Rising Current Account Dispersion: Financial or Trade Integration?*

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Preliminary. Please do not circulate.

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

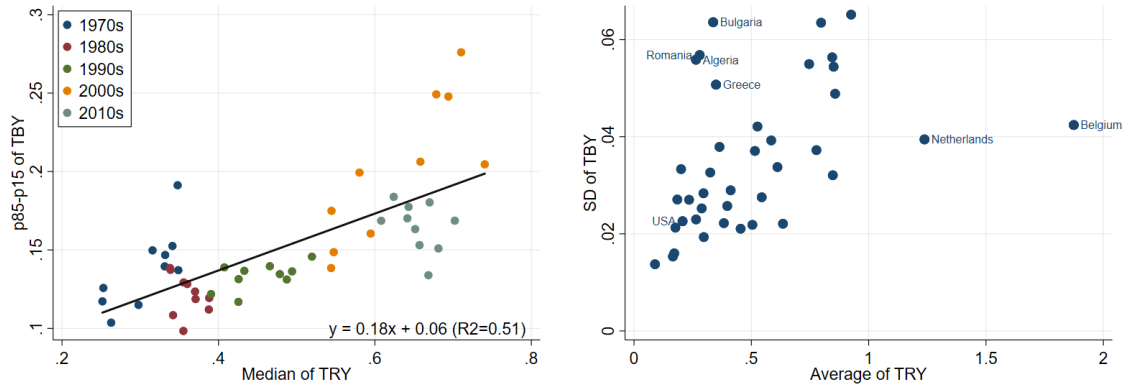
Over the last fifty years, the global economy has been characterized by a large increase in international borrowing-lending. For example, China has accumulated a large positive net foreign asset position even as the United States has de-accumulated a large negative net foreign asset position or debt.[1] 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 a global phenomenon as the distribution of annual borrowing and lending has become more dispersed over time. The aim of this paper is to identify the key economic forces that have lead to the large increase in net trade flows over time.

There are three main candidates for the large increase in borrowing and lending. First, financial frictions 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 external 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 as we find that country-specific shocks in TFP have become less common over time. And third, it just may have become easier to borrow and lend because trade barriers may 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 over time seems to explain the largest share of the increase in borrowing and lending over time. This is also consistent with the substantial rise in trade. Figure 3 provides suggestive evidence. In the left panel, we scatter a measure of the annual cross country dispersion in the trade balance as a share of GDP against the median trade share of GDP for each year from 1970 to 2019. To capture the time series we group observations by decade. There is a striking positive relationship summarized by the regression line. This

[1] According to **?** US external debt went from 10 percent of GDP in 2000 to about 50 percent at the end of 2019.

Figure 1: Trade Balance Dispersion



relationship between dispersion in the trade balance and the level of trade in the cross section also holds in the panel. In the right hand figure, 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. Here too we find a striking positive relationships. 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, the impact of business cycle asymmetries on the trade balance will be amplified.

We evaluate relative contribution of trade and financial integration on the rise of international borrowing-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 TBY movements–their size, volatility, and persistence—-have changed over time. We propose a simple decomposition of the trade balance to gdp ratio 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 trade balance share of trade by leveraging the benchmark Armington trade model, 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 considerable 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 **?** 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 productivity shock, demand shock, and differentiated and common trade cost shock. We vary the trade cost to generate the observed level of trade. The 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-to-import ratio, relative price and spending with trade. If we vary the financial friction to international borrowing, we are unable to increase the level of trade and this leads the export-import ratio to become too dispersed.

The next section 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 **?** business cycle model extended to include shocks to allow for pricing-to-market and slow adjustment of trade flows. We follow **?** 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 **?** 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 5.1 we explore 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 **?**. **?** 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 (**?**). **?** also study the dynamics of capital flow data from 1980 to 2000. Our work also relates to literature on international risk sharing. **?** uses a large sample of countries to demonstrate the lack of international risk sharing.. **?** test international risk sharing with consumption and real exchange rate data. **?** study the decline in consumption co-movement between the United States and Europe following an increase in cross-border equity flows. **?** 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 **?**, a series of papers have explored the role of trade barriers in aggregate fluctuations and capital flows, (**?**, **?**, **?**, **?** and **?**). Most related is **?** 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. **?** and **?** 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 **?**, several papers have studied the trade comovement puzzle—the tendency for business cycles synchronization to increase with bilateral trade flows. Most recently, **?** 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 relative prices and trade frictions. We demonstrate theoretically, using a basic multi-country, multi-good trade model, that net trade flows are related to variations in cross-country asymmetries (relative pricing and relative expenditures) and the amount of trade, which is inversely related to trade barriers. The key finding is 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 or relative prices.

