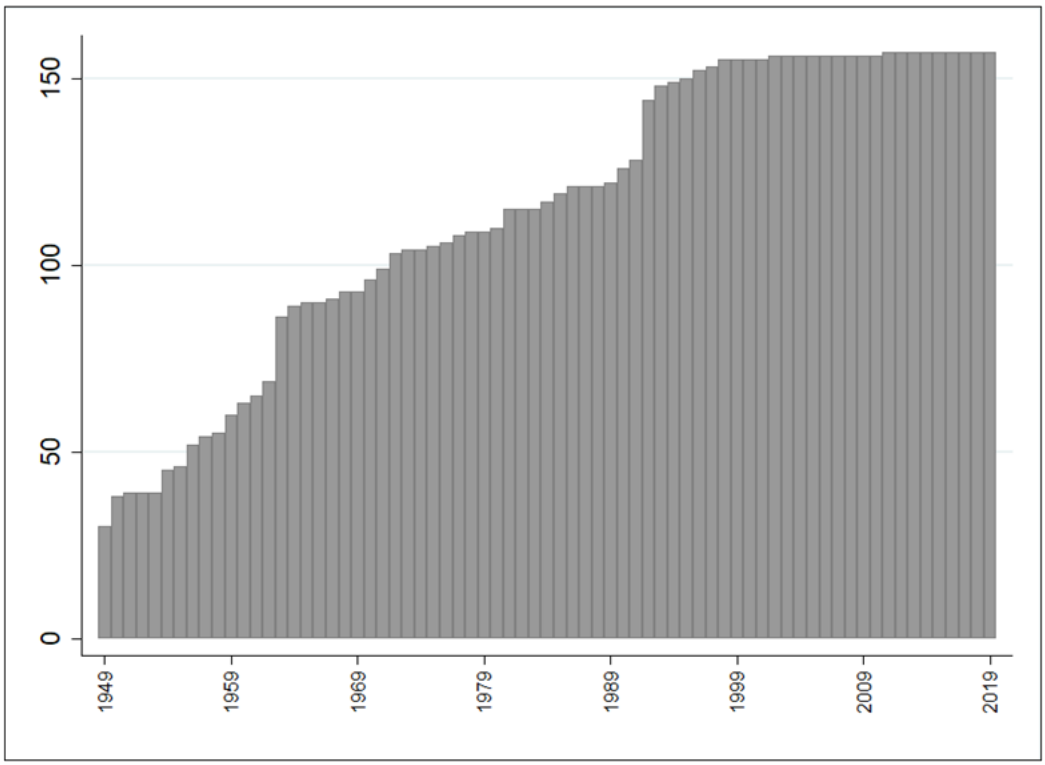
Figure 1: MATR country coverage over time



Y axis presents the number of countries that have data for that particular year.

Figure 2: MATR against the size of the economy in 2016

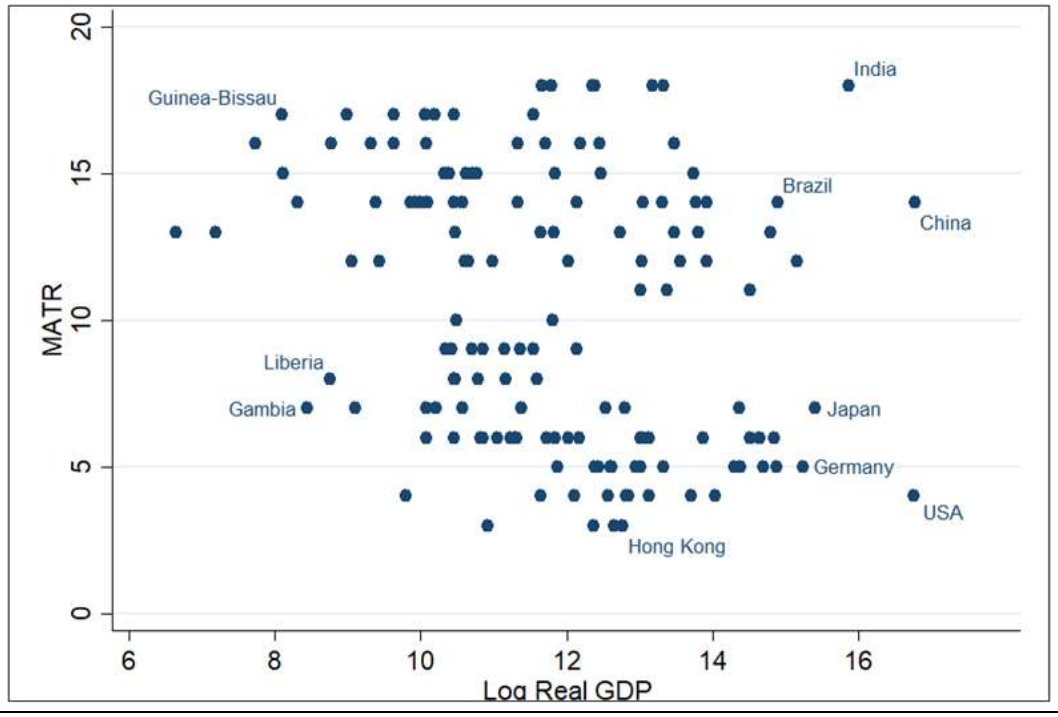


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Figure 3: Evolution of MATR over time, by income groups

