Rising Current Account Dispersion: Financial or Trade Integration?*

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Abstract

This paper studies the factors accounting for the large, coincident increases in international borrowing and lending and international trade from 1970 to the present. We focus on the rise in annual changes in borrowing and lending across countries as summarized by the rise in the dispersion of the trade balance as a share of GDP. We show that these two salient features–a rise in net and gross international trade–are largely a consequence of a reduction in intratemporal trade barriers rather than a substantial reduction in the frictions on intertemporal trade or greater asymmetries in business cycles. Beyond explaining changes in the distribution of gross and net trade, the fall in frictions on intratemporal trade are consistent with the reduction in dispersion in other key macro time series such as the real exchange rate, terms of trade, and export-import ratio.

JEL Classifications: F12, F13, F14

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1 Introduction

Over the last thirty years, the global economy has been characterized by a large increase in international borrowing and lending. For example, China has accumulated a large positive net foreign asset position even as the United States has de-accumulated a large negative net foreign asset position or debt.[1] Importantly, these diverging asset positions were built up relatively quickly through a string of very large current account surpluses and deficits for each country. The large increase in international borrowing and lending is widespread, as the distribution of annual borrowing and lending across countries many countries around the world has become more dispersed over time. The aim of this paper is to identify the key economic forces that have led to the large increase in net trade flows over time.

There are three main candidate explanations for the large increase in international borrowing and lending. First, financial frictions on cross border capital flows may have fallen. This may be a result of removing explicit barriers to capital flows or implicit barriers that arise from foreign investors demanding an interest premium for borrowing externally. Second, differences in the returns to saving in different markets may have widened owing to larger or more persistent country-specific shocks. It is fairly straightforward to discount this explanation though as we find that country-specific shocks in total factor productivity (TFP) have become less common over time. And third, it just may have become easier to borrow and lend because barriers on international trade, such as shipping costs and policy barriers, have fallen. With lower trade barriers and more trade, it is less costly for lenders to give up resources today and ship them to a trade partner in return for the resources the trade partner ships back in the future. Thus country-specific shocks lead to more borrowing and lending than in the past. Of these three candidates explanations, we find that the decline in policy and non-policy trade barriers seems to explain the largest share of the increase in borrowing and lending over time.

The importance of the trade barriers is also consistent with the substantial rise in trade. Figure 1 provides suggestive evidence for this mechanism. In the upper panel, we scatter

[1] According to Milesi-Ferretti (2021), from 1999 to 2008, US external debt went from 11 percent of GDP to 30 percent while China went from being in balance in 1999 to 30 percent of GDP in external assets in 2008.

a measure of the annual cross country dispersion in borrowing-lending, measured by the standard deviation of the trade balance as a share of GDP, against the scale of gross trade, measured by the median trade share of GDP for each year, from 1970 to 2019 using data from the Penn World Tables version 10.0. There is a striking positive relationship summarized by the regression line. This relationship between dispersion in the trade balance and the level of trade in the annual cross section also holds when we look at the time series for individual countries. In the lower panel, we take each country as a unit of observation and scatter the standard deviation of the trade balance as a share of GDP against the average trade share of GDP. Here too we find a striking positive relationships, albeit with less explanatory power and some important outliers. That changes in trade barriers can explain rising borrowing and lending should be intuitive since a country closed to international trade is also closed to intertemporal trade. As a country opens its borders to trade goods and services, the impact of business cycle asymmetries on intertemporal trade and the trade balance will be amplified.

We evaluate the relative contribution of trade and financial integration on the rise of international borrowing and lending. We focus on these two aspects of global integration as potential forces that could determine larger movements in both net and gross trade flows. We begin with the observation that features of trade balance to output (hereafter, TBY) movements–their size, volatility, and persistence–have changed over time. We propose a simple decomposition of the TBY that shows most of these changes are due to a larger scale of trade rather than the movements in trade balance as a share of trade. We then decompose the movements in the trade balance share of trade by leveraging the benchmark Armington trade model, which is the core trade block in nearly all international macro models with more than one good. To examine the role of trade and financial frictions when the trade balance fluctuates with the shocks generating business cycles, we develop a general equilibrium model of international trade. We start with the symmetric two-country model and show how the properties of the model vary with trade and financial frictions. We further extend it to the multi-country setting to better capture dispersion across countries, asymmetric trade barriers, and dynamics along the transition.

In section 3, we summarize the changes in key properties of international macroeconomic variables related to borrowing and lending. We first show that the widening imbalances as a share of GDP over time primarily reflect a rise in trade as a share of GDP rather than a rise in net trade flows as a share of trade. Indeed, as a share of trade we find that dispersion in net trade flows has fallen considerably over time. We then show that over time movements in international relative prices and relative income have become more muted. In some sense, countries are more synchronized than before. Finally, we undertake a simple reduced form regression analysis that relates to the growing dispersion in the trade balance as a share of GDP to the level of trade, business cycle asymmetries, and find that trade is the main factor explaining the increase in borrowing and lending.

We then build a multigood, multicountry general equilibrium model to examine how the properties of borrowing and lending and overall business cycles change with financial frictions and trade frictions. We follow Armington (1969) and assume home and foreign goods are imperfect substitutes. We follow Schmitt-Grohé and Uribe (2003) and assume countries can borrow and lend a non-contingent bond at an interest rate that increases with debt.

We estimate the model to four asymmetric countries, U.S., Europe, China, and the rest of the world with shocks to productivity, demand, trade costs, and finance. Our model matches successfully the observed increase in the volatility of trade balance to GDP with trade, and the fall in the volatility of the export-import ratio, relative price and spending with trade. In fact, most of these patterns are due to trade integration. In a counterfactual case when we do not vary the financial friction to international borrowing, the observed pattern changes little. However when we do not vary trade frictions, we are unable to increase the level of trade and this leads the export-import ratio to become too dispersed.

Section 2 explains how our paper relates to previous work. In section 3 we evaluate several features of the data and provide a simple decomposition of the rise in borrowing and lending into trade and non-trade related factors. In section 4 we develop a stochastic multi-country model. The model is a variation of the Backus et al. (1994) business cycle model extended to include broader set of shocks and to allow for pricing-to-market and slow adjustment of trade flows. We follow Alessandria and Choi (2021) in modelling pricing-to-market by allowing the country-specific markups to vary with the real exchange rate. This feature is necessary to match the relative volatility of the real exchange rate and terms of trade. We introduce trade adjustment frictions as in Rabanal and Rubio-Ramirez (2015), Erceg et al. (2008), and Engel and Wang (2011) to better capture the short and long-run response to various shocks. In section 5 we relate the properties of the model to the data. In section 5.3 we explore the effects our key assumptions. Section 6 concludes.

2 Related Literature

Our paper relates to an extensive literature on the determinants of capital flows. It also relates to a growing literature exploring the role of trade integration for business cycles.

Early work on capital flows focused on the high correlation between domestic savings and investment rates, following Feldstein and Horioka (1980). Tesar (1991) shows that the saving-investment puzzle is substantially mitigated when there are barriers to international trade. An expansive literature attributes the high correlation to financial market incompleteness (Bai and Zhang (2010)). Gourinchas and Jeanne (2013) also study the dynamics of capital flow data from 1980 to 2000. Our work also relates to literature on international risk sharing. Lewis (1996) uses a large sample of countries to demonstrate the lack of international risk sharing.. Backus and Smith (1993) test international risk sharing with consumption and real exchange rate data. Heathcote and Perri (2004) study the decline in consumption co-movement between the United States and Europe following an increase in cross-border equity flows. Bai and Zhang (2012) explains why there is little improvement in international risk sharing among developed and emerging economies after an increase in international debt flows. Our paper considers both trade and financial frictions in a many country general equilibrium model. We use the salient features of cross-country capital flows, relative prices, and trade integration to disentangle the importance of the two frictions.

Our paper expands on recent efforts to bridge the gap between international trade and international finance. Starting with Obstfeld and Rogoff (2000), a series of papers have explored the role of trade barriers in aggregate fluctuations and capital flows, (Fitzgerald, 2012, Alessandria and Choi, 2021, Reyes-Heroles, 2016, Eaton et al., 2016, Sposi, 2021 and Mac Mullen and Woo, 2023). Most related is Alessandria and Choi (2021) who study the role of trade integration in explaining the growing trade deficits of the U.S. over time in a two country model of the U.S. that is estimated to match the path of business cycles and trade integration. Here we consider the effects of integration and borrowing and lending for a much broader set of countries. Reyes-Heroles (2016) and Sposi (2021) also study the joint determination of trade integration and borrowing and lending in a many country model over a similar period. Unlike these papers which focus on a perfect foresight economy we explicitly allow for uncertainty about trade policy and aggregate shocks. Building on the work of Kose and Yi (2006), several papers have studied the trade comovement puzzle—the tendency for business cycles synchronization to increase with bilateral trade flows. Most recently, Bonadio et al. (2021) show that business cycle synchronization does not seem to have increased with trade. Unlike this work, which ignores how dynamics of the trade balance by focusing on models with financial autarky, we focus on the rising dispersion in the trade balance as a share of GDP. A key finding is the trade balance is much more volatile for countries that trade more.

3 Empirical Work

To better understand the driving forces behind cross-country borrowing and lending, we investigate the relationship between net and gross trade flows across countries and over time, as well as their interaction with trade and macroeconomic asymmetries across countries. We organize our analysis using the demand system from the standard two-country, two-good trade model. From that framework it is clear that net trade flows are related to variations in cross-country asymmetries, summarized by relative prices and relative expenditures, and the amount of trade. We then turn to the data to show that while net flows as a share of GDP have become more dispersed over time, this is due to an increase in gross trade rather than an increase net trade flows as a share of trade.

Following Alessandria and Choi (2021), our empirical work is organized around a constant elasticity of substitution (CES) demand system. We show this system assumes that net trade flows (trade balance) are tightly linked to gross trade flows (trade share of GDP), relative prices, relative expenditures, and trade wedges. Here trade wedges are basically deviations from theoretically predicted movements in net trade flows. We begin with a mechanical decomposition that splits the trade balance as a share of GDP (TBY) into two terms: trade to GDP (TRY) and the trade balance to trade (TBTR),

$$\underbrace{\frac{X-M}{Y}}_{TBY} = \underbrace{\frac{X-M}{X+M}}_{TBTR} \cdot \underbrace{\frac{X+M}{Y}}_{TRY} \tag{1}$$

where X is home exports to the rest of world (ROW), M is home imports from ROW, and Y is GDP. The ratio of the trade balance to trade, TBTR, can be approximated with one half of the log of the ratio of exports to imports ($\ln X/M$),

$$TBTR = \frac{X-M}{X+M} \approx 0.5 \ln \frac{X}{M}.$$

We can further decompose the export-import ratio ($\ln X/M$) using the Armington model, the standard trade block in nearly all multi-good international macro models. In this model with imperfectly substitutable home and foreign goods and a CES demand system, exports, X, and imports, M, are given by

$$X = \omega^* \left(\frac{p\tau^*}{P^*}\right)^{-\gamma} D^*, \qquad M = \omega \left(\frac{p^*\tau}{P}\right)^{-\gamma} D$$

where γ is the elasticity of substitution between home and foreign goods (the Armington elasticity), ω denotes the taste or bias for imports, τ is an ad valorem trade cost, p is the price of the differentiated good before any trade costs, P is the price level, D is domestic spending on tradables, and an asterisk refers to the foreign analogues to a home variable. Defining the real exchange rate, $rer = \ln P^*/P$, terms of trade, $tot = \ln p/p^*$, trade wedge, $\xi = \ln(\omega\tau^{-\gamma})$, and expenditures, $d = \ln D$, we can rewrite the log ratio of exports to imports as

$$\ln \frac{X}{M} = (\xi^* - \xi) - \gamma(tot - rer) + (d^* - d). \tag{2}$$

Hence, the export-import ratio is determined by cross-country differences in trade wedges, international relative prices, differences in expenditures, and the Armington elasticity. Note that equation (2) holds regardless of assumptions on asset or goods market structure, even though these assumptions could influence price and expenditures. Importantly, most terms have clear empirical counterparts.