Following **?**, we consider a CES organizing framework and show theoretically that net flows of trade (trade balance) is tightly linked to gross flows (trade share to GDP), relative prices and spending, and trade wedges. We begin with a mechanical decomposition that splits the trade balance as a share of GDP 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 trade balance to trade, TBRY, can be approximated with log ratio

of exports to imports,

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

We can further decompose $\ln X/M$ using the Armington framework, which is the standard trade block in most multi-good international macro models. In this model with imperfect substitutable home and foreign goods and constant elasticity of substitution (CES), demand for export X and import 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 so called Armington elasticity), ω home bias, τ ad valorem trade cost, p the price of differentiated good, P price level, D domestic spending on tradables, and asterisk refers to the foreign analogous to a home variable. Define the real exchange rate, $rer = \ln P^*/P$, terms of trade, $tot = \ln p/p^*$, trade wedge, $\xi = \omega\tau^{-\gamma}$, and $d = \ln D$. We can write the log ratio of exports to imports as

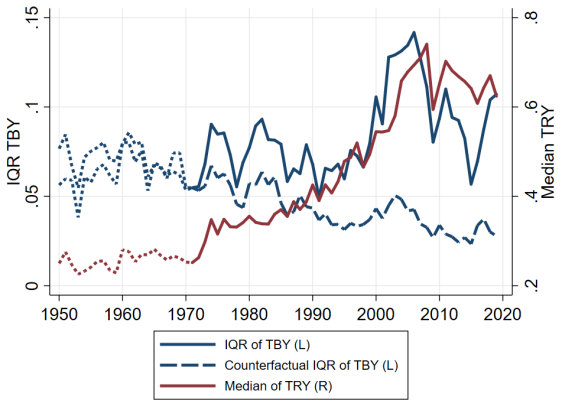
$$\ln \frac{X}{M} = (\xi^* - \xi) - \gamma(tot - rer) + (d^* - d). \tag{2}$$

Hence, the export-to-import ratio is determined by cross-country disparities in trade wedges, international relative prices and 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 demand movements. Importantly, most terms have clear empirical counterparts.

We take data from Penn World Table 10.0 and consider 50 countries including both developed and emerging countries. The median TRY across these countries rises over time, as illustrated in Figure 2. We also plot the 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, we consider a counterfac-

tual dispersion holding the trade share constant at its level in 1971. The relationship then disappears, and the counterfactual dispersion is rather decreasing over time. This suggests that the growth in trade balance dispersion is largely due to trade integration amplifying the movements in trade balance to trade ratio.