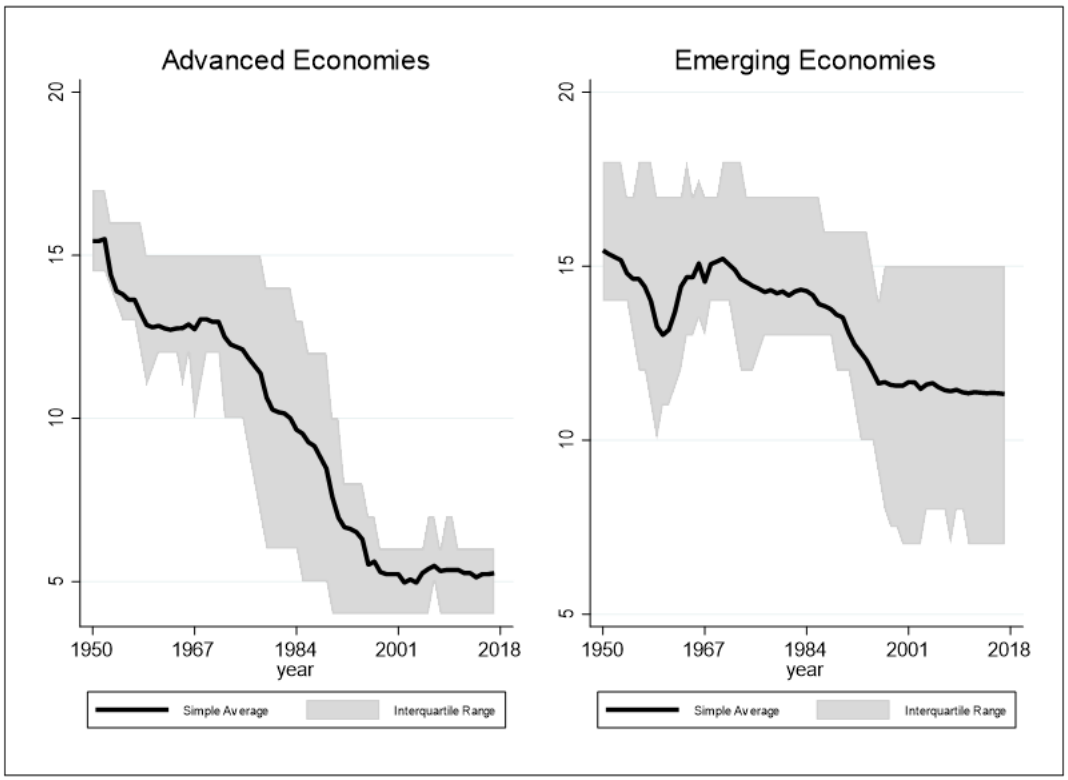

Figure plots year specific simple average and interquartile range of MATR for Advanced and Emerging Economies, classified following the IMF World Economic Outlook.

Figure 4: Evolution of MATR over time, by region

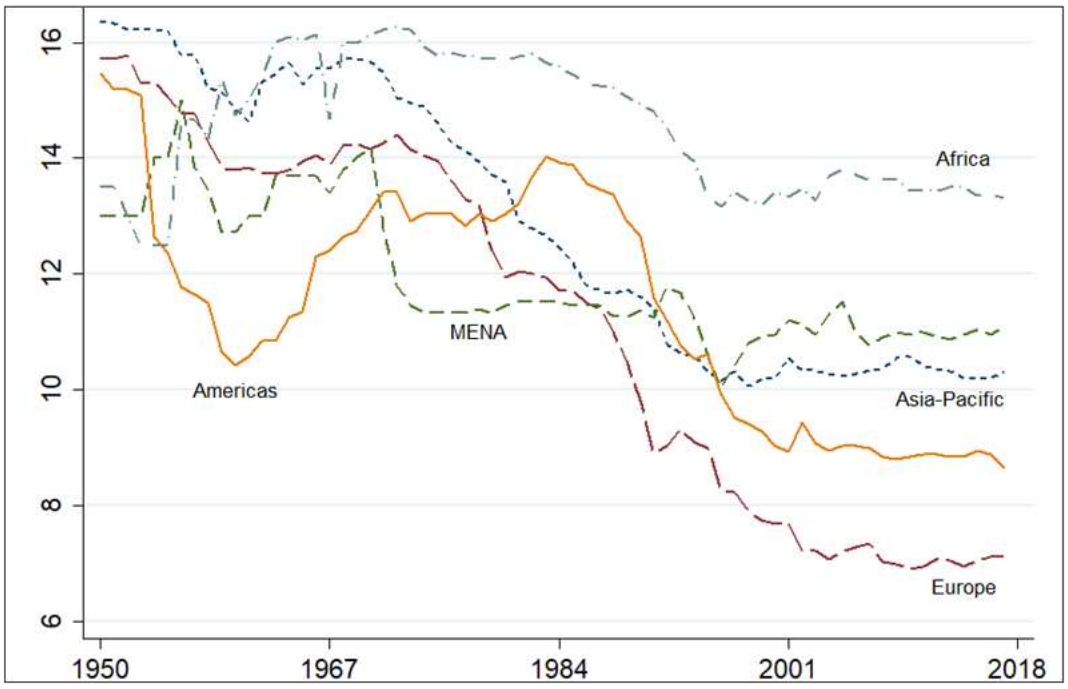

Figure plots the simple average of MATR by region. Regions are classified following the IMF World Economic Outlook.