We explore the behavior of these variables in a sample of 37 countries that includes both developed and emerging countries. We consider countries in the Penn World Tables at least since 1970 and are covered in the broad basket of the Bank for International Settlements (BIS) Effective Exchange Rates.[2]

The median level of trade (TRY) rises over time, as illustrated in Figure 2. At the start of the sample in 1970, trade was about 24 percent of GDP. By 2019, trade had almost tripled to 58 percent of GDP. Trade grow persistently until the Great Recession, peaking at nearly 70 percent of GDP but has since fallen. We also plot trade balance dispersion, as measured by the annual interquartile range of TBY across countries. The two series are positively correlated, particularly after the 1990s, when most countries, including emerging countries, liberalized trade and capital account. To further understand the role of trade in the widening trade imbalances, we consider a counterfactual measure of dispersion that holds the trade share constant for each country at its level in 1971. With this alternative measure, which is essentially just each countries trade balance as a share of trade, the relationship between widening imbalance and trade largely disappears as this counterfactual measure of dispersion falls over time. This suggests that the growth in trade balance dispersion may be attributed to trade integration amplifying the movements in trade balance to trade ratio.

The upper panel of Figure 1 presents this positive relationship between trade balance dispersion, measured in nominal terms, and mean TRY in a scatter plot. The elasticity of dispersion to trade is about 11 percent. To compare, we scatter the annual cross-country dispersion of the log export-import ratio in the upper panel of Figure 3. Over time, the dispersion of the export-import ratio declines. These two graphs imply that the growth in trade, rather than the increase in trade balance, is responsible for the rising dispersion in net borrowing and lending, based on the decomposition of equation (1).

The lower panel of Figure 3 shows that using the country as a unit of observation that the volatility of the export-import ratio falls. Thus, similar to the annual cross-sectional evidence, net trade as a share of GDP becomes more dispersed with trade while the export-

[2]In the appendix, we show that results for a broader sample of countries are similar.

import ratio becomes less dispersed.

We next use our theoretical decomposition from the Armington model to uncover the source of cross-country dispersion in export-import ratio. Specifically, we next construct cross-country dispersion of the terms of trade, real exchange rate, and domestic expenditures, which is the sum of consumption, investment, and government spending. For dispersion in relative expenditures we construct a measure of foreign expenditures using the BIS trade weights. Also, for relative prices, we focus on the annual changes rather than the levels. First three graphs of Figure 4 presents the scatter plots of these measures of dispersion against the median trade share to GDP in each year. In all panels of Figure 4, we observe a negative relationship: as the trade share of GDP increases over time, the relative prices and spending become less dispersed over country.

It is worth noting that the growing dispersion in trade balance, TBY, cannot be attributed to underlying productivity shocks. The cross-country dispersion of TFP, measured with its interquartile range, has declined during the last five decades. Aggregate output also becomes less divergent across countries over time, as shown in the lower right panel of Figure 4.

We now show that trade integration remains the key explanatory variable even when we bring other variables into the analysis. Specifically, we turn to a reduced form regression analysis that relates the time-series variation in the cross-country dispersion in the trade balance to time-series variation in trade integration and other business cycle variables. Table 1 presents the result. The median trade to output plays a crucial role in explaining the variation in dispersion in the trade balance over time; it alone explains about 60 percent of the variation in the annual dispersion in the trade balance, as shown in the R-square of regression (1). Including other regressors, such as median output growth, output growth dispersion, real exchange rate dispersion, and oil prices, as in regressions (2)-(7) raises the explanatory power only marginally. Furthermore, excluding the trade share as in the regression (8)-(9) lowers the R-squared significantly. In all cases, the median trade to output ratio is significant, implying a percentage point higher trade to output ratio is related to 0.18-0.21 percentage point higher dispersion in the trade balance to output ratio.

Our decomposition of net trade flows into observables allows us to estimates of the Armington elasticity by treating the trade wedge as a residual. Following Alessandria and Choi

(2021), we conduct three types of regressions: in levels, in first differences, and with an error correction term, to allow for different short-run and long-run adjustment. For each of three types we consider two cases, one with the constraint on the coefficient of short-run relative spending to be one as theory suggests, and the other where the coefficient is estimated. Using our panel of 37 countries during the period of 1970-2019, Table 2 reports the results.

The regression in levels does not fit the data very well. When estimated in first differences, with and without the error correction term, the Armington elasticity is significant around 0.23 regardless of how we treat the coefficient on expenditures. To distinguish short-run and long-run effects of relative prices on the export-import ratio, we consider the error correction model. Columns (5) and (6) show that the long-run elasticity is higher than in the short run, closer to 3, as was shown in Alessandria and Choi (2021). The gap between short-run and long-run Armington elasticity suggests we will need a model with a time varying Armington elasticity lest we attribute movements in net trade to shocks.

In summary, we document that over time, the trade balance has become more dispersed across countries, owing primarily to increased economic integration. The trade balance is linked to trade shares, relative prices, and relative spending across countries, according to standard theories. We find that neither relative price, relative spending, nor TFP can explain the growing disparities in trade balance because all three have declining dispersion over time. In relative terms, the world has seen a 'Great Moderation' in relative output, prices, and expenditures, as well as growing economic integration but widening dispersion in the trade balance.

4 Model

We now develop a multi-country variation of the canonical international business cycle model of Backus et al. (1994) that includes trade frictions and financial frictions. In each country, there is a final non-tradable good used for consumption and investment, made by combining a different mix of imperfectly substitutable intermediates from all countries. Intermediates are produced using domestic capital and labor. There are country-specific shocks to the productivity of producing these intermediates. Trading these intermediates across countries is subject to a stochastic bilateral trade cost. Also, as in Baxter and Crucini (1995), Heathcote and Perri (2002), and Schmitt-Grohé and Uribe (2003), the consumers can trade a non-contingent bond denominated in units of the final good of country 1. Beyond being non-contingent, the interest rate is debt-elastic and there are country-specific (UIP) shocks to the borrowing rate that create an additional wedge between the returns to saving across countries. We also incorporate adjustment costs in the use of intermediate imported inputs to produce the final good, and intermediate producers setting a destination specific price (pricing-to-market) as these have been shown to be crucial to explain the dynamic pattern between relative prices and relative trade flows (see Rabanal and Rubio-Ramirez (2015) and Alessandria and Choi (2021)).

Consumers Consumers in country n choose consumption, leisure, investment, and bonds to maximize welfare

$$\max\ E_0 \sum_{t=0}^{\infty} \beta^t u(c_{nt}, \bar{h}_n - h_{nt})$$

subject to a sequence of budget constraints

$$c_{nt} + i_{nt} + e_{nt} q_{nt} b_{nt+1} = w_{nt} h_{nt} + r^k_{nt} k_{nt} + e_{nt} b_{nt} + \Pi_{nt}$$

where $u(c_{nt}, \bar{h}_n - h_{nt}) = \frac{[c^{\mu}_{nt}(\bar{h}_n - h_{nt})^{1-\mu}]^{1-\sigma}}{1-\sigma}$, q_{nt} is the country-specific discount rate of a non-contingent bond denominated in units of country 1 consumption, $e_{nt} \equiv P_{1t}/P_{nt}$ is real exchange rate defined as the final good price relative to country 1, and Π_{nt} is the dividend payments from domestic firms. The evolution of the capital stock is given by

$$k_{nt+1} = (1 - \delta^K) k_{nt} + i_t - \frac{\psi}{2} \left(\frac{k_{nt+1}}{k_{nt}} - 1 \right)^2 k_{nt}.$$

Following Schmitt-Grohé and Uribe (2003), we assume the country faces an interest rate that depends on the endogenous world interest rate r_t, the debt of the country $-b_{nt}$, and a country specific interest rate shock ϕ_{nt},

$$1/q_{nt} = r_t + F_t \left(e^{-(b_{nt}-\bar{b}_n)} - 1 \right) + \left(e^{\phi_{nt}-1} - 1 \right)$$

where F_t governs the interest rate elasticity to debt. Let λ_{nt} be the marginal utility of consumption. We can define the consumers' stochastic discount factor Λ_{nt} as $\Lambda_{nt} = \Theta_t \frac{\lambda_{nt}/P_{nt}}{\lambda_{0t}/P_{n0}}$.

Final good producers Final good producers are competitive and combine all home and foreign intermediates with a CES aggregator. To allow for short-run elasticity different from the long-run one, we follow Ravn et al. (2010) and assume deep habits in import demand, which has the feature of habit formation in the level of individual goods. Specifically, the final good production D_{nt} in country n is given by

$$D_{nt} = \left\{ \sum_{m=1}^{N} \omega_{nm}^{\frac{1}{\gamma}} \left[\frac{a_{nmt}}{(a_{nm,t-1}/D_{nt-1})^{\frac{\delta}{(1-\delta)}\frac{1}{(1-\gamma)}}} \right]^{\frac{\gamma-1}{\gamma}} \right\}^{\frac{\gamma}{\gamma-1}} \tag{3}$$

where a_{nmt} is the intermediate good produced in country m at time t, γ is the long-run elasticity, and the parameter δ determines the degree of deep habit. When $\delta = 0$, the demand function goes back to the standard CES function.

Final goods producers at country n have to pay iceberg trade costs τ_{nmt} when importing goods from country m. Taking as given the aggregate prices P_{nt} and the intermediate goods prices $\{p_{nmt}\}$, a final good producer chooses inputs $\{a_{nm,t}\}$ to solve the following problem,

$$\max \quad E_0 \sum_t \Lambda_{nt} \left[P_{nt} D_{nt} - \sum_{m=1}^{N} p_{nmt} \tau_{nmt} a_{nmt} \right].$$

The implied demand function is given by

$$\ln \frac{a_{nmt}}{D_{nt}} = \ln \omega - \gamma \ln \left(\frac{p_{mnt}}{P_{nt}} \tau_{mnt} \right) + \delta \ln \frac{a_{nm,t-1}}{D_{nt-1}}.$$

Note that we assume that each final goods producer views $a_{nm,t-1}$ as an economy-wide value and does not internalize the impact of its current choice of $a_{nm,t}$ on future D_{nt+1}.

Given this specification, the export-import ratio of the model is characterized with the following condition,

$$\ln \frac{X_t}{M_t} = \ln \frac{\omega^* \xi_t^{*-\gamma}}{\omega \xi_t^{-\gamma}} + \gamma \ln \left(\frac{p_{Ft}}{p_{Ht}^*} \frac{P_t^*}{P_t} \right) + \delta \ln \frac{Y_{Ht-1}^*}{Y_{Ft-1}} - \delta \frac{D_{t-1}^*}{D_{t-1}} + \ln \frac{D_t^*}{D_t},$$

which closely relates to our ECM specification in the empirical section.