Figure 2: Trade Balance Dispersion and Trade Share

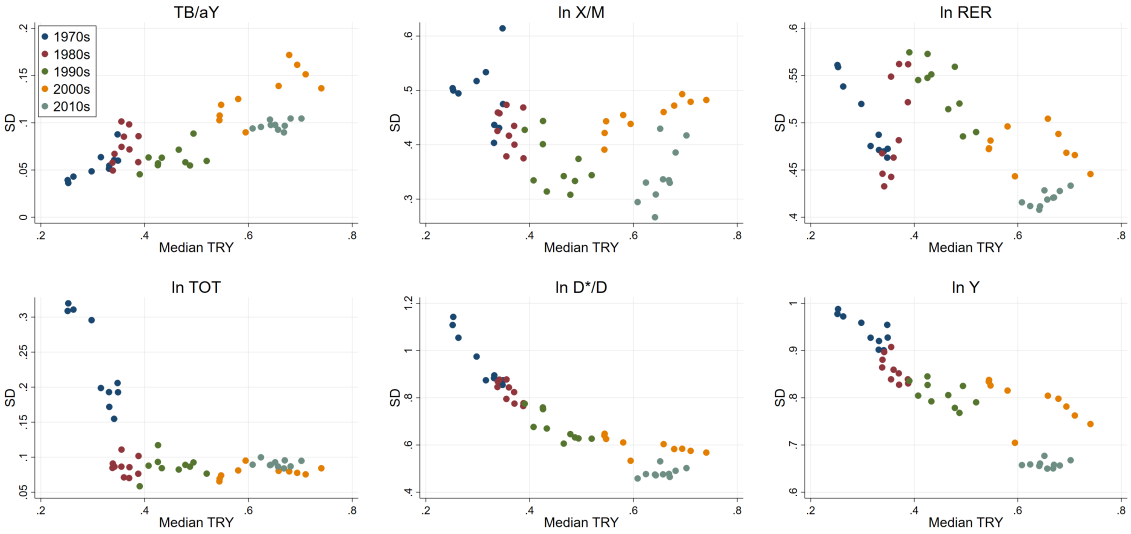


The upper left panel of Figure 3 presents this positive relationship between trade balance dispersion and median TRY in a scatter plot. To compare, we scatter the annual cross-country dispersion of the export-import ratio in the upper right panel. Over time, the dispersion of the export-import ratio actually declines. The two graphs in Figure 3 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).

To uncover the source of cross-country disparities in export-to-import ratio, we construct cross-country dispersion of terms of trade, real exchange rate, and domestic spending, which is sum of consumption, investment, and government spending. Figure 3 presents the scatter plots of these dispersions against the median trade share to GDP in each year. In all lower panels of Figure 3, we observe negative relationships: as trade share 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 total factor productivity (TFP), measured with its interquatile range, has declined during the last five decades. Aggregate output also becomes less divergent across countries over time, as shown

Figure 3: Dispersions and Economic Integration



in the last panel of Figure 3.

Taking all of these findings together, we undertake a reduced form regression analysis that relates the rise in 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 50 percent of the variation in the annual dispersion in the trade balance, as shown in the R-square of regression (1). Including other regressors, including median output growth, output growth dispersion, and real exchange rate dispersion, 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-square 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 **?**, 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. Using a panel of 50 countries during the period of 1970-2019, Table 2 reports the results. For each of three types we consider two

Table 1: Cross-sectional Regressions

VARIABLES	(1) Disp TBY	(2) Disp TBY	(3) Disp TBY	(4) Disp TBY	(5) Disp TBY	(6) Disp TBY	(7) Disp TBY	(8) Disp TBY	(9) Disp TBY
TRY med	0.181***	0.194***	0.170***	0.211***	0.207***	0.189***	0.186***		
	(0.032)	(0.035)	(0.031)	(0.039)	(0.040)	(0.036)	(0.037)		
dY med		0.211**				0.240**	0.241**	0.355**	0.334**
		(0.103)				(0.108)	(0.109)	(0.165)	(0.141)
dY med (-1)		0.159				0.144	0.144	0.137	0.085
		(0.116)				(0.119)	(0.121)	(0.164)	(0.134)
Oil price			0.008			0.007	0.007	0.025**	0.020**
			(0.006)			(0.006)	(0.007)	(0.010)	(0.009)
Disp dY				0.472	0.486	0.409*	0.417	0.042	0.589**
				(0.292)	(0.336)	(0.235)	(0.272)	(0.253)	(0.273)
Disp dY (-1)				-0.067	-0.082	-0.411	-0.428*	-0.868**	-0.870**
				(0.250)	(0.259)	(0.256)	(0.251)	(0.363)	(0.334)
Disp dRER					-0.033		-0.036		-0.365***
					(0.100)		(0.099)		(0.117)
Disp dRER (-1)					0.010		0.022		-0.236*
					(0.120)		(0.128)		(0.140)
Observations	50	48	50	48	48	48	48	48	48
R-squared	0.506	0.565	0.516	0.538	0.538	0.600	0.601	0.265	0.402

Data from Penn World Table 10.0, 1970-2019 with 50 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	0.832***	0.115***	1.083***	0.961***	1.095***	0.979***
	(0.0594)	(0.0262)	(0.0596)	(0.0729)	(0.0599)	(0.0744)
SR spending	1	-0.0578***	1	0.764***	1	0.780***
		(0.00608)		(0.0611)		(0.0622)
Adjustment					0.00890***	0.00825***
					(0.00181)	(0.00179)
LR price					2.975**	2.749*
					(1.032)	(1.102)
Observations	2500	2500	2450	2450	2450	2450
R-squared	-9.927	0.0556	0.237	0.250	0.246	0.257

Data from Penn World Table 10.0, 1970-2019 with 50 countries. ECM stands for the error correction model: $\Delta \ln X_t/M_t = \beta + \gamma_{SR}\Delta p_t + \Delta d_t - \alpha(\ln X_{t-1}/M_{t-1} - \gamma_{LR}p_{t-1} - d_{t-1})$.
Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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.