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Figure 5: Evolution of MATR over time, by decade

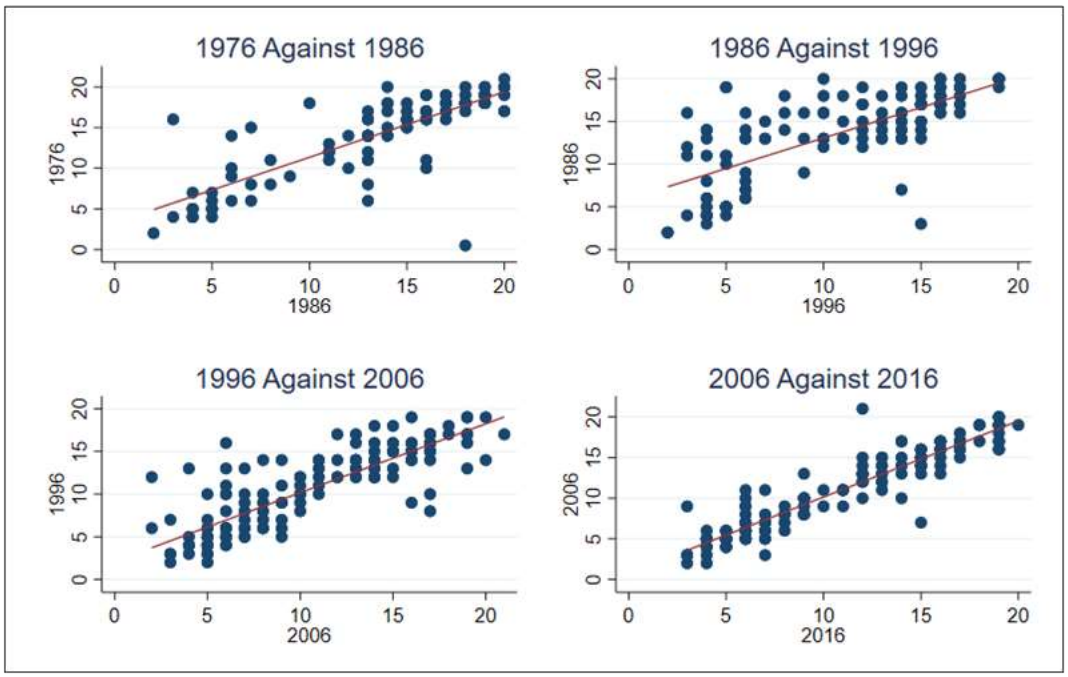

Figure compares of MATR against MATR by decades.