Intermediate good producers An intermediate goods producer uses domestic labor h_{nt} and capital k_{nt} to produce a differentiated product with a Cobb-Douglas production function $y_{nt} = z_{nt} k_{nt}^{\alpha} h_{nt}^{1-\alpha}$ where z_{nt} is the productivity. We assume the intermediate producers are competitive. Taking as given the prices $(p_{nt}, P_{nt}, w_{nt}, r_{nk}^k)$, a producer solves the following problem,

$$\max_{h_{nt}, k_{nt}} \quad \frac{p_{nt}}{P_{nt}} y_{nt} - w_{nt} h_{nt} - r_{nt}^k k_{nt}.$$

In the data, the real exchange rate is more volatile than the terms of trade and this increased volatility has been attributed to pricing to market (PTM). As in Alessandria and Choi (2021), we take a simple approach to modeling PTM and assume that firms charge a markup over marginal cost that is a function of local market conditions proxied by the real exchange rate.[3] The idea would be that when the dollar is strong all firms selling in the US charge high markups while all firms selling outside the US would reduce their markup.[4] Specifically, the price of country n producer selling to country m, p_{mnt} is given by

$$\frac{p_{mnt}}{P_{nt}} = \frac{\eta \left(\frac{P_{nt}/P_{mt}}{P_n/P_m} \right)^{\theta}}{\eta \left(\frac{P_{nt}/P_{mt}}{P_n/P_m} \right)^{\theta} - 1} \cdot \frac{1}{z_{nt}} \left(\frac{1}{\alpha} \right)^{\alpha} \left(\frac{1}{1-\alpha} \right)^{1-\alpha} r_{nt}^{k\alpha} w_{nt}^{1-\alpha}$$

Equilibrium In equilibrium, consumers and firms in each country take as given prices and optimize their decisions. The following market clearing conditions hold: $D_{nt} = c_{nt} + i_{nt}$, $y_{nt} = \sum_m \tau_{mn,t} a_{mn,t}$, and $\sum_n b_{nt} = 0$.

[3] Alessandria and Kaboski (2011) and Drozd and Nosal (2012) show that a model with consumer search frictions yields price setting that looks like this.

[4] This formulation can be justified with a nested CES framework in which country specific varieties are differentiated and the markup depends on the real exchange rate in the way described above.

5 Quantitative Analysis

In this section, we present the results on the role of trade and financial frictions for borrowing and lending. We calibrate the model and consider the dynamic aspect of the trade and financial frictions. The trade friction shows up in the costs of bilateral trade, while the financial friction creates a wedge between countries' borrowing rates. Our model incorporates multiple countries and multiple goods, allowing us to examine cross-sectional dispersion in both gross and net trade flows.

We find that reducing financial friction results in higher capital flows across countries. However, the increase in gross flows is not affected by the changes in financial frictions. Reducing the financial friction also produces more divergent export-import ratios ($\ln X/M$) across countries. This contradicts the data, which indicate a less divergent $\ln X/M$ following economic integration. On the other hand, a changes in trade barriers can produce the observed patterns in capital flows and other macroeconomic variables. In particular, lower trade barriers is associated with an increase in the dispersion of TBY and a decline in the dispersion of X/M, relative prices, and aggregate GDP, which is consistent with the data.

5.1 Parameterization

We assume the trade cost $\tau_{nm,t}$ between any pair of country n and m has two components, a common world trade shock ξ_{ct} and a differential trade cost shock $\xi_{nm,t}$, which are opposite to the two countries.[5] Specifically,

$$\ln \tau_{nm,t} = \ln \xi_{ct} + 0.5 \ln \xi_{nm,t}, \qquad \ln \tau_{mn,t} = \ln \xi_{ct} - 0.5 \ln \xi_{nm,t} \tag{4}$$

where both the common and differential trade cost shock follow an AR(1) process,

$$\begin{aligned} \xi_{ct} &= \bar{\xi}_c e^{\hat{\xi}_{ct}}, & \hat{\xi}_{ct} &= \rho_{\xi_c} \hat{\xi}_{ct-1} + \varepsilon_{\xi_c t}, & \varepsilon_{\xi_c t} &\sim N(0, \sigma_{\xi_c}), \\ \xi_{nm,t} &= \bar{\xi}_{nm} e^{\hat{\xi}_{nm,t}}, & \hat{\xi}_{nm,t} &= \rho_{\xi_{nm}} \hat{\xi}_{nm,t-1} + \varepsilon_{\xi nmt}, & \varepsilon_{\xi nmt} &\sim N(0, \sigma_{\xi}). \end{aligned}$$

[5] It is straightforward to add a bilateral common shock process to account for bilateral trade agreements.

The interest rate shock ϕ_{nt} of country n follows an AR(1) process

$$\phi_{nt} = e^{\hat{\phi}_{nt}}, \quad \hat{\phi}_{nt} = \rho_\phi \hat{\phi}_{nt-1} + \varepsilon_{\phi nt}, \quad \varepsilon_{\phi nt} \sim N(0, \sigma_\phi). \tag{5}$$

The debt elasticity F_t is common to all countries, and it follows an AR(1) process around the steady state $\bar{F}$,

$$F_t = \bar{F} e^{\hat{F}_t}, \quad \hat{F}_t = \rho_F \hat{F}_{t-1} + \varepsilon_{Ft}, \quad \varepsilon_{Ft} \sim N(0, \sigma_F).$$

A country n's productivity shock is given as

$$\ln z_{nt} = \ln \bar{z}_n + \ln z_{ct} + \ln z_{dnt}.$$

It evolves around its steady state $\bar{z}_n$, and is subject to the global shock z_{ct} and country-specific shock z_{dnt}, all which follow an AR(1) process,

$$\ln z_{ct} = \rho_{zc} \ln z_{ct-1} + \sigma_{zc} \varepsilon_{zct}$$
$$\ln z_{dnt} = \rho_{zd} \ln z_{dnt-1} + \sigma_{zd} \varepsilon_{zdnt}.$$

We estimate the model to four asymmetric countries: the U.S., Europe, China, and the rest of the world. While this is a sparse representation of the world economy, we find that adding more countries does not alter the relationship between the cross-country dispersion in borrowing and lending and the median trade share (see Appendix C).

There are two groups of parameters. The first group is set externally, and the second group is estimated jointly to match the relevant cross-section and time-series moments. The first group includes the discount factor β, capital share α, depreciation rate δ, the intertemporal elasticity of substitution $1/\sigma$, the preference weights on consumption of foreign goods ω_{mn}, the average debt $\bar{b}_n$, and persistence parameters of the shocks ρ_{ξ_c} ρ_{ξ_d} ρ_{z_d}. Our model is an annual model, we therefore choose $\beta = 0.96$ to get the annual interest rate of 4%. The capital share is 0.36, which is consistent with the labor share in the U.S. The depreciation rate is 10% annually. We set the intertemporal elasticity of substitution as

0.5, which implies a standard risk aversion of 2. The steady state debt level $\bar{b}_n$ equals zero. We set all persistence of common trade shocks and productivity shocks as 0.97 and 0.96, repectively, and conduct sensitivity analysis on them. The parameters are reported in Table 3.

The second group includes the Armington elasticity γ, the lag in import demand δ, the RER elasticity in the pricing-to-market θ, the debt elasticity of interest rate at the steady state $\bar{F}$, volatility and persistence of financial shocks σ_F ρ_F σ_ϕ ρ_ϕ, volatility and persistence of trade shocks σ_{ξ_c} ρ_{ξ_c} σ_{ξ_d} ρ_{ξ_d}. Table 4 reports the parameter values. In our benchmark estimation, we choose these parameters jointly with a range of common trade costs $\bar{\xi}_c$ to generate the observed trade share over output, the relative GDP of the countries, the mean and dispersion of trade shares, the relation between integration and cross-country dispersion of net and gross trade, the relative prices, and relative GDP and domestic spending.

Every parameter matters for the general equilibrium and affects all the moments. However, there is a clear correspondence between certain parameters and moments. The Armington elasticity γ disciplines the response of prices and matters for the comovement of integration and global dispersion in the trade balance. The resulting γ is 3.2. The pricing-to-market parameter θ governs the relative volatility of the terms of trade and real exchange rate. The input adjustment cost δ determines the differences between short- and long-run trade elsticities. When θ and δ equal zero, we go back to the standard models. The estimation calls for positive values: $\theta = 0.14$ and $\delta = 0.94$. A higher debt-elasticity F reduces intertemporal risk-sharing and lowers the volatility of the trade balance. It also allows the model to match the observed cross-country comovement of consumption. The estimated debt elasticity is $F = 1.42$. All the shocks, trade, interest rate, and productivity, affect the persistence and volatility of GDP.

Both the financial friction, governed by debt elasticity F and the UIP wedge ϕ, and trade barrier ξ_c affect cross-border capital flows. In our benchmark estimation, we let all of the the debt elasticity F, UIP wedge ϕ, and trade cost ξ_c vary over time. We then consider counterfactual cases when there is no changes in financial or trade frictions.

5.2 Model Results

Given the calibrated parameters, we simulate the model 5,000 periods and compute the cross-sectional standard deviations of trade-balance-to-GDP (TBY), export-import ratio $\ln X/M$, real exchange rate, terms of trade, relative spending, and GDP. We then take average of these standard deviations across time. Figure 6 shows the scatter plots with the standard deviations on the y-axis and trade share over GDP (TRY) on the x-axis.

Our estimated model closely matches the observed changes in global trade balance dispersion with world integration. When the gross trade flows, measured with TRY, increase from 25% to 65%, the net capital flow (TBY), diverges by more across countries, with the standard deviation increasing from 0.03 to about 0.1. As in the data, high trade openness (TRY) in the model leads to a lower dispersion in the export-import ratio. The reason is that lower trade costs promote risk sharing and lead to more dispersed net trade flows and aligned movement of X and M. The relation between TRY and the export-import ratio dispersion is slightly non-monotonic in the data, and the model captures well this pattern.

Our model also successfully produces the observed average volatility in the real exchange rate, terms of trade, and relative spending with economic integration. Higher economic integration also makes the real exchange rate less dispersed across countries. Output and relative spending become less dispersed when the world becomes more open, in both the data and the model.

Financial Integration and Global Dispersion We now explore the role of changes in financial frictions in the aggregate behaviour of our economy. Specifically, we eliminate shocks to the debt elasticity parameter and the UIP shock ($\sigma_F = \sigma_\phi = 0$). Results are reported in the column "No financial integration" of Table 5 and in Figure 7. We find that overall dispersion in the trade balance as a share of GDP is a bit lower and thus its elasticity with trade is a bit flatter. There are several other changes to the properties of the model from removing financial shocks that are consistent with the work of Itskhoki and Mukhin (2021) and Mac Mullen and Woo (2023). We find that relative prices are much less volatile, the correlation between relative consumption and the real exchange rate becomes positive, and investment and consumption become less volatile. However, the absence of the changes in financial friction matter little for the observed patterns in net and gross trade flows.

Trade Integration and Global Dispersion We now consider the role of changes in trade frictions. Here we eliminate shocks to the common trade shocks that influence the overall level of trade ($\sigma_{\xi_c} = 0$). Results are reported in the column "No trade integration" of Table 5 and in Figure 8. Without trade shocks, we are not able to generate any noticeable changes in gross trade flows. Additionally, net trade flows become excessively dispersed. Indeed, the relationship between trade and dispersion becomes almost vertical. Thus, changes in global trade barriers are crucial for generating the observed relationship between net and gross trade flows.

5.3 Robustness

Our theoretical work has sought to stay very close to the canonical models used for business cycle analysis. Having shown the importance of studying the interactions of trade barriers for understanding capital flows we plan to enrich the analysis along several key dimensions.

