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

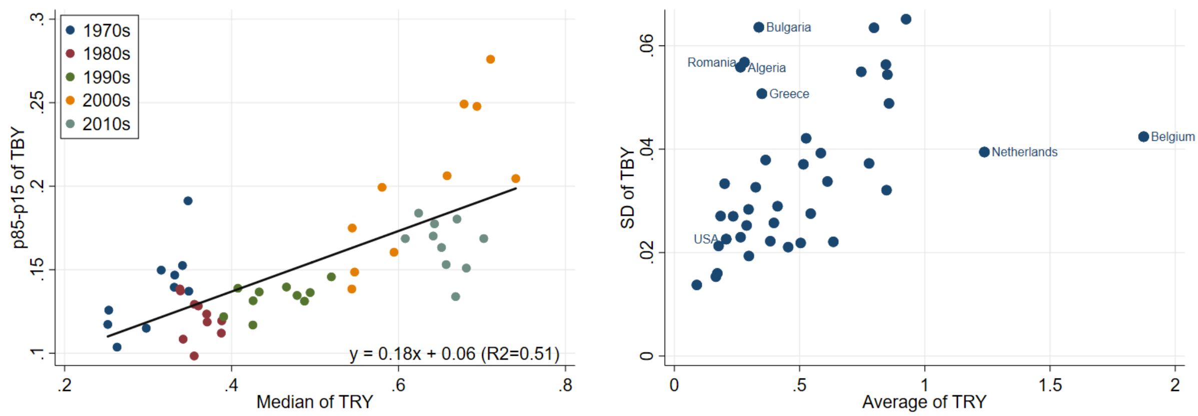
Over the last fifty years, the global economy has been characterized by a large increase in international borrowing-lending. For example, China has accumulated a large positive net foreign asset position even as the United States has de-accumulated a large negative net foreign asset position or debt.[1] 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 1 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 Milesi-Ferretti (2021) 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 and Trade
Over Time and Across Countries



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 the 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 the 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 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 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 Backus et al. (1994) business cycle model extended to include shocks 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) 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 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 and Sposi, 2021).

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 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 Alessandria and Choi (2021), 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, TBTR, 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

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

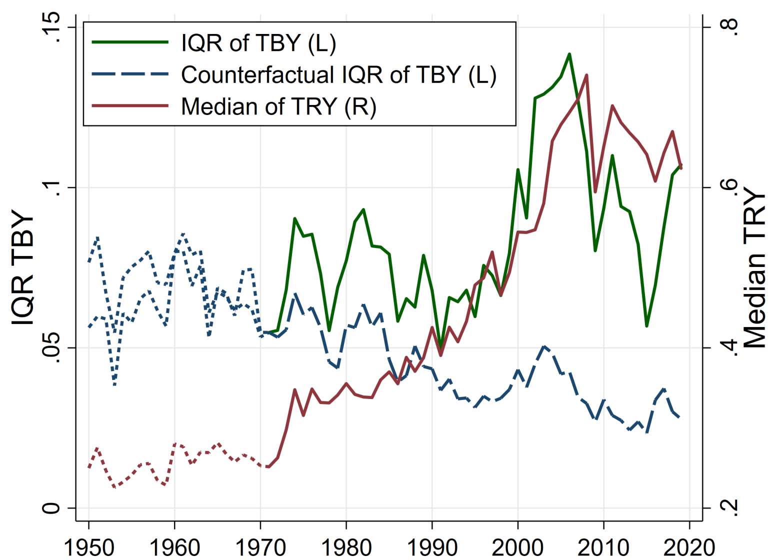
where γ is the elasticity of substitution between home and foreign goods (the so called Armington elasticity), ω home bias, τ ad valorem trade cost, p the price of differentiated good, P price level, D domestic spending on tradables, and asterisk refers to the foreign analogous to a home variable. Define 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.