Figure 6: Evolution of MATR over time, for specific countries

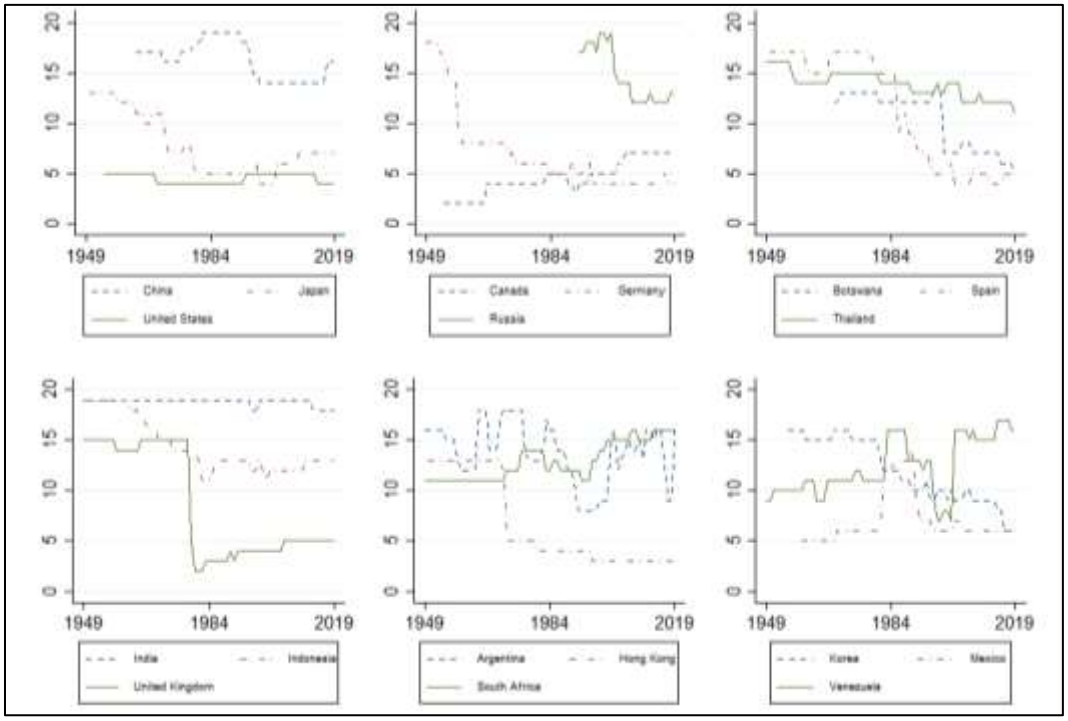

Figure shows levels of MATR trough time for a different set of countries.

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Figure 7: MATR in 1996 vs. income, size, tariff and trade openness

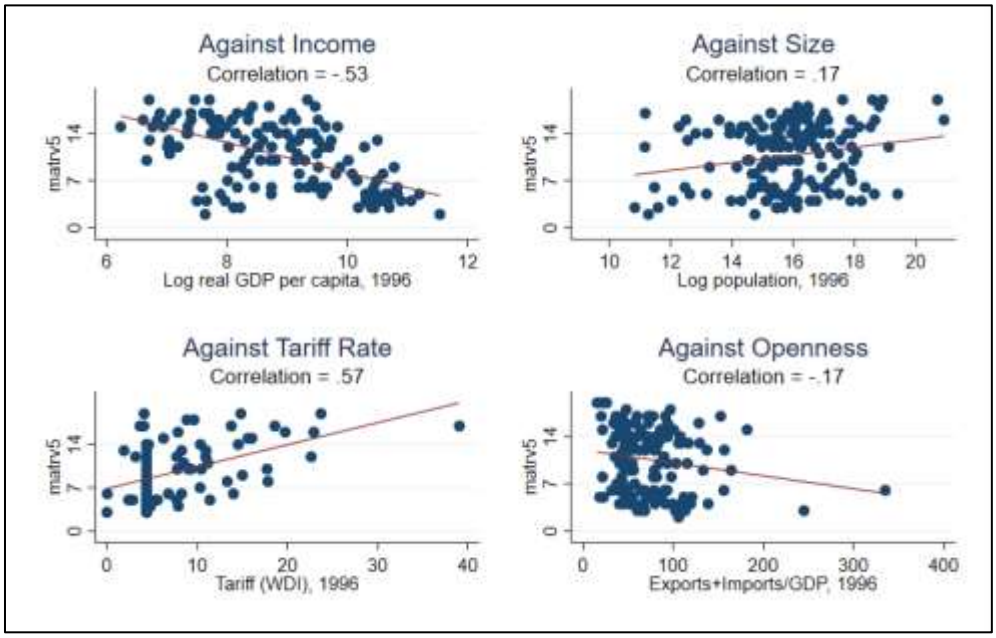
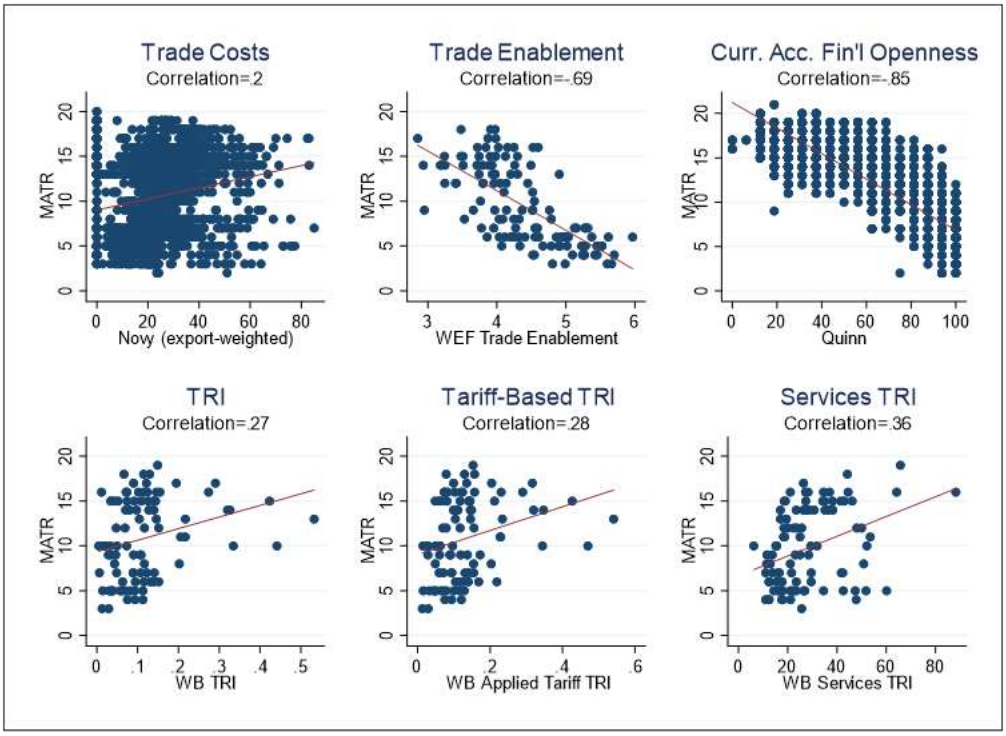


Figure shows scatterplot and correlation of MATR against four key variables for 1996 (mid-point of the sample).