Estimation of Trade Integration Process A key element of our analysis is to study how the process for trade barriers influences the amount of borrowing and lending. We have found the relationship between borrowing and lending depends on how we specify that process. Specifically, we have found that the relationship is stronger when reforms are modelled as being phased-in as is typical of global or preferential trade agreements than an AR(1) process. We have also found that time varying volatility in trade policy can have an important effect on the desire to borrow. Our aim would be to use long-time series on trade integration to extract a process for trade policy and trade policy volatility. We plan to estimate these process both inside and outside the model.

Solution Method A key contribution of our analysis is to study the interaction of business cycles with trade integration. Our first pass in the model has studied the dispersion of net flows for different levels of trade integration. The estimated relationships from the data come from a transition from a closed world to a more open world and so current work is focused on how this transition affects the theoretical finding between net flows and average gross flows. To capture this transition requires working with global solutions or high-order approximations. To date, we have found that using higher-order approximations leads to a much stronger positive relationship between the dispersion in capital flows and trade. We attribute the stronger relationship to the trade changing macroeconomic volatility through its interaction with other shocks.

Number of countries We have focused on a model with a limited number of countries. We have explored using a larger set of countries with lower order approximations and simulating the model around alternative steady states of openness. Our results are robust to this case and we discuss this in the appendix.

6 Summary

This paper studies the coincident rise in the level of international trade and dispersion in net trade flows across countries over the last 30 years. We develop a simple variation of the canonical multi-good RBC model of Backus et al. (1994) with the usual business cycle shocks plus changes in trade barriers and financial frictions. When relating the model to the data, we show that most of the rise in borrowing and lending across countries over time is related to a fall in international trade barriers. With lower barriers on trade, it becomes easier to borrow and lend in response to a shock without inducing a larger movement in the real exchange rate as we see in the data. We find little evidence that financial frictions have fallen or that countries are experiencing more asymmetric shocks. Indeed, these alternative explanations should have led to an increase in the dispersion of relatives prices and net trade flows as a share of overall trade rather than the moderation we find in the data.

In line with work on the trade-comovement puzzle (see Kose and Yi, 2006) we have focused on the business cycle properties of model economies that differ in their openness. We have then compared the properties of fluctuations in these models around their steady state to the data. Future work should explicitly study the impact of shocks that have led the world to become more integrated and perhaps even fully match the transitions in the model to the data. Recent work, (Alessandria and Choi, 2021) suggest that the shocks to trade barriers may further expand borrowing and lending if they are viewed as asymmetric.

Our analysis relies on the assumption that financial frictions between countries have little or no direct role on the level of trade. Certainly, there is some mixed evidence on the relationship of financial development on trade (Beck, 2003, Leibovici, 2021), but on balance, we view the evidence to be too weak for such a relationship to explain much of the growth in trade. Moreover, here we are considering how the variability of interest rates affects the overall level of trade and there seems to be even more limited evidence of this channel. Alternatively, trade could also affect financial frictions as the capacity to borrow could be related to the ratio of debt relative to the level of trade rather than the level of output.