The regression in levels presents poor R-squared and the estimates the Armington elasticity as the coefficient of short-run prices differ when the constraint on the spending is relaxed. When estimated in first differences, with and without the error correction term, the Armington elasticity is significant around one. 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 **?**. 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, trade balances 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. The world has seen a 'Great Moderation' in output, relative price and spending, as well as growing economic integration but widening disparities in the trade balance.

4 Model

We now develop a multi-country variation of the canonical international business cycle model of **?** 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, and trading these intermediates across countries is subject to a stochastic bilateral trade cost. Also, as in **?** and **?**, 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 interest rate and there are country-specific 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 **?** and **?**).

Consumers Consumers in country n choose consumption, leisure, and investment 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 interest rate of a non-contingent bond, $e_{nt} \equiv P_{1t}/P_{nt}$ 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 capital is given by

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

Let λ_{nt} be the marginal utility of consumption. We can define consumers' stochastic discount factor Λ_{nt} as $\Lambda_{nt} = \beta^t \frac{\lambda_{nt}/P_{nt}}{\lambda_{0t}/P_{n0}}$.

Final good producers Final good producers are competitive and combine all home and foreign intermediates with a CES aggregator. Specifically, the final good production D_{nt} at country n is given by

$$D_{nt} = \left(\omega^{\frac{1}{\gamma}}_{nn} a^{\frac{\gamma-1}{\gamma}}_{nnt} + \varphi^{\frac{\gamma-1}{\gamma}}_{nt} \sum_{m \neq n} \omega^{\frac{1}{\gamma}}_{nm} a^{\frac{\gamma-1}{\gamma}}_{nmt}\right)^{\frac{\gamma}{\gamma-1}}$$

where a_{nmt} is the intermediate good produced in country m at time t. To allow for a short-run trade elasticity different from the long-run elasticity γ, we follow **?** and assume an input

adjustment cost φ_{nt} with

$$\varphi_{nt} = 1 - \frac{\iota}{2}\left(\frac{(\sum_{m\neq n} a_{nmt})/a_{nnt}}{(\sum_{m\neq n} a_{nmt-1})/a_{nnt-1}} - 1\right)^2.$$

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 optimal choices can be characterized with the following first order conditions,

$$\begin{aligned}\frac{p_{nmt}}{P_{nt}}\tau_{nmt} = {} & D_{nt}^{\frac{1}{\gamma}}\varphi_{nt}^{\frac{\gamma-1}{\gamma}}\omega_{nt}^{\frac{1}{\gamma}}a_{nmt}^{-\frac{1}{\gamma}} - D_{nt}^{\frac{1}{\gamma}}\varphi_{nmt}^{-\frac{1}{\gamma}}\,\iota G_{nm,t}\frac{1/a_{nnt}}{\sum_{m\neq n} a_{nmt-1}/a_{nnt-1}}\left(\sum_{m\neq n}\omega_{nmt}^{\frac{1}{\gamma}}a_{nmt}^{\frac{\gamma-1}{\gamma}}\right) \\ & + \beta E_t\left[\frac{\lambda_{nt+1}}{\lambda_{nt}}D_{nt+1}^{\frac{1}{\gamma}}\varphi_{nt+1}^{-\frac{1}{\gamma}}\,\iota G_{nm,t+1}\frac{\sum_{m\neq n} a_{nmt+1}/a_{nnt+1}}{\sum_{m\neq n} a_{nmt}^2/a_{nnt}}\left(\sum_{m\neq n}\omega_{nmt+1}^{\frac{1}{\gamma}}a_{nmt+1}^{\frac{\gamma-1}{\gamma}}\right)\right].\end{aligned}$$

where $G_{nm,t} = \left(\frac{\sum_{m\neq n} a_{nmt}/a_{nnt}}{\sum_{m\neq n} a_{nmt-1}/a_{nnt-1}} - 1\right)$.

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, which implies the pricing to market (PTM). As in **?**, 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. 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. Specifically, the price of country n producer selling to country

m, p_{mnt} is given by

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

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 $\sum_n b_{nt} = 0$.

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 significantly less than what we observed in the data. Reducing financial friction also produces more divergent export-to-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, trade barrier reduction 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.