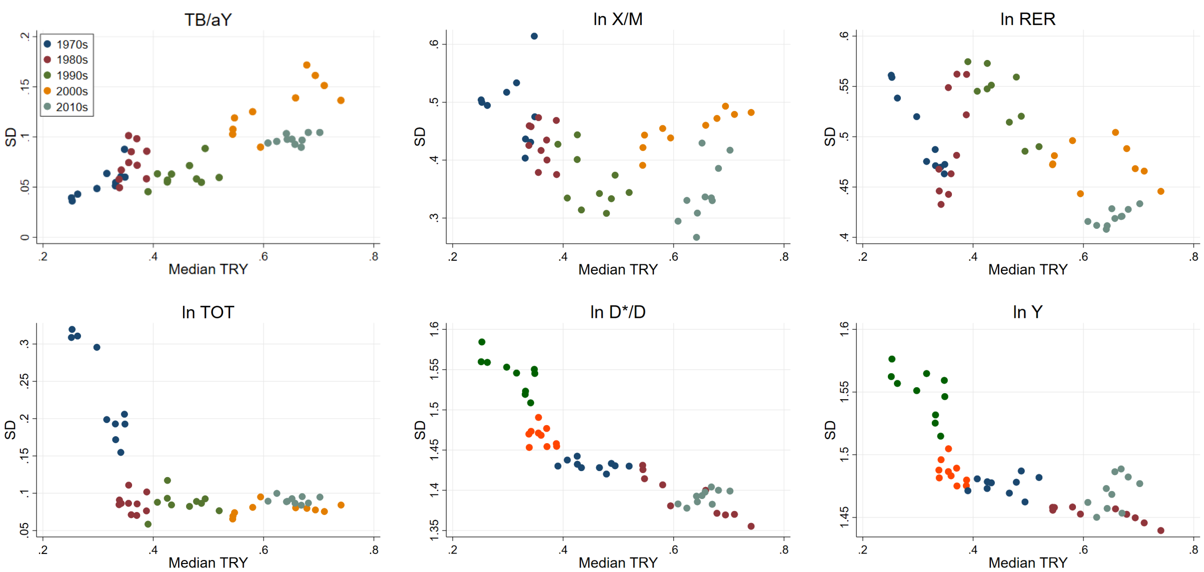
We take data from Penn World Table 10.0 and consider 50 countries including both developed and emerging countries. The countries in our sample are those that are available in the Penn World Table at least since 1970 and are covered in the broad basket of BIS Effective Exchange Rates. The median TRY across 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 counterfactual 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: Counterfactual



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).

Figure 3: Macroeconomic Dispersion and Economic Integration



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 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.

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	0.181***	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.

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. 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 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

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: $\Delta \ln X_t/M_t = \beta + \gamma_{SR}\Delta p_t^r + \Delta d_t^r - \alpha(\ln X_{t-1}/M_{t-1} - \gamma_{LR}p_{t-1}^r - d_{t-1}^r)$.
Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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, 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 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) and Heathcote and Perri (2002), 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 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

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

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 the capital stock is given by

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

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

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

where F governs the interest rate elasticity to debt. 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

$$D_{nt} = \left(\omega_{nn}^{\frac{1}{\gamma}} a_{nnt}^{\frac{\gamma-1}{\gamma}} + \varphi_{nt}^{\frac{\gamma-1}{\gamma}} \sum_{m \neq n} \omega_{nm}^{\frac{1}{\gamma}} a_{nmt}^{\frac{\gamma-1}{\gamma}}\right)^{\frac{\gamma}{\gamma-1}}$$

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 Rabanal and Rubio-Ramirez (2015) 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 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. 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.[2] Specifically, the price of country n producer selling to country m, p_{mnt} is given by

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

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

[2]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 teh way described above.

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.[3] 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,

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

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

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

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

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. 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 B). 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.