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7 Figures and Tables

Figure 1: Trade Balance Dispersion and Trade
Over Time and Across Countries

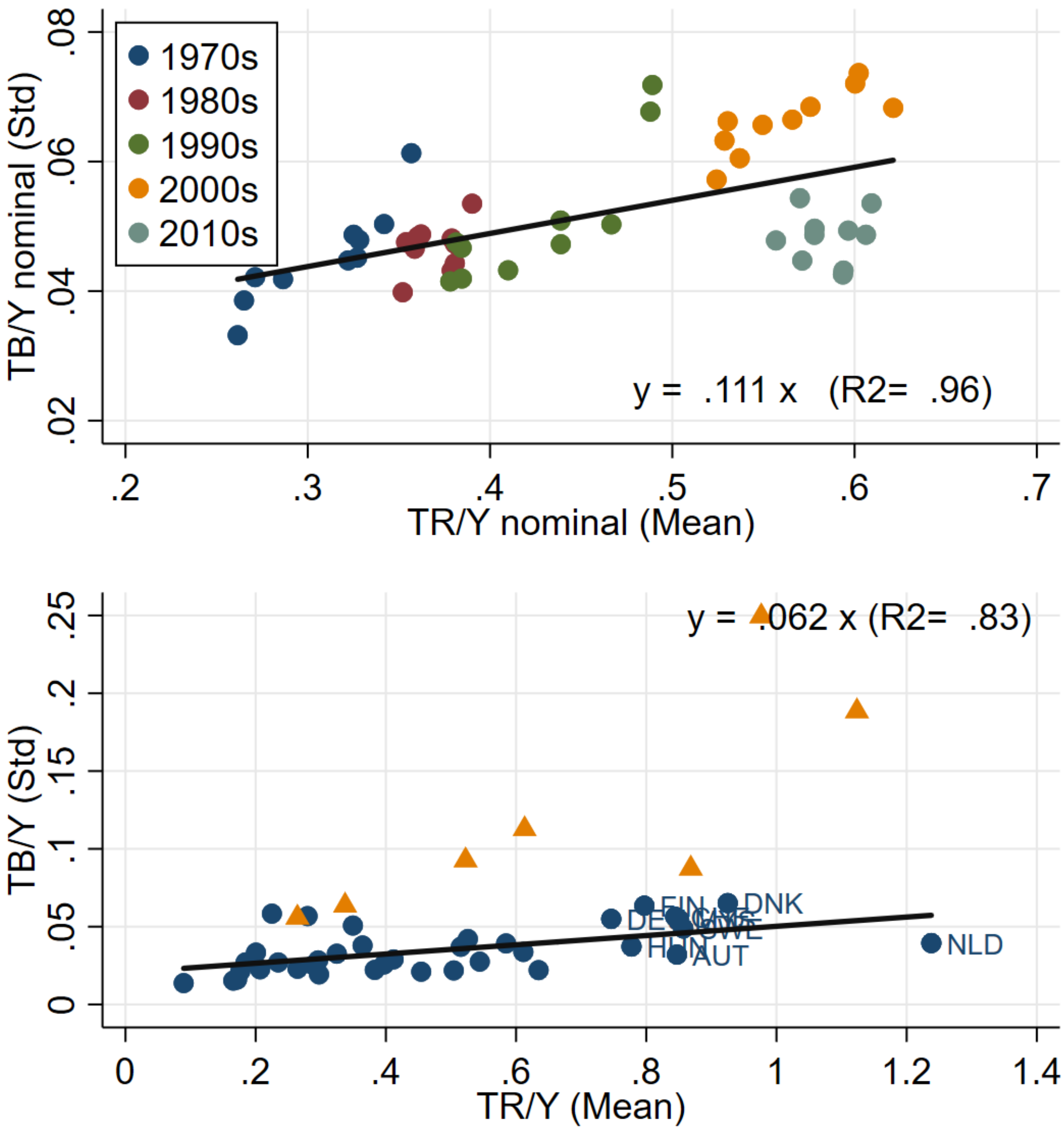


Figure 2: Trade Balance Dispersion and Trade Share: Counterfactual

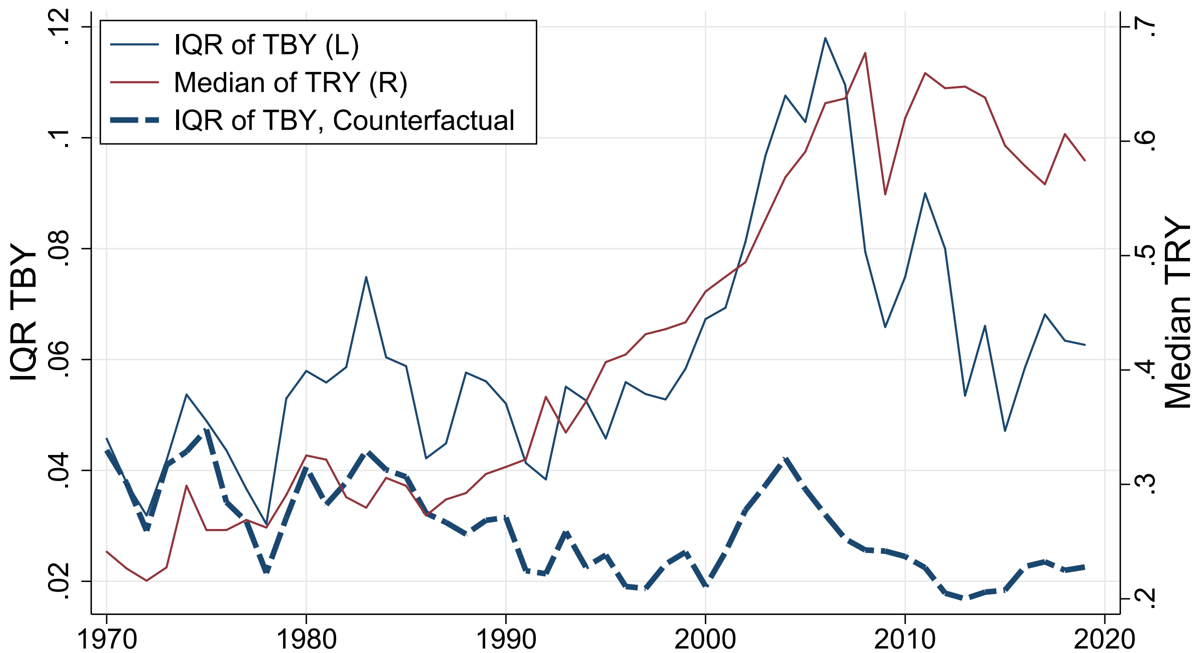


Figure 3: Net Trade Flow Dispersion and Trade Across Countries

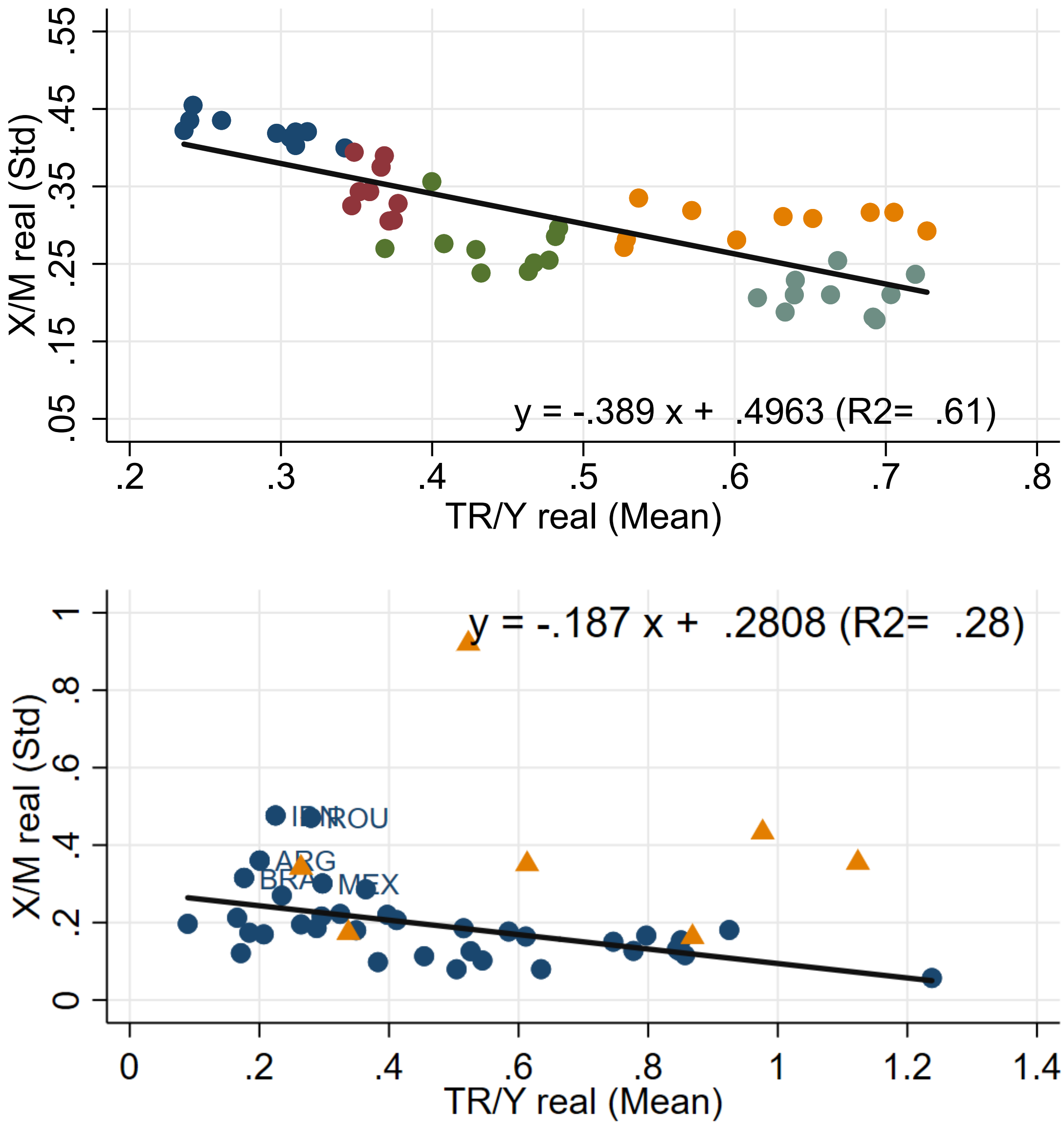


Figure 4: Macroeconomic Dispersion and Economic Integration

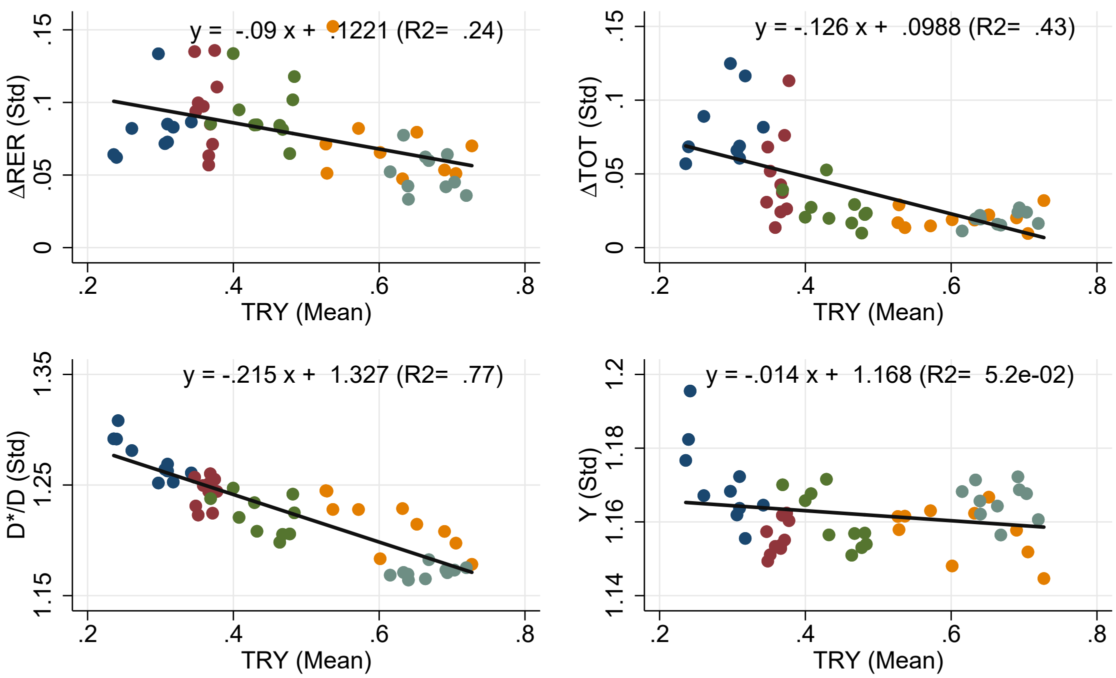


Figure 5: Declining TFP Dispersion

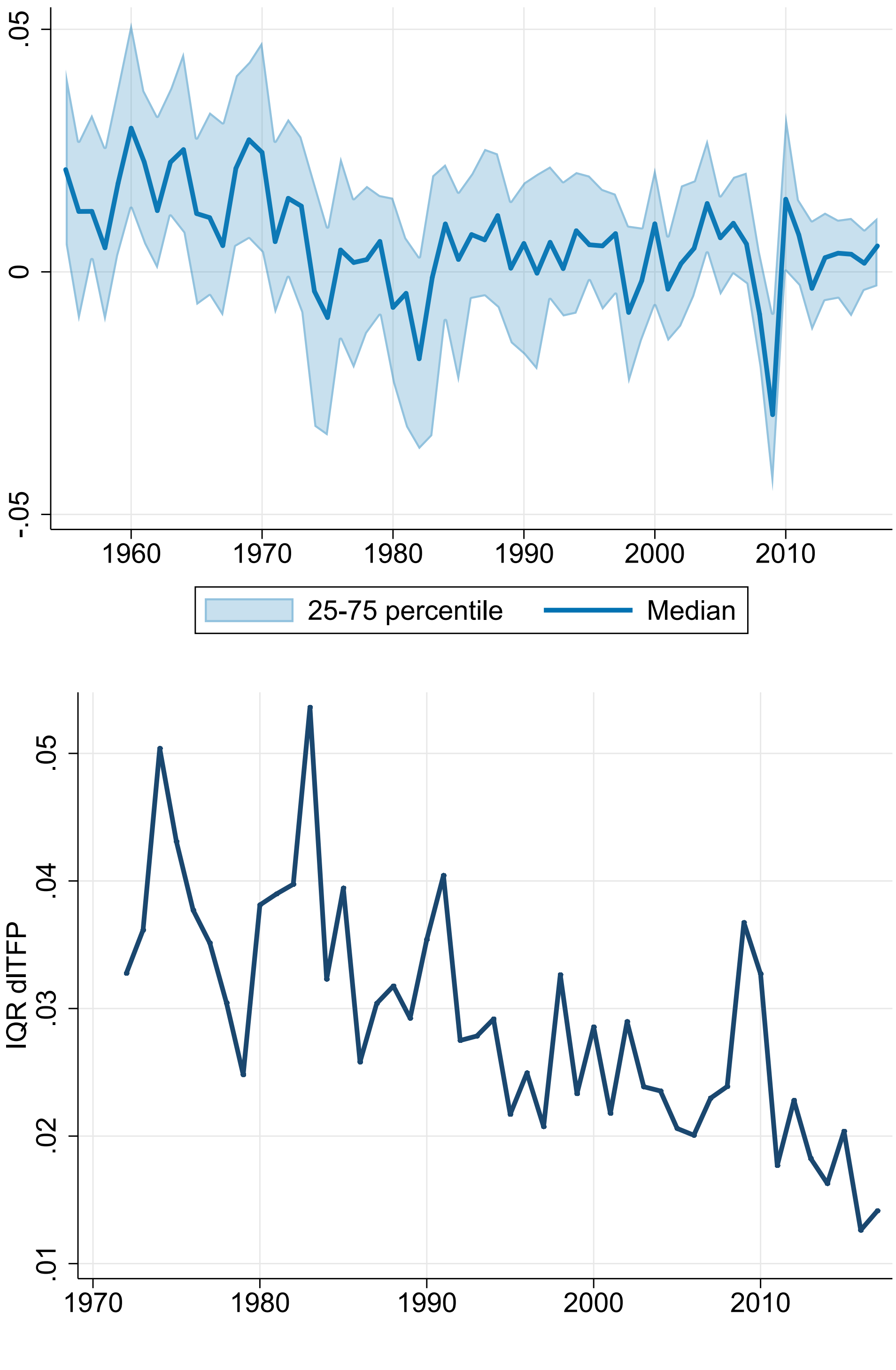
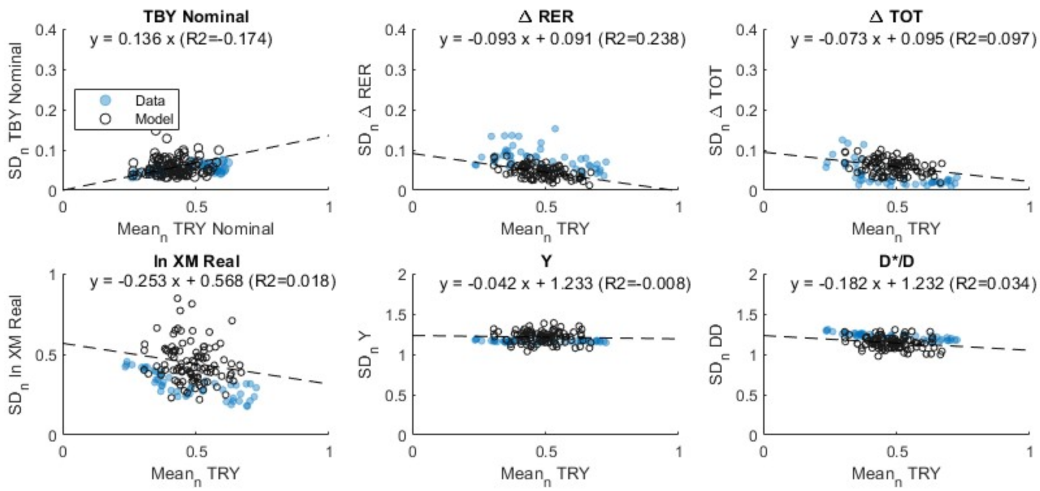
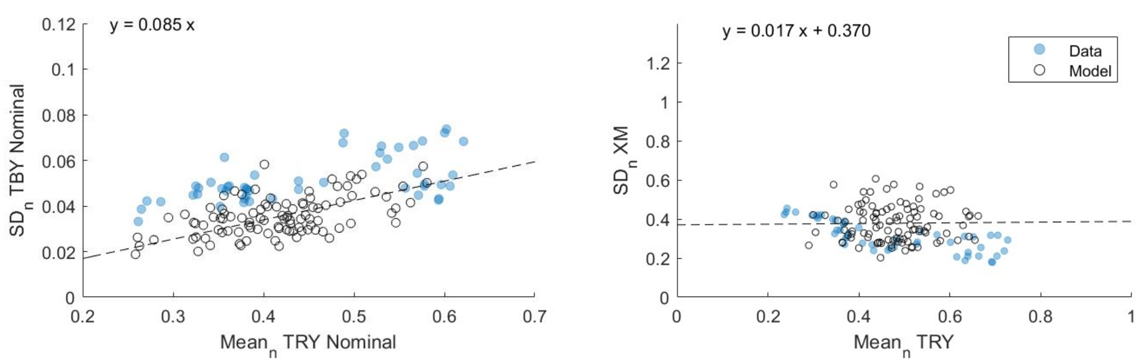


Figure 6: Trade Integration and Global Dispersion



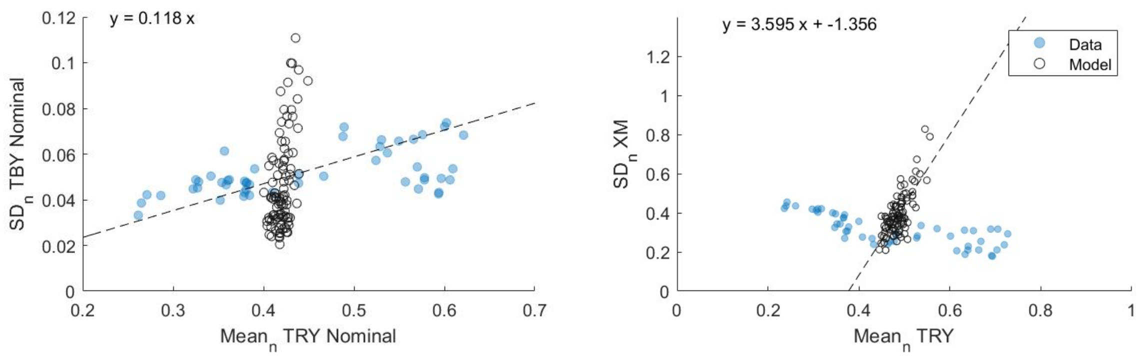
In each graph, y-axis is the standard deviation, x-axis is trade share over output. The black line shows the benchmark model results.