Parameterization and Moments 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. Specifically,

$$\ln \tau_{nm,t} = \ln \xi_{ct} + 0.5 \ln \xi_{nm,t}, \qquad \ln \tau_{mn,t} = \ln \xi_{ct} - 0.5 \ln \xi_{nm,t} \tag{3}$$

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

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

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

$$\phi_{nt} = e^{\hat{\phi}_{nt}}, \quad \hat{\phi}_{nt} = \rho_{\phi}\hat{\phi}_{nt-1} + \varepsilon_{\phi nt}, \quad \varepsilon_{\phi nt} \sim N(0, \sigma_{\phi}). \tag{4}$$

There is also a world productivity shock z_t, which follows an AR(1) process with persistence ρ_z and volatility σ_z. Lastly, we also allow for a discount factor shock Θ_{nt} as

$$\ln(\Theta_{nt}/\Theta_{nt-1}) = \ln \beta_{nt} = (1-\rho^{\beta}) \ln \bar{\beta}_n + \rho^{\beta} \ln \beta_{nt-1} + \varepsilon^{\beta}_{nt},$$

where $\bar{\beta}_n$ is the steady-state discount factor of country n.

We estimate the model to four asymmetric countries, the U.S., Europe, China, and the rest of the world. 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, and depreciation rate δ, the intertemporal elasticity of substitution, preference weight on consumption and home goods, the average debt, and persistence parameters of the shocks. 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 as 0.8 and conduct sensitivity analysis on them.

The second group includes the Armington elasticity γ, the markup parameter η, the RER elasticity in the pricing-to-market θ, the input adjustment cost ι, the debt elasticity of country specific interest rate F, the persistence of the discount factor shock ρ_{β}, and the volatilities of shocks parameters: σ_{ϕ}, σ_z, σ_{β}, σ_{ξ_c}, and σ_{ξ_d}. Table 3 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 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 dispersions of net and gross trade, the relative prices, and relative GDP and domestic spendings.

Table 3: Parameter Values

Endogenously chosen			Exogenously chosen		
γ	Armington elasticity	8	β	Discount factor	0.96
η	Markup	1.45	α	Capital share	0.36
θ	RER-elasticity of PCM	1.85	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	0.25	μ	Weight on consumption	0.37
σ_β	Discount rate shock	0.10	ψ	Capital adjustment cost	0.001
ρ_β	Discount rate persistence	0.91	ω_{nn}	Weight on home goods	0.80
σ_z	Productivity shock	0.20	$\bar{z}_n$	Mean productivity	1
σ_ϕ	Interest rate shock	0.08	$\bar{b}_n$	Mean debt	0
σ_{ξ_c}	Common trade cost shock	0.01	$\bar{h}_n$	Population	1
σ_{ξ_d}	Differential trade cost shock	0.01	ρ_z	Productivity persistence	0.98
$\bar{\xi}_c$	Common trade cost SS	(vary)	ω_{mn}	Weight on foreign goods	0.20
			$\bar{\xi}_d$	Mean differential trade cost	1
			ρ_{ξ_c}	Common trade cost persistence	0.80
			ρ_{ξ_d}	Differential trade cost persistence	0.80
			ρ_ϕ	Interest rate shock	0.80

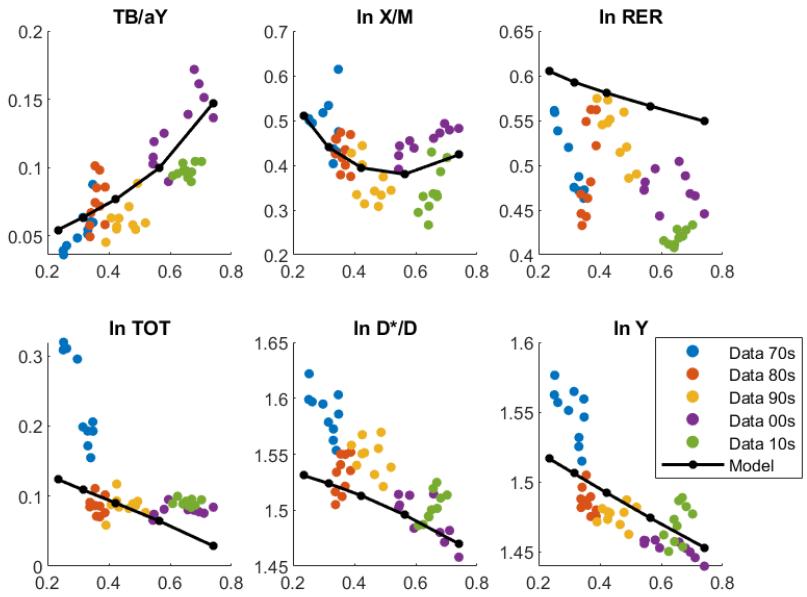
Every parameter matters for the general equilibrium and affects all the moments. However, there is by and large a clear correspondence between certain parameters and moments. The Armington elasticity Γ disciplines the response of prices and matters for the comovement of integration and global dispersions. The resulting γ is 8, The pricing-to-market parameter θ governs the relative volatility of the terms of trade and real exchange rate. The input adjustment cost ι shapes the relationship between net trade flows and the real exchange rate. When θ and ι equal zero, we go back to the standard models. The estimation calls for positive values: $\theta = 1.85$ and $\iota = 10$. 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 $F = 0.25$. All the shocks, trade, interest rate, and productivity, affect the persistence and volatility of GDP.