Figure 8: MATR vs. alternative measures



Note: Figure shows scatterplot and correlation of MATR against six ad-hoc trade restriction existing measures: Novy's (2012) measure of trade costs; The World Economic Forum's 2016 Enabling Trade Index; Quinn's measure of current account financial openness; Trade Restriction Index (TRI) produced by the World Bank (2009), using methodology from Kee et al. (2009); World Bank TRI produced using only tariffs, for 2009; and World Bank TRI for the service sector.

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Figure 9: MATR vs. Trade Freedom Indicator

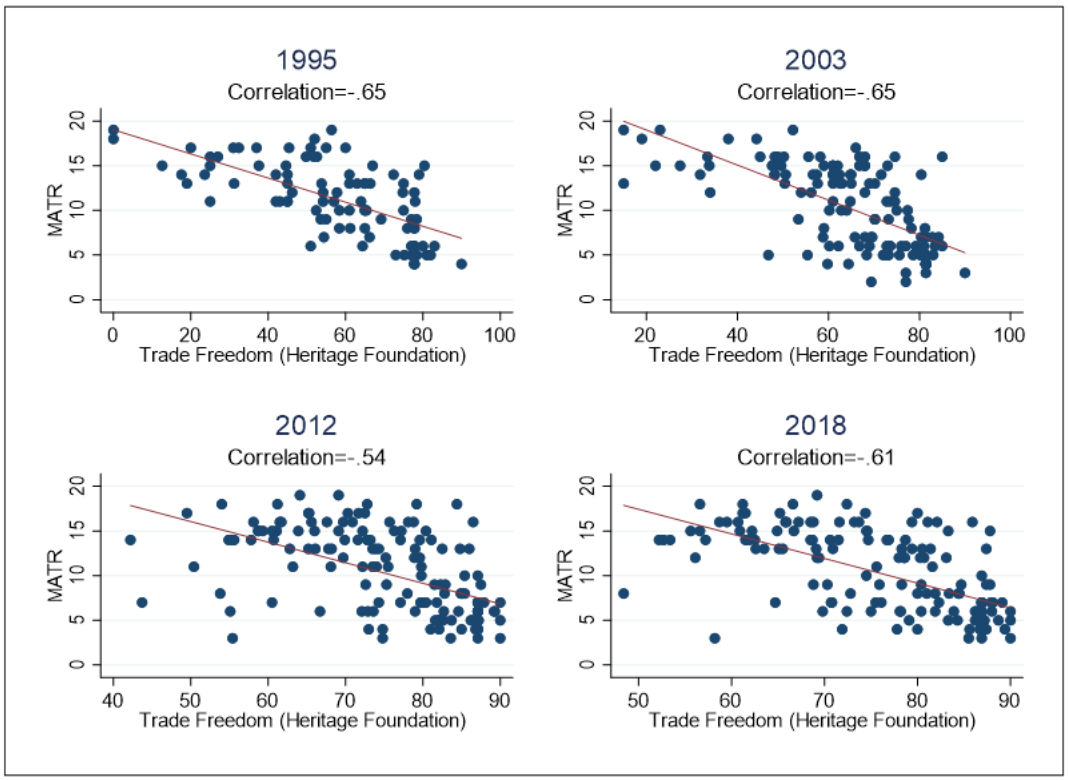

Figure 10: MATR vs. Chinn-Ito

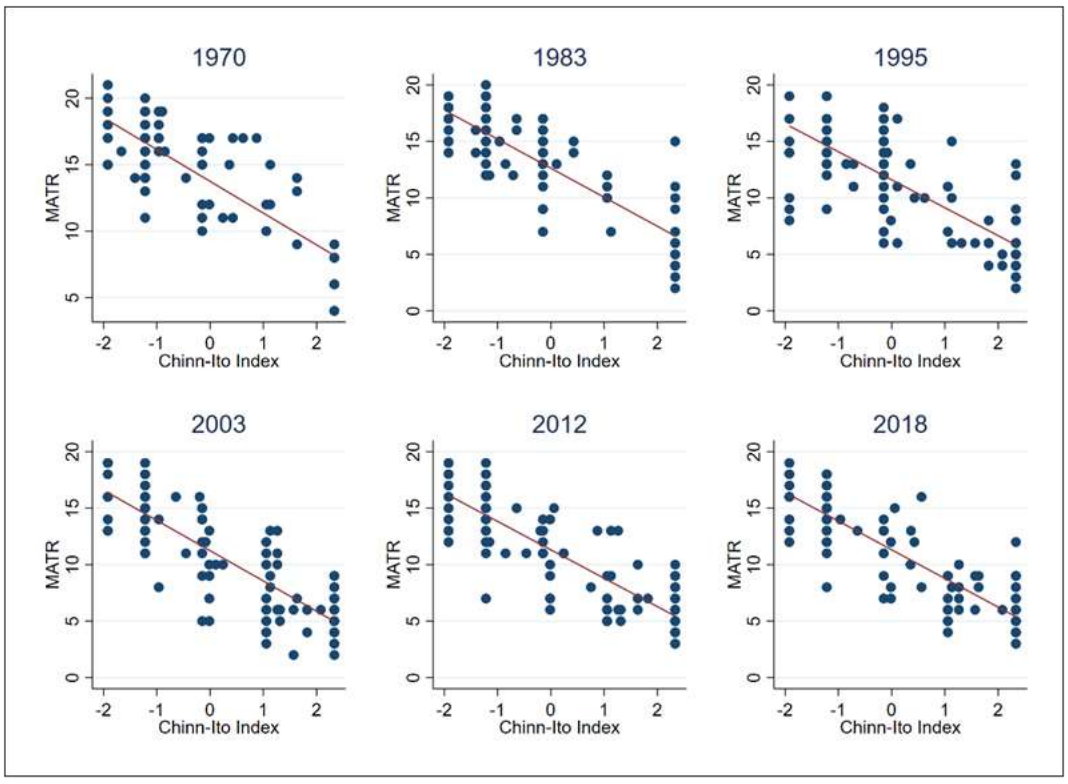

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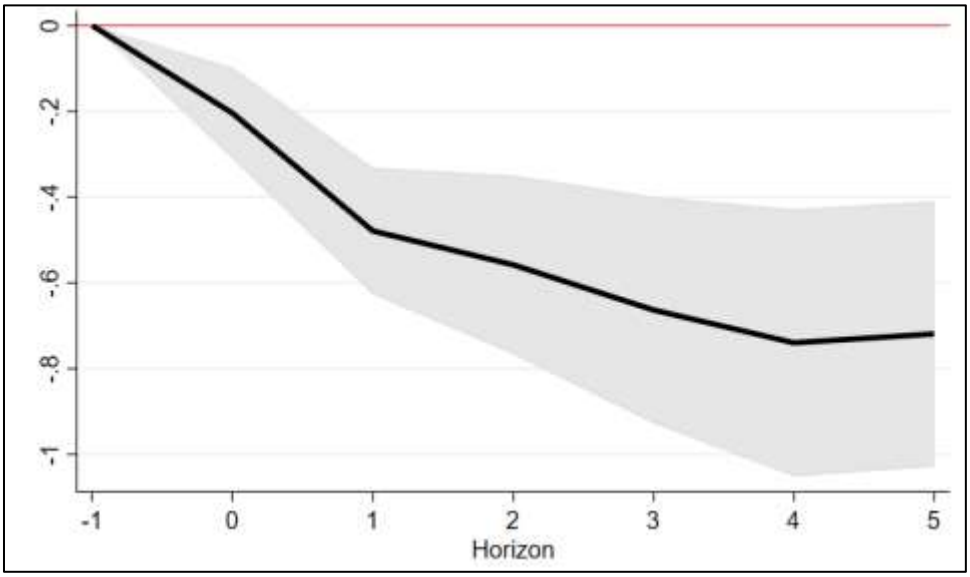
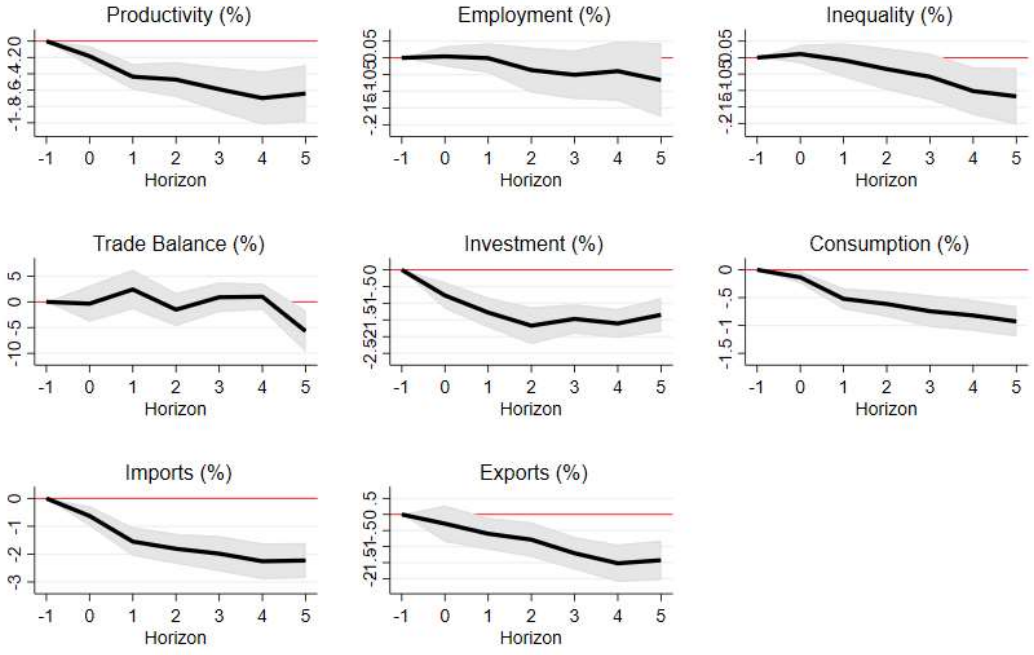
Figure 11: Response of (log) GDP to Changes in MATR (%)



Cumulative IRFs after one standard deviation increase in MATR; shaded area is 90 percent confidence interval; Driscoll-Kraay standard errors.