Figure 7: Trade Integration and Global Dispersion
No Financial Shocks



In each graph, y-axis is the standard deviation, x-axis is trade share over output. The black line shows the benchmark model results.

Figure 8: Trade Integration and Global Dispersion
No Common Trade Shocks



In each graph, y-axis is the standard deviation, x-axis is trade share over output. The black line shows the benchmark model results.

Table 1: Cross-sectional Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Disp TBY	Disp TBY	Disp TBY	Disp TBY	Disp TBY	Disp TBY	Disp TBY	Disp TBY	Disp TBY
TRY med	0.190***	0.190***	0.177***	0.187***	0.214***	0.164***	0.181***		
	(0.026)	(0.022)	(0.025)	(0.027)	(0.037)	(0.022)	(0.030)		
d ln Y med		2.290**				2.855***	2.778***	3.689**	3.943**
		(0.951)				(1.004)	(1.001)	(1.706)	(1.506)
d ln Y med (-1)		2.386**				2.470**	2.486**	2.286	2.086
		(1.051)				(1.027)	(1.052)	(1.851)	(1.457)
ln Oil price			0.008			0.009	0.008	0.029***	0.024**
			(0.005)			(0.007)	(0.007)	(0.010)	(0.009)
Disp d ln Y				0.040	-0.151	-0.031	-0.142	-0.304	0.249
				(0.233)	(0.316)	(0.228)	(0.289)	(0.375)	(0.439)
Disp d ln Y (-1)				-0.098	-0.019	-0.376	-0.328	-0.699*	-0.830**
				(0.225)	(0.250)	(0.245)	(0.274)	(0.357)	(0.340)
Disp d ln RER					0.089		0.034		-0.312***
					(0.117)		(0.091)		(0.096)
Disp d ln RER (-1)					0.127		0.089		-0.190*
					(0.131)		(0.110)		(0.100)
Observations	50	48	50	48	48	48	48	48	48
R-squared	0.614	0.701	0.625	0.596	0.608	0.733	0.738	0.416	0.546

Data from Penn World Table 10.0, 1970-2019 with 37 countries. Disp denotes dispersion and is the difference between 85th and 15th percentile. Oil price is an annual average of imported crude oil price ($/barrel, real) (US EIA).
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Estimation of Armington Elasticity

	(1) Level1	(2) Level2	(3) Diff1	(4) Diff2	(5) ECM1	(6) ECM2
SR price	0.0426	0.107***	0.226***	0.223***	0.234***	0.228***
	(0.0575)	(0.0196)	(0.0346)	(0.0351)	(0.0349)	(0.0351)
SR spending	1	0.00127	1	1.025***	1	1.059***
		(0.00575)		(0.0710)		(0.0730)
LR price					3.075*	3.221*
					(1.477)	(1.523)
Adjustment					0.00615**	0.00622**
					(0.00218)	(0.00218)
Observations	1800	1800	1764	1764	1764	1764
R-squared	-10.58	0.0263	0.273	0.273	0.281	0.281

Data from Penn World Table 10.0, 1970-2019 with 37 countries. ECM stands for the error correction model: $\Delta \ln X_t/M_t = \beta + \gamma_{SR}\Delta p^r_t + \Delta d^r_t - \alpha(\ln X_{t-1}/M_{t-1} - \gamma_{LR} p^r_{t-1} - d^r_{t-1})$. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Externally Calibrated Parameters

Parameters		Value
β	Discount factor	0.96
α	Capital share	0.36
δ_k	Capital depreciation rate	0.10
$1/\sigma$	Intertemporal elasticity of substitution	0.50
μ	Weight on consumption	0.37
ω_{mn}	Weight on each foreign good	0.25
ω_{nn}	Weight on home goods	0.25
$\bar{b}_n$	Mean debt	0
$\bar{z}_n$	Mean productivity	1,1,3,4.8
ρ_{ξ_c}	Common trade cost persistence	0.97
ρ_{z_c}	Common productivity persistence	0.96
ρ_{z_d}	Differential productivity persistence	0.96

Table 4: Internally Calibrated Parameters

Parameters		Value
γ	Armington elasticity	3.2
δ	Habit in import demand	0.94
θ	RER-elasticity of PCM	0.14
ψ	Capital adjustment cost	6.77
F	Debt-elasticity of interest rate	1.42
σ_F	Debt-elasticity shock volatility	0.001
ρ_F	Debt-elasticity shock persistence	0.76
σ_ϕ	Interest rate shock volatility	0.04
ρ_ϕ	Interest rate shock persistence	0.99
ρ_{ξ_c}	Common trade cost persistence	0.97
σ_{ξ_c}	Common trade cost shock volatility	0.03
σ_{ξ_d}	Differential trade cost shock volatility	0.03
ρ_{ξ_d}	Differential trade cost persistence	0.95
σ_{z_d}	Differential productivity volatility	0.04
σ_{z_c}	Common productivity volatility	0.02

Table 5: Business Cycle Moments

	Data	Baseline	No financial integration	No trade integration
Nominal tby – slope	0.11	0.14	0.08	0.12
x/m – slope	-0.39	-0.25	0.02	3.59
x/m – const	0.50	0.57	0.37	-1.36
Δ rer – slope	-0.09	-0.09	0.00	0.20
Δ rer – const	0.12	0.09	0.01	-0.05
Δ tot – slope	-0.13	-0.07	0.01	0.30
Δ tot – const	0.10	0.09	0.01	-0.09
y – slope	-0.01	-0.04	-0.04	2.66
y – const	1.17	1.23	1.23	-0.08
dd – slope	-0.22	-0.18	-0.18	1.91
dd – const	1.33	1.23	1.23	0.21
std Δy (%)	3.69	3.93	3.61	3.89
std Δc / std Δy	1.06	1.08	0.87	1.08
std Δinv / std Δy	3.16	3.16	1.50	3.18
corr $(\Delta y_t, \Delta y_{t-1})$	0.39	0.21	0.26	0.22
corr $(\Delta c_t, \Delta c_{t-1})$	0.37	0.16	0.31	0.17
std try	0.16	0.08	0.05	0.07
corr(tb/y, Δy)	-0.01	-0.07	-0.08	-0.12
corr(nominal tb/y, real Δy)	-0.04	-0.16	-0.15	-0.24
corr(Δ(c-c*), Δrer)	-0.21	-0.20	0.36	-0.37
corr(Δy,Δy*)	0.21	0.21	0.26	0.22
SR elasticity	0.22	0.20	0.20	0.20
LR elasticity	3.22	3.26	3.32	3.14

Appendix

In this section we discuss four things. First, we describe the data and variables we use for our empirical analysis. Second, we show that the positive relationship between the size of gross and net trade flows is robust across measures of net flows and country coverage. Third, we show that the theoretical relationship from the model is robust to considering more countries. Finally, we show that the relationship holds within simulations rather than just when studying simulations around different steady states.

A Data

In this section we describe our data source and choice of variables. We focus on countries that are available in the Penn World Table (PWT) 10.0 at least since 1970 and are covered in the broad basket of BIS Effective Exchange Rates. Among 50 countries that satisfy such condition, we further exclude six countries (Belgium, Luxembourg, Hong Kong, Saudi Arabia, Singapore, and Malta), resulting in the sample of 44 countries. Using data from PWT 10.0, we construct variables including trade to output ratio (TRY) and trade balance to output (TBY) as follows:

- TRY, real: Sum of export and import shares at current PPPs
- TRY, nominal: Sum of export and import shares at current PPPs, inflated by the price level of export relative to the price level of output
- TBY, real or nominal: Difference of export and import shares at current PPPs (inflated if nominal)
- lnX/M, real or nominal: Ratio of export and import shares at current PPPs (inflated if nominal)
- lnRER: Rest-of-the-world price level of output relative to that of a country
- lnTOT: Ratio of the price level of exports to imports
- lnD*/D, real: Rest-of-the-world real domestic absorption relative to that of a country
- lnD*/D, nominal: Real relative domestic absorption inflated by the price level of absorption
- lnY, real: Expenditure-side real GDP at current PPPs (2017 US$)
- lnY, nominal: Real GDP inflated by the price level of output.

In the two-country analysis, rest-of-the-world output price level or domestic absorption is measured by the trade weighted average of non-US countries. Trade weights are from BIS and updated every 4 years during 1993-2016. For the period of 1970-1992, weights from 1993-1995 are used, while for the period of 2017-2019 weights from 2014-2016 are used.

Our empirical findings are based on the real variables measured as above with the sample of 37 countries and 50 years (1970-2019). We check the robustness of the findings in three different aspects. First, we re-do the analysis using different source of data. Second, we consider different measurement of trade. Third, we look at the pattern in nominal terms.

First, we evaluate PWT in comparison to the System of National Accounts from United Nation Statistics Division (UN SNA). To construct trade to output ratio (TRY), trade balance to output (TBY), and export-import ratio (lnX/M) using UN SNA, we use GDP by expenditure at constant 2015 USD prices.

Comparing two different data sources, PWT and UN SNA, suggests potential problem of using PWT to look at trade across countries over time, as discussed in Johnson et al. (2013). For example, Norway's TBY of 1970 when measured with PWT exceeds -50%, while it is around 0% with UN SNA. In our sample, there are seven countries that show the differences in real TBY larger than 20% at least once during the sample period, potentially attributing to the measurement errors and terms of trade effects when constructing real terms. In Figure 9, we plot real TBY of these countries over time, measured with PWT (solid line) and UN SNA (dashed line). For the baseline analysis, we exclude these seven countries and use a sample of 37 countries.

However, such errors are not crucial for the observed relationship with cross-sectional TBY dispersion with level of trade. In Table 6 we compare the elasticity when we take a year as an unit of observation, measured with PWT (columns 1 and 3) to the one measured with UN SNA (columns 2 and 4). The the results from two sources are similar, suggesting that pattern we observe in the left panels of Figures 1 and 3 is robust to the source of data.

On the other hand, when we take a country as an observation, these seven countries indeed are outliers. The graph with all 44 countries as an observation is presented in Figure 10, with the seven countries in yellow triangle dots. Accordingly, we exclude these countries from Figures 1 and 3.

Second, we further consider the trade balance measured a share of country-specific output (TBY) instead of as a share of world average output (TBaY). On the left, we show the elasticity with a year as an observation, while the right panel shows the results with a country as an observation. We again see the pattern is robust to the different measurement of trade.