Both financial friction, governed by debt elasticity F, and trade barrier $\bar{\xi}_c$ affects cross-

border capital flows. In our benchmark estimation, we fix the debt elasticity F and consider the trade integration by varying $\bar{\xi}_c$. We then vary the financial friction parameter F to show that financial friction matters more for net capital flows across countries than for gross capital flows. It has difficulty in generating the observed gross capital flows.

Trade Integration and Global Dispersion To get the trade integration (TRY), we vary the mean of the common trade cost $\bar{\xi}_c$. For each trade cost, we simulate the model 5,000 periods with four countries. For each period, we compute the standard deviations of trade-balance-to-GDP (TBY), $\ln X/M$, real exchange rate, terms of trade, relative spending, and GDP. We then take average of these standard deviations across time. Figure 4 shows the scatter plots with the standard deviations on the y-axis and trade share over GDP (TRY) on the x-axis.

Figure 4: 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.

Our estimated model produces well the observed changes in global dispersion after world integration. When the gross capital flow, measured with TRY, increases from 20% to 80%,

the net capital flow TBY becomes more diverged across countries, with the standard deviation increasing from 0.05 to about 0.15. As in the data, high TRY in the model leads to a lower dispersion in X/M. 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 X/M dispersion is slightly non-monotonic in the data, and the model captures well this pattern.

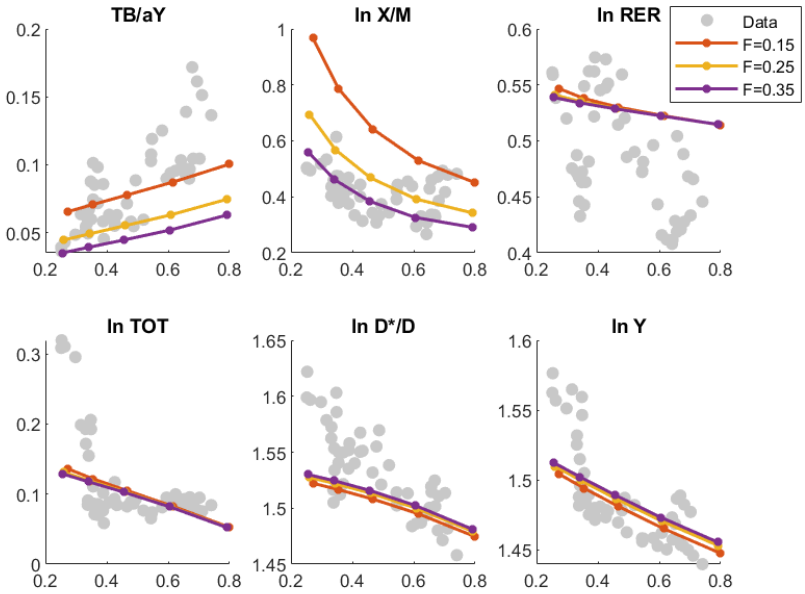
Our model also successfully produces the observed average volatilty in real exchange rate, terms of trade, and relative spendings after economic integration. Higher economic integration also makes RER less dispersed across countries. The relative spending and output also becomes less volatile across countries when the world becomes more open, in both the data and the model.