Figure 12: Response of (log) Economic Indicators to Changes in MATR



Cumulative IRFs after one standard deviation increase in MATR; shaded area is 90 percent confidence interval; Driscoll-Kraay standard errors.

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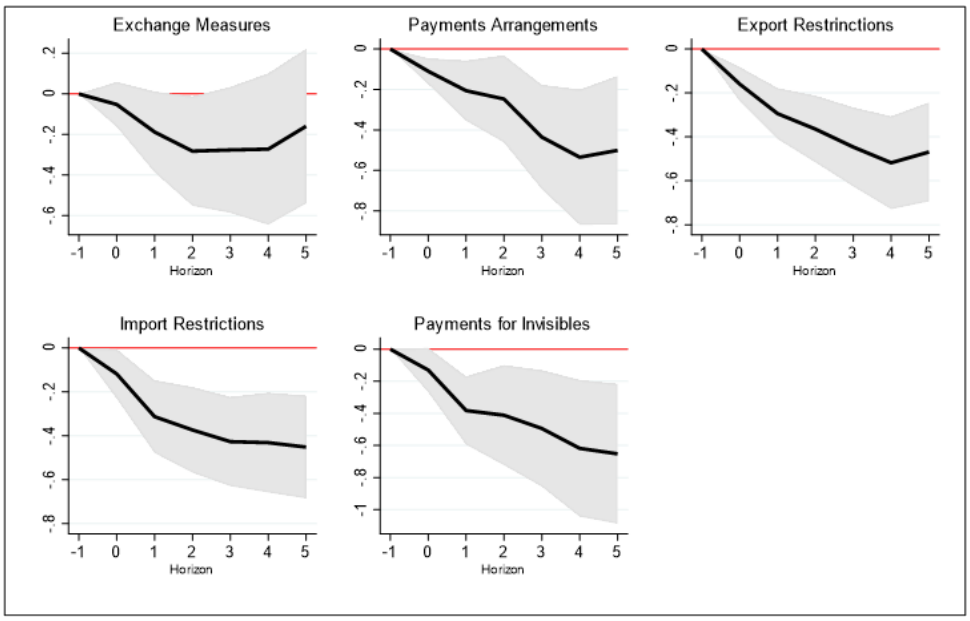
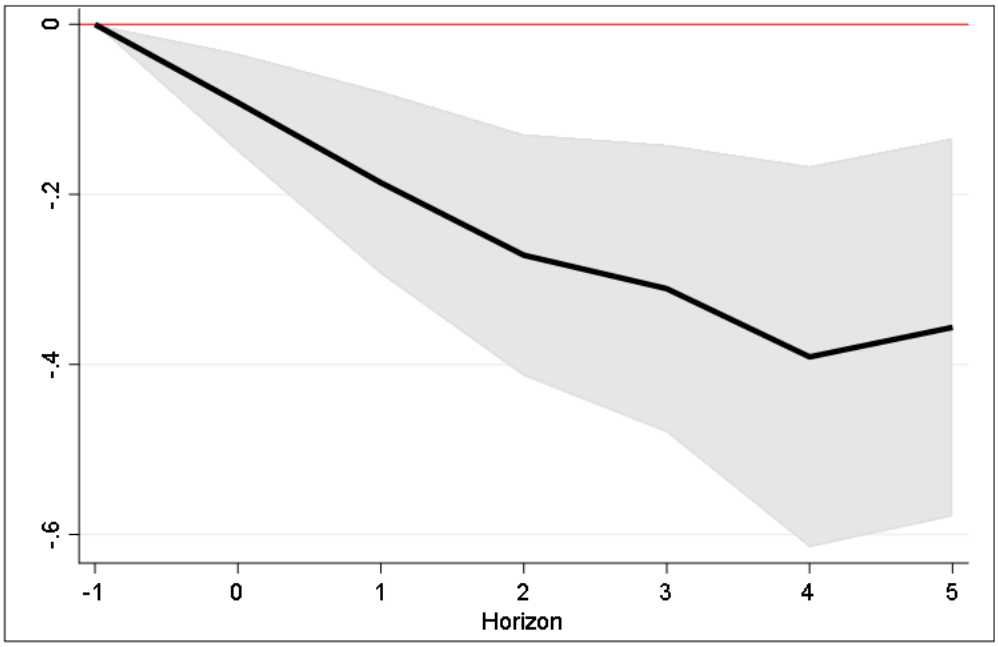
Figure 13: Response of (log) GDP to Changes in MATR components (%)



Cumulative IRFs after one standard deviation increase in MATR; shaded area is 90 percent confidence interval; Driscoll-Kraay standard errors.