Finally, we look at the sensitivity of the pattern measured in nominal terms. Figure 12 shows the relationship holds in nominal terms.

B Robustness: Capital flows and trade

In this section we describe how the relationship between dispersion in net flows and trade is related to our measure of net flows and trade. Specifically, we show our findings are robust to using the current account, including more countries, and alternative measures of the trade balance that down-weights smaller countries.

In Figure 2, we observe the trade balance dispersion is increasing in the median level of trade. This positive correlation is still found when we use current account as a measure of net flows. Figure 13 shows the interquartile range of net trade flows over time, measured by the ratio of either trade balance or current account to GDP. Although there exists minor differences in these measures due to the differences between trade balance and current account – net income and net transfers – the two measures of dispersion move similarly over time, implying the positive relationship with the level of trade.

We also show the relationship between dispersion in net flows is a bit stronger if we measure the trade balance as a share of world GDP (right panel). This approach has the advantage of down-weighting small countries with large imbalances. Now we find that over the range of the changes in trade integration that dispersion triples compared to almost doubling in our main measure. Thus, our findings are robust to using the interquartile range and standard deviation as well as an alternative weighting.

Our results on the comovement between trade integration and trade balance dispersion are robust to including more countries. The bottom panel shows that dispersion in borrowing and lending is also rising when we consider a broader set of the 157 countries in the Penn World Tables from 1970 onwards.

When using a country as a unit of account, we find the positive between net and gross trade flows relationship holds (figure 1) when we look at alternative windows. To show this we further split the sample by considering 15-year windows for each country (figure 14). Similar to the earlier findings, there is a positive relationship between the trade balance dispersion and level of trade, and a negative relationship between the dispersion of the export-import ratio and trade.

We also highlight several countries with very high levels of trade and very volatile trade balances. In terms of high levels of trade, we see that key entrepots like Belgium, Hong Kong, and Singapore stand out. In terms of highly volatile trade balance, it is Norway and Saudia Arabia in the periods from 1970-85 that stand out. Obviously these outliers arise from very substantial asymmetric shocks related to oil discoveries and the price of oil.

C Robustness: Number of countries

In this section we show that our results on the relationship between net flows and trade in the model is robust to the number of countries in the model. Specifically, we expand the model to have n symmetric economies and evaluate how dispersion in net trade (as a share of average country gdp) varies with the median level of trade.

Figure 15 shows that the model's prediction for the dispersion of trade balance as a share of average GDP is roughly invariant to the number of countries for the empirical relevant range of openness.

D Transitions

In this section we compare the results from our analysis based on varying the steady state level of trade to one that samples periods within simulations. Given that we are allowing the level of trade and trade costs to vary quite substantially we solve the model with a 3rd-order approximation. This level of approximation yields more accurate solutions than lower order approximations. However, a challenge with high-order approximations is that computational time increases quite substantially with the number of countries. Thus, for now we focus on estimating the effects in a two country variation of the model.

The mean of the trade cost $\bar{\xi_c}$ is fixed to match the average trade-to-output ratio of 60 percent, and we let ξ_c vary over time. In order to generate persistent movements in trade growth from trade policy, as in data, we add a trend shock to ξ_c:

$$\begin{aligned} \xi_{ct} &= (1-\rho_{\xi c}) \cdot \bar{\xi_c} + \rho_{\xi c} \cdot \xi_{ct-1} + \Delta_t + \varepsilon_{\xi_c t} & \varepsilon_{\xi_c t} &\sim N(0, \sigma_{\xi c}) \\ \Delta_t &= \rho_\Delta \cdot \Delta_{t-1} + \varepsilon_{\delta t} & \varepsilon_{\xi_\Delta t} &\sim N(0, \sigma_\Delta). \end{aligned}$$

We simulate the model with the third order approximation for 100,000 periods. The parameter values used are reported in Table 7. For each period, we compute the trade share over GDP (TRY) and the standard deviations of trade-balance-to-GDP (TBY) and $\ln X/M$ across countries. We then split the sample into intervals of 2000 periods and take the average of the level of trade and dispersion in net trade. Figure 16 shows the scatter plots for the trade within the range from 20 to 80 percent, corresponding to the range observed in data. Here we see that the slope of the relationship between trade and dispersion in the trade balance is nearly 15 percent compared to 18 percent in the data.

Appendix - Figures and Tables

Figure 9: Countries with large differences in real TBY

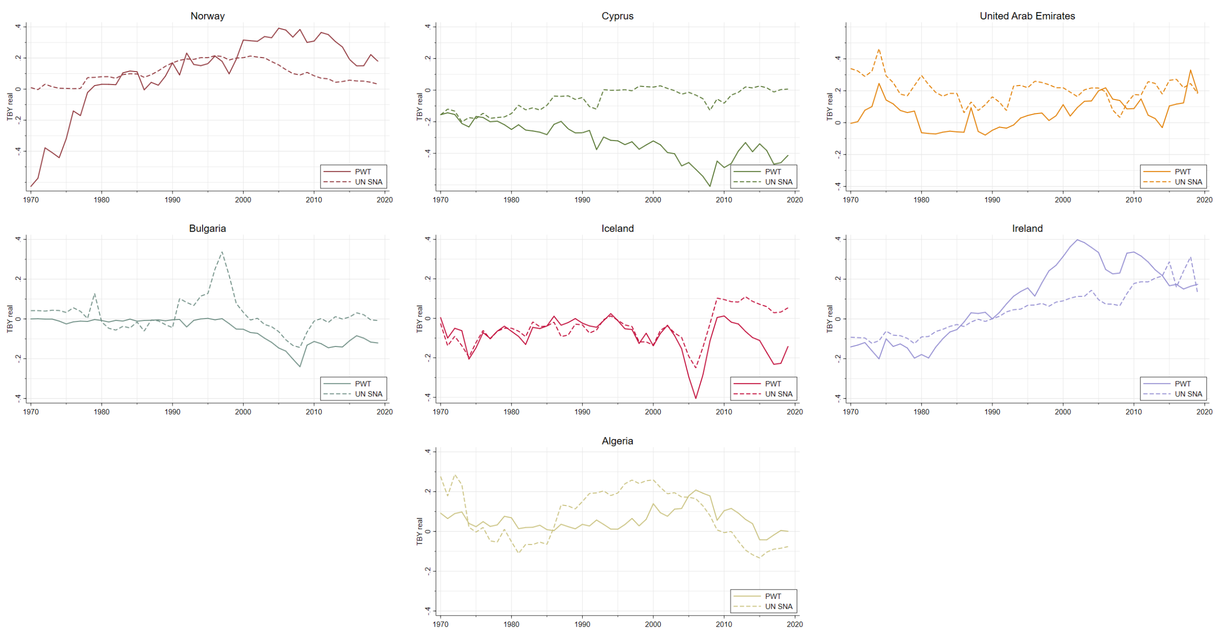


Figure 10: Country as an Observation – with Outlier Countries

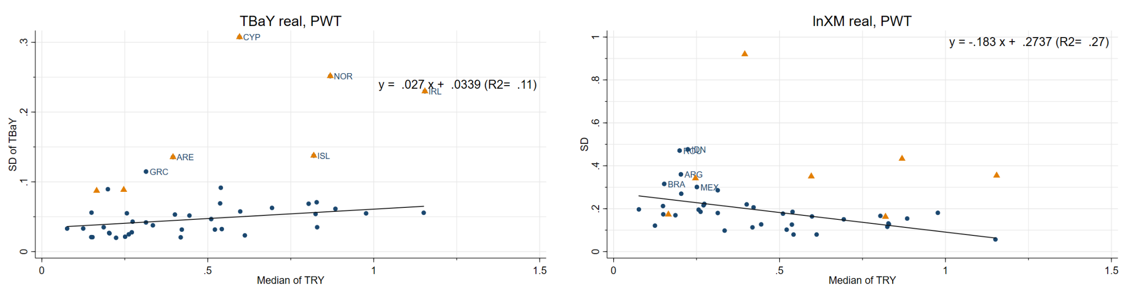
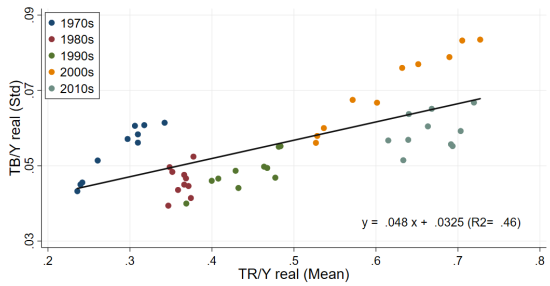


Figure 11: Relationship in share of output



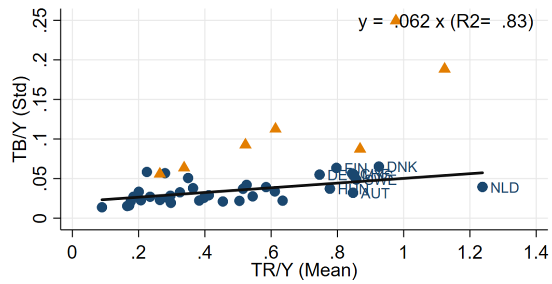


Figure 12: Relationship in nominal terms

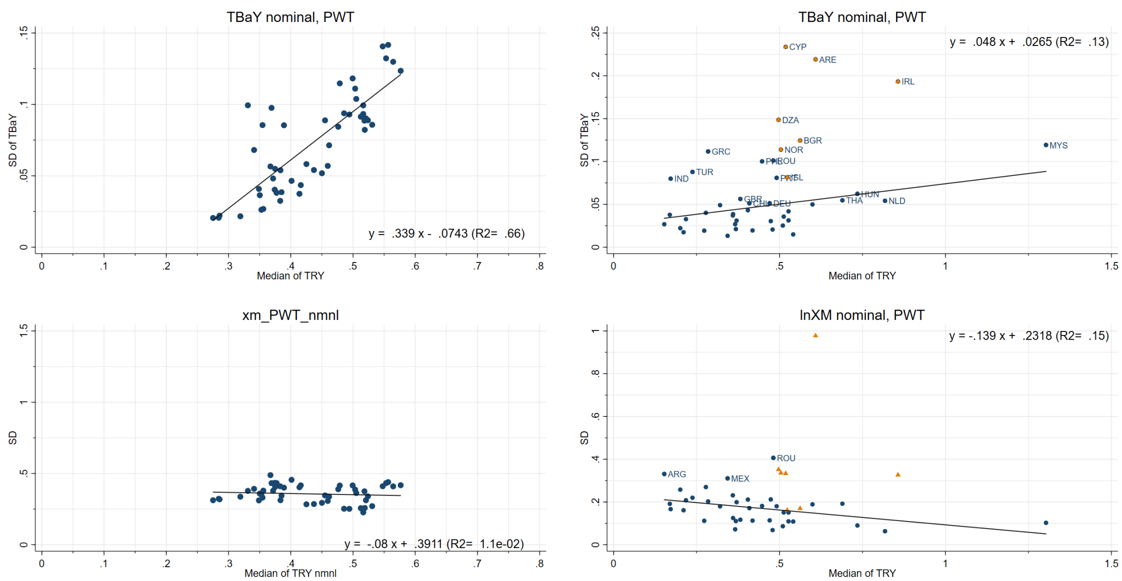


Figure 13: Sensitivity to Current Account, Country Coverage, and Measure of Net Trade