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 dispersion in the trade balance. 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

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	0.3	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	0.03	$\bar{h}_n$	Population	1
σ_{ξ_d}	Differential trade cost shock	0.1	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

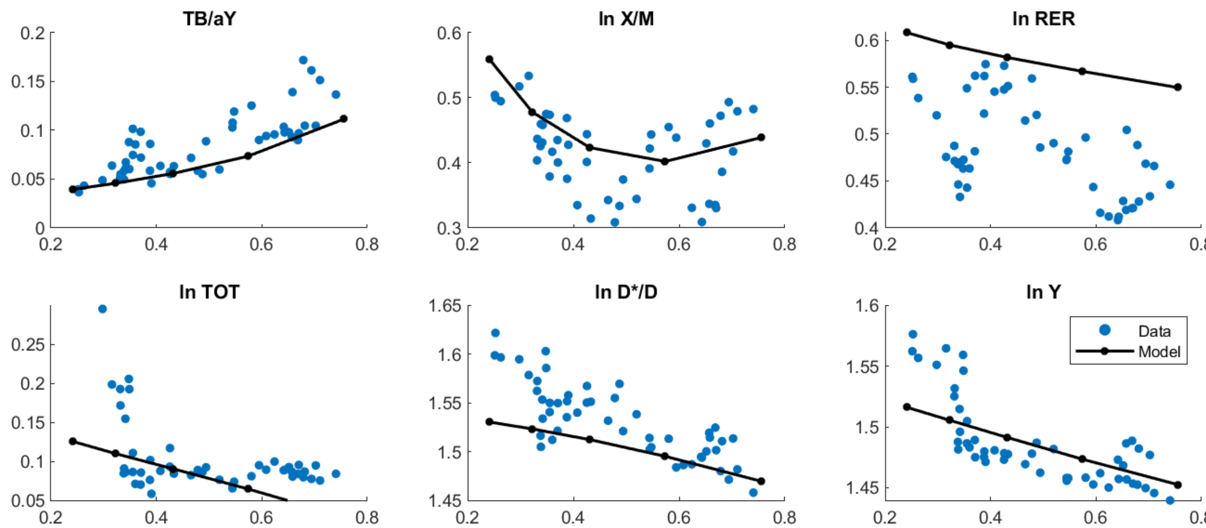
and the real exchange rate. When θ and ι equal zero, we go back to the standard models. The estimation calls for positive values: $\theta = 1.85$ and $\iota = 10$. Higher debt-elasticity F reduces intertemporal risk-sharing and lowers the volatility of the trade balance. It also allows the model to match 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 trade flows. It can not generate an increase in observed gross trade flows.

Trade Integration and Global Dispersion To get the level of trade integration (TRY) to vary, 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.

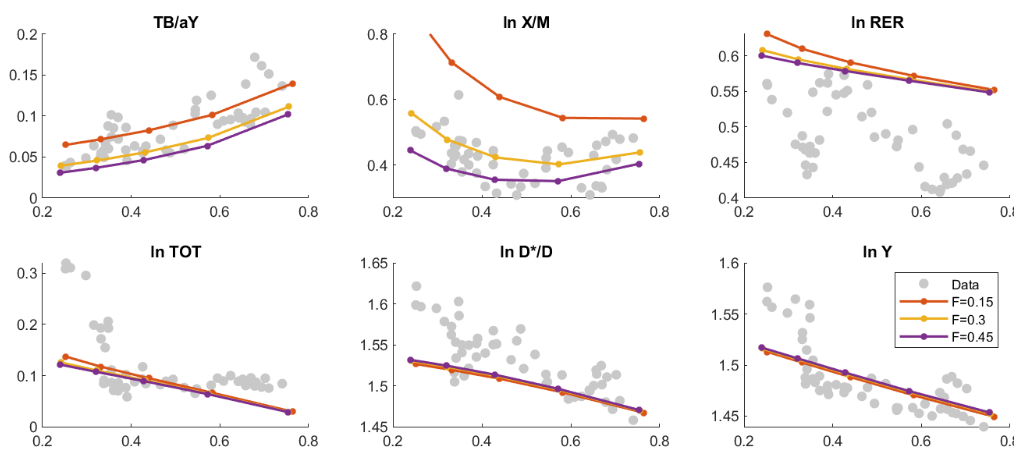
Our estimated model closely matches the observed changes in global trade balance dispersion with world integration. When the gross trade flows, measured with TRY, increase from 20% to 80%, the net capital flow, TBY, diverges by more across countries, with the standard deviation increasing from 0.05 to about 0.15. As in the data, high trade openness, 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 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

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.