Financial Integration and Global Dispersion To see the role of financial integration on global dispersion, we consider three levels of debt elasticity F with 0.15, 0.25, and 0.35. See Figure 5 for the results. Lower F allows countries to borrow and lend for better risk sharing and the pursuit of investment opportunities. We therefore observe an increase in trade balance dispersion. Additionally, a country's export and import diverge more. The volatilities of TBY nearly double when F is reduced from 0.35 to 0.15. However, the volatilities of relative prices, spending, and output are relatively insensitive to the change in F. Furthermore, the total trade share as a percentage of output varies little with F. This analysis shows that financial frictions have a large impact on cross-country net capital flows, but not on gross capital flows. To better gauge the quantitative impact of financial frictions, we plan to jointly estimate the trade and financial frictions in the next step.

5.1 Further development

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.

Figure 5: Financial Integration and Global Disperion



In each graph, y-axis is the standard deviation, x-axis is trade share over output. The lines shows model results under different debt elasticity parameter F.

Estimation of Trade Integration Process A key element of our analysis is to estimate a process for trade barriers as 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.

A second computational issue is that we lack a many country GE model of exporter dynamics and aggregate fluctuations. A key challenge to bringing country heterogeneity and exporter dynamics is that the state space grows quadratically with the number of countries and thus makes using global or high-order methods challenging. A key aim of the project will be to develop ways to capture the rich country heterogeneity without inducing large numerical errors.

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 60 years. We develop a simple variation of the canonical multi-good RBC model of **?** 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 lead to very different properties in relatives prices and net trade flows as a share of overall trade.

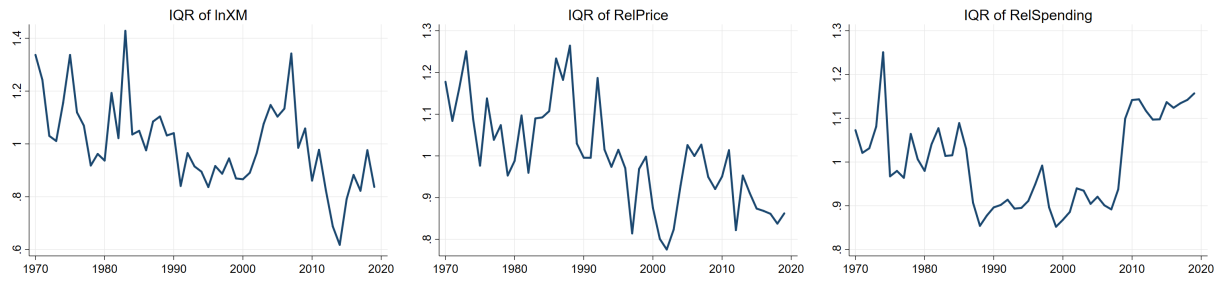
In line with work on the trade-comovement puzzle (see **?**) we have focused on the business cycle properties of model economies that differ in their openness. We have then compared the properties of fluctuations in these models around their steady state to the data. Future work should explicitly study the impact of shocks that have lead the world to become more integrated and perhaps even fully match the transitions in the model to the data. Recent

work, (**?**) 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 trade finance relationship (**?**, **?**), 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.

Appendix

Figure 6



Note: Balanced panel of 50 countries from the BIS Sample. IQR is normalized by the mean IQR of 1970-2016. For RelPrice and RelSpending of 1970-1992, trade weights of 1993 are used, and for 2017-2019, weights of 2016.

Table 4: By periods

VARIABLES	(1) Disp TBY		
	# (1970-1989)	# (1990-2006)	# (2007-2019)
TRY med	0.186	0.306***	0.947***
	(0.126)	(0.065)	(0.180)
dY med	0.268*	0.571***	-0.454*
	(0.147)	(0.092)	(0.230)
dY med (-1)	0.197*	0.370	-0.483**
	(0.097)	(0.282)	(0.200)
Oil price	0.031***	0.001	-0.038
	(0.010)	(0.015)	(0.029)
Disp dY	0.809**	0.038	3.923***
	(0.339)	(0.313)	(1.143)
Disp dY (-1)	-0.584	-0.331	-1.296**
	(0.432)	(0.268)	(0.469)
Disp dRER	-0.154	0.187	-1.841***
	(0.117)	(0.236)	(0.622)
Disp dRER (-1)	-0.253**	-0.024	-2.072***
	(0.109)	(0.181)	(0.730)
Observations		48	
R-squared		0.924	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Y, Oil price, and RER are logged