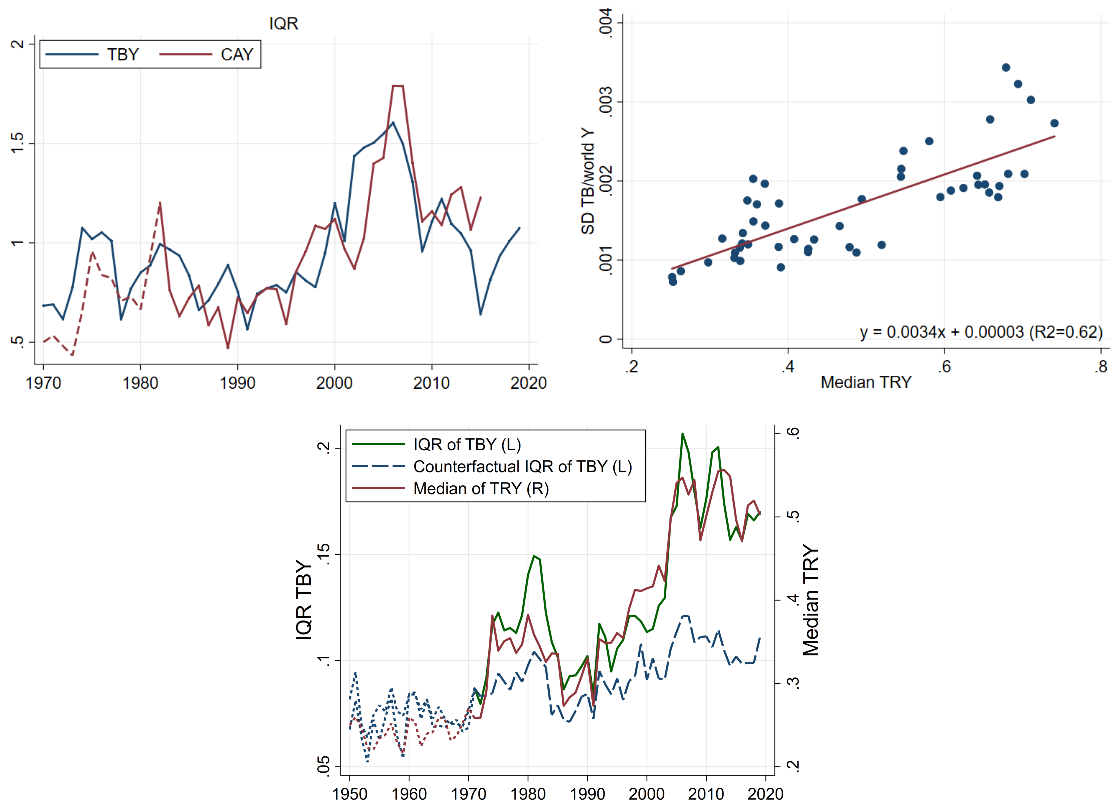


Figure 14: Salient features of Net Trade Robust Across Time Periods

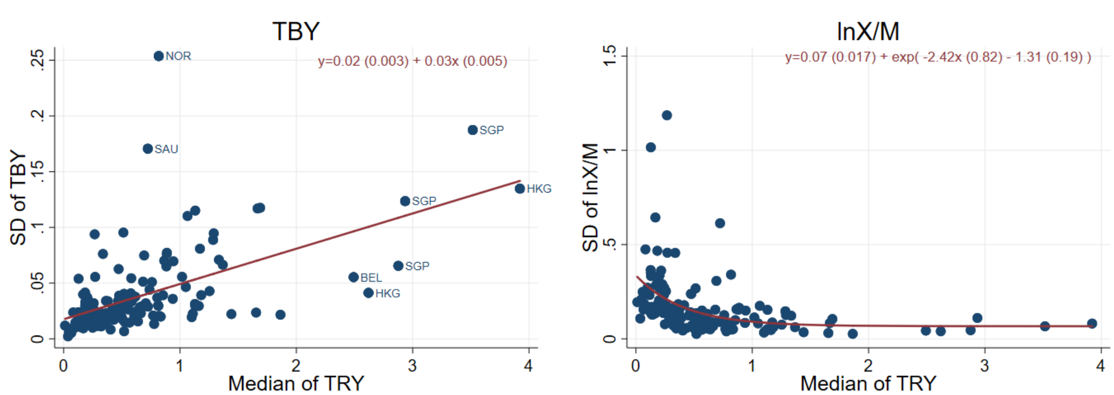


Figure 15: Trade Balance Dispersion is Minimally Affected by Number of Countries

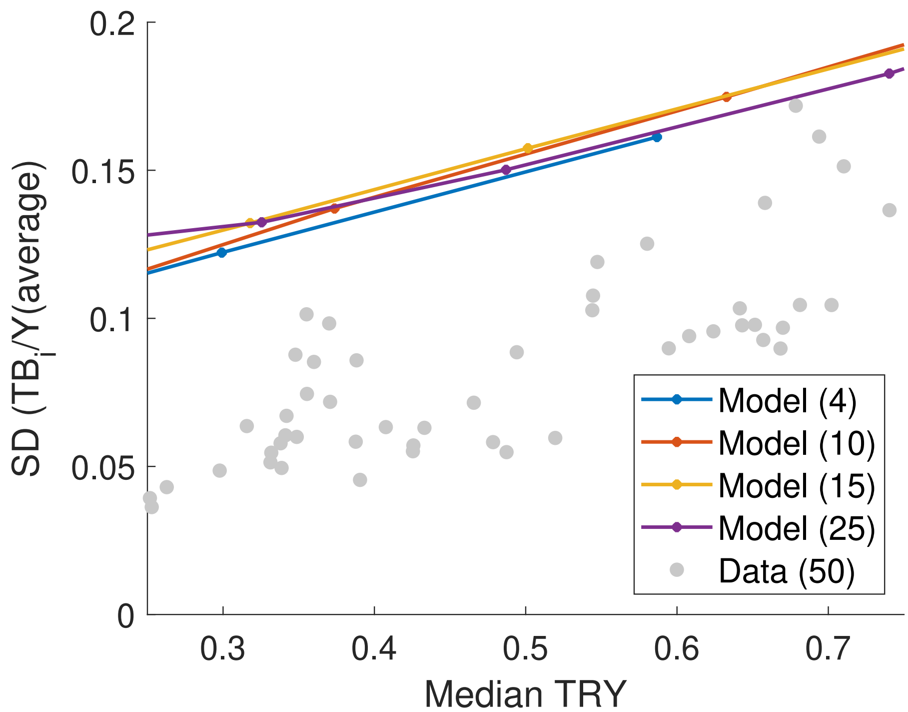


Figure 16: Trade Integration and Global Dispersion – 3rd order approximation

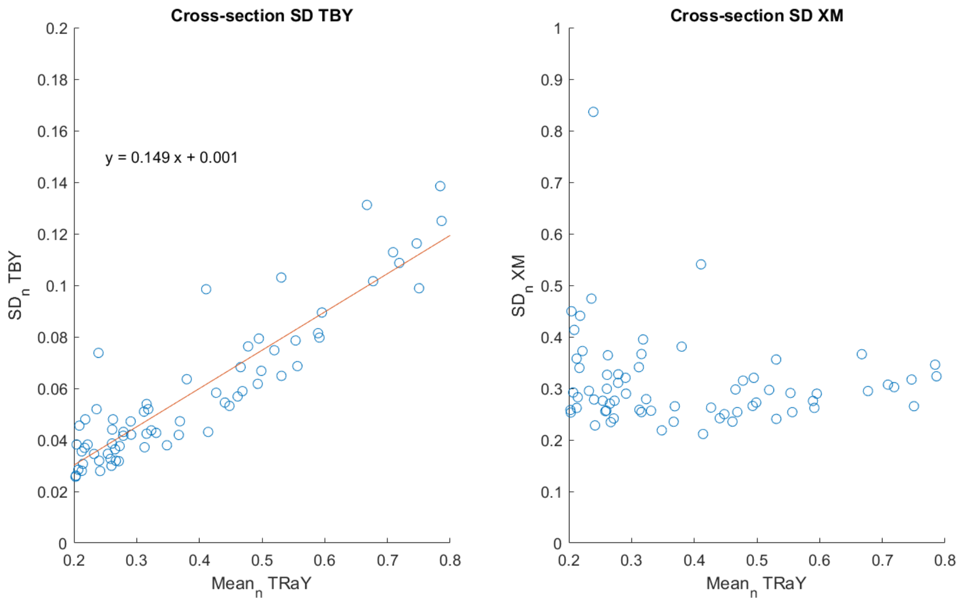


Table 6: Comparison of data sources

	(1)	(2)	(3)	(4)
VARIABLES	TBaY	TBaY	ln X/M	ln X/M
TRY	0.171***	0.129***	-0.141**	-0.393***
	(0.022)	(0.013)	(0.063)	(0.028)
Constant	-0.000	-0.003	0.454***	0.434***
	(0.009)	(0.005)	(0.024)	(0.014)
Observations	50	50	50	50
R-squared	0.608	0.651	0.109	0.785
Data source	PWT	UN SNA	PWT	UN SNA

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Parameter Values – 3rd Order Approximation

Endogenously chosen			Exogenously chosen		
γ	Armington elasticity	1.5	β	Discount factor	0.96
η	Markup	1.05	α	Capital share	0.36
θ	RER-elasticity of PCM	1.95	δ	Capital depreciation rate	0.10
ι	Input adjustment cost	10	$1/\sigma$	Intertemporal elasticity of substitution	0.50
F	Debt-elasticity of interest rate	0.15	μ	Weight on consumption	0.37
σ_β	Discount rate shock	0.002	ψ	Capital adjustment cost	0.001
ρ_β	Discount rate persistence	0.8	ω_{nn}	Weight on home goods	0.50
σ_z	Productivity shock	0.05	$\bar{z}_n$	Mean productivity	1
σ_ϕ	Interest rate shock	0.001	$\bar{b}_n$	Mean debt	0
σ_{ξ_c}	Common trade cost shock	0	$\bar{h}_n$	Population	1
σ_{ξ_d}	Differential trade cost shock	0.05	ρ_z	Productivity persistence	0.98
$\bar{\xi}_c$	Common trade cost SS	5.44	ω_{mn}	Weight on foreign goods	0.50
σ_{ξ_Δ}	Trend shock to common trade cost	0.03	$\bar{\xi}_d$	Mean differential trade cost	1
ρ_Δ	Trend shock to common trade cost persistence	0.8	ρ_{ξ_c}	Common trade cost persistence	0.80
			ρ_{ξ_d}	Differential trade cost persistence	0.88
			ρ_ϕ	Interest rate shock	0.80

Table 8: Business Cycle Statistics

Variable	n	Mean	S.D.	Min	.25	Mdn	.75	Max
sd(Δy_n)	37	0.04	0.01	0.02	0.03	0.04	0.04	0.07
sd(Δc_n)	37	0.04	0.01	0.02	0.03	0.03	0.05	0.09
sd(Δi_n)	37	0.11	0.04	0.06	0.08	0.11	0.13	0.25
corr($\Delta y_n, \Delta y_{US}$)	36	0.19	0.21	-0.25	0.01	0.23	0.33	0.63
corr($\Delta c_n, \Delta c_{US}$)	36	0.08	0.19	-0.35	-0.07	0.10	0.23	0.49
corr($\Delta c_n/c_{US}, \Delta P_n/P_{US}$)	36	-0.21	0.19	-0.57	-0.35	-0.23	-0.07	0.13

Real variables from PWT. First difference of logged variables. Aggregate, not per capita. Distribution over countries (denoted n). Distribution of correlation statistics exclude the US.