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.

5.1 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 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 as in Mix (2020). A key challenge to bringing country heterogeneity and exporter dynamics into the model 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 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 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 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 lead 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 trade finance relationship (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 debt relative to the level of trade rather than the level of output.

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Appendix

In this section we discuss three things. First, 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. Second, we show that the theoretical relationship is robust to considering more countries. And third, we show that the relationship holds within simulations rather than just when studying simulations around different steady states.

A 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 6 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 7). 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.

Figure 6: Sensitivity to Current Account, Country Coverage, and Measure of Net Trade

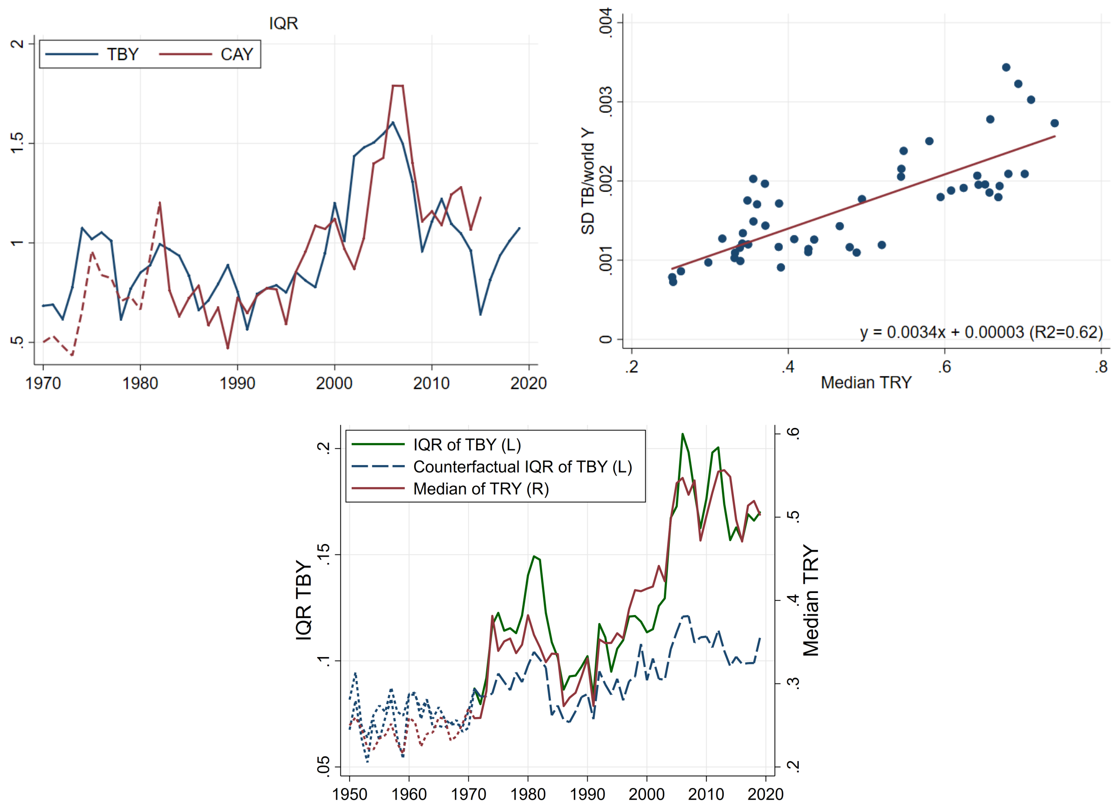
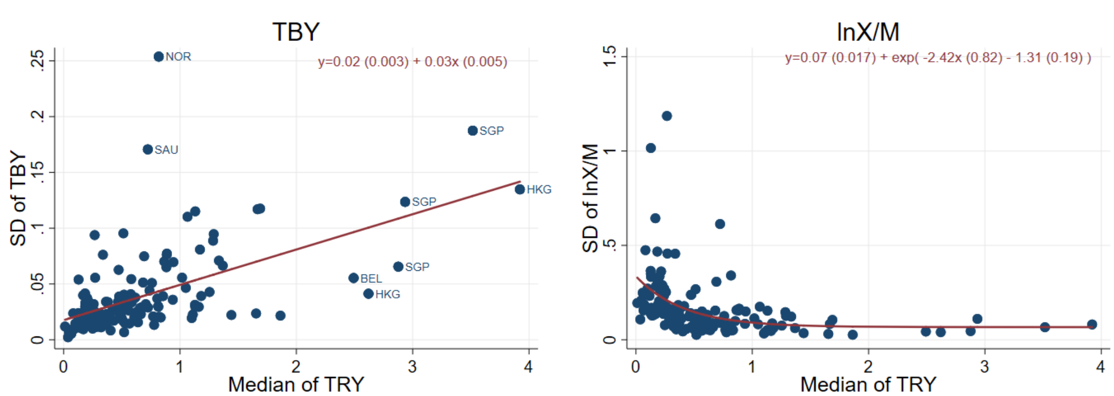