Figure 14: Response of (log) GDP to Large Changes in MATR outside crisis periods (%)



Cumulative IRFs after one standard deviation increase in MATR; shaded area is 90 percent confidence interval; Driscoll-Kraay standard errors. Large changes in MATR defined as changes in index > |2σ|, excluding recessions within one year of change: 1 ≡ increase in restrictions; -1 ≡ liberalization; 0 ow.

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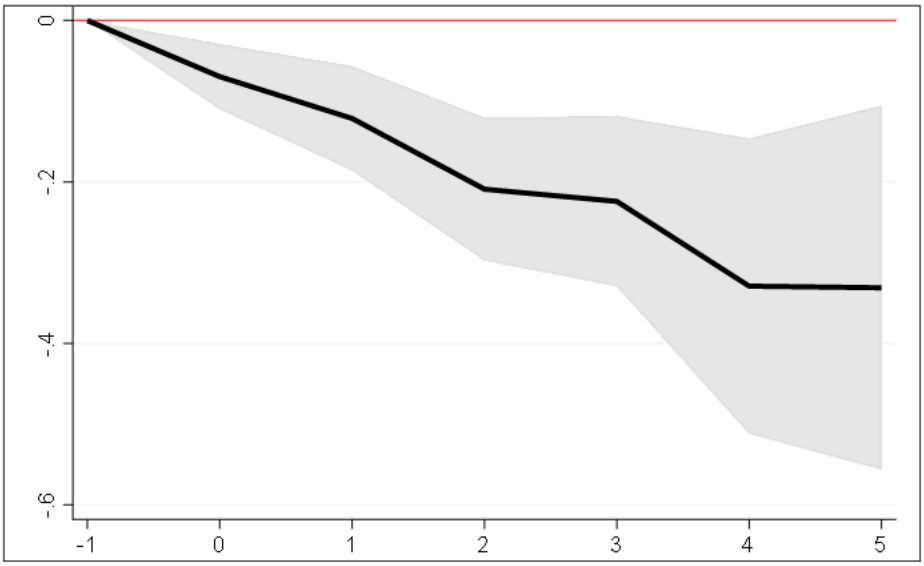
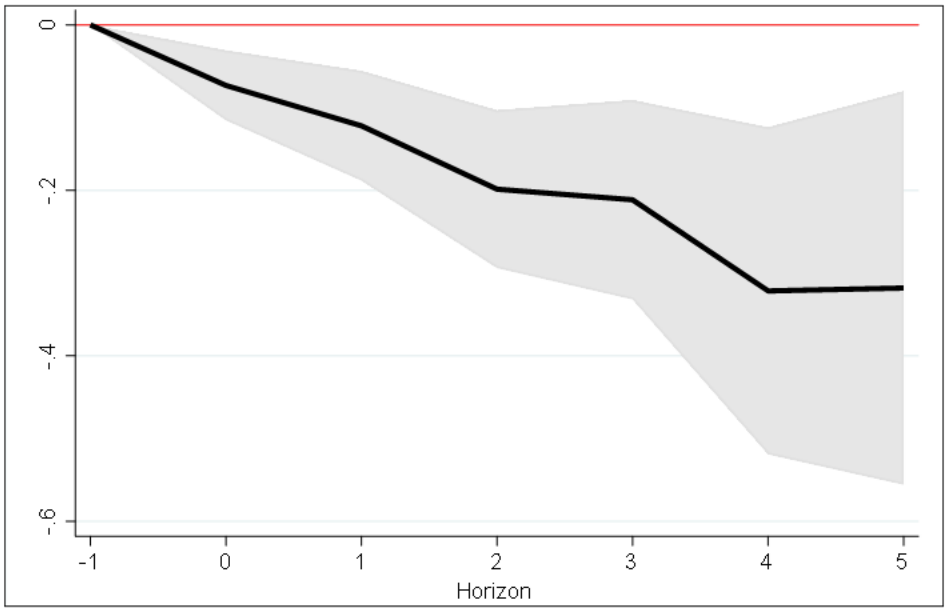
Figure 15: Response of (log) GDP to Exogenous Changes in MATR (%)



Cumulative IRFs after one standard deviation increase in MATR; shaded area is 90 percent confidence interval; Driscoll-Kraay standard errors. Large changes in MATR defined as changes in index > |2σ|, excluding recessions and structural reforms within one year of change, using narrative approach to check: 1 ≡ increase in restrictions; -1 ≡ liberalization; 0 ow.

Figure 16: Response of (log) GDP to Exogenous Changes in MATR, also cleaned by Structural Reforms (%)



Cumulative IRFs after one standard deviation increase in MATR; shaded area is 90 percent confidence interval; Driscoll-Kraay standard errors. Large changes in MATR defined as changes in index > |2σ|, excluding recessions and structural reforms within one year of change, using narrative approach to check: 1 ≡ increase in restrictions; -1 ≡ liberalization; 0 ow.

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