Figure 7: Salient features of Net Trade Robust Across Time Periods



B 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 8: Trade Balance Dispersion is Minimally Affected by Number of Countries

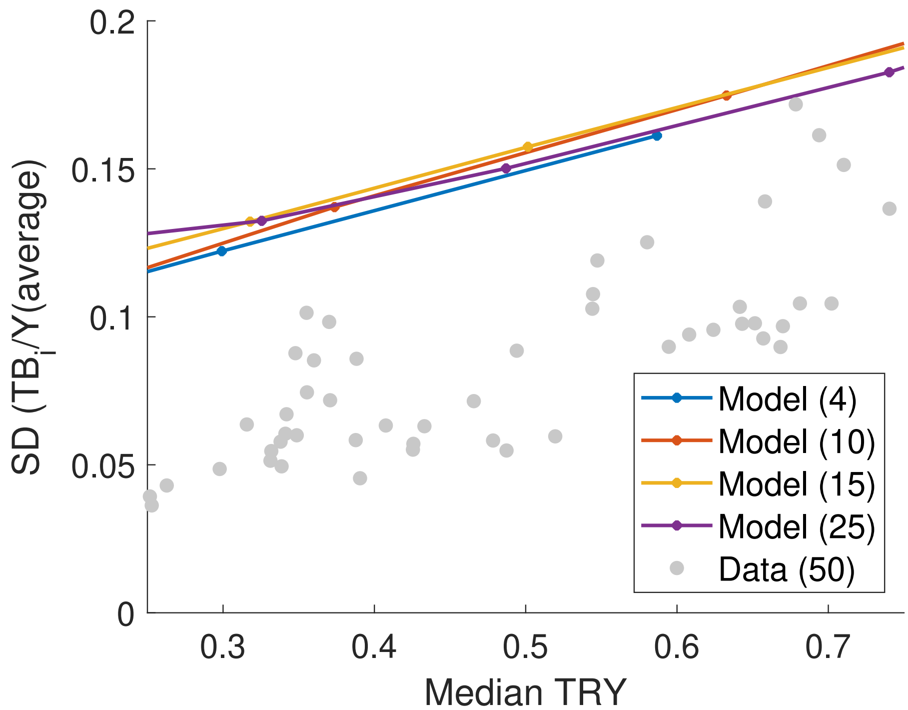


Figure 8 shows that the model's prediction for the dispersion of trade balance as a share of average GDP is roughly invariant to the number of countries for the empirical relevant range of openness.

C 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 4. 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 9 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.

Table 4: 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

Figure 9: Trade Integration and Global Dispersion – 3rd order approximation