Unbalanced Trade 2.0

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Abstract

Do trade imbalances boost incomes in surplus economies at the expense of deficit economies? We show that the answer is yes in an important subclass of quantitative trade models. This is the consequence of scale economies in the traded sector. A rise in net exports causes the traded sector to expand which raises productivity and real income in surplus economies. The flipside is a decline in productivity and income in deficit economies. Under plausible calibrations of the strength of scale economies, observed trade imbalances cause a sizeable redistribution of the gains from trade towards surplus economies. If these imbalances are the outcome of steady-state equilibrium in international asset markets, financial autarky may be welfare-improving for major deficit economies.

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1 Introduction

Large and very persistent trade imbalances have been a feature of the global economy since the late 1990s. These imbalances have now assumed centre stage in discussions about trade policy.[1] The concern about imbalances is not restricted to policy makers, but has also been taken up by a new strand of thought—primarily from outside mainstream economics—that views imbalances as a significant economic burden on deficit economies. Although proponents of this view differ in the specifics, they share at least three common assertions.[2] First, trade imbalances have boosted industrial production in surplus economies at the expense of deficit economies. Second, de-industrialisation in deficit economies has been "excessive". Third and consequently, deficit economies would be strengthened by a move towards more balanced global trade. In this paper, we show that these assertions are qualitatively consistent with an important subclass of commonly used trade models. Depending on parameter assumptions, they may have quantitatively meaningful implications for the distribution of the gains from trade. Having documented it, we explore some of the implications of this finding.

The modern quantitative analysis of trade policy counterfactuals relies on models that generate a gravity equation of international trade. One appealing feature of these gravity models is that, despite differences in microfoundations, they imply a common macro structure that relates parameter shocks to changes in trade patterns and real incomes.[3] Within this structure, we show that there are two effects that relate changes in imbalances to incomes. The first is a terms-of-trade effect, common to all gravity models. Since spending is home-biased in the presence of trade barriers, a deficit shifts demand towards the output of a deficit economy, which improves its equilibrium terms of trade and raises its real income. Meanwhile, a surplus economy experiences lower terms of trade and real income. This mechanism has a long pedigree in international macroeconomics, harking back to Germany's World War I reparations (Keynes, 1929). However, it contradicts the view that deficits hurt the deficit economy. Instead it is the surplus economy that experiences a "double burden", both from transferring consumption to the rest of the world and from a deterioration of its terms of trade.

The second is a productivity effect, which is present only in models in which the production of traded goods is subject to economies of scale—such as the

[1]For example, the "reciprocal tariffs" announced by the U.S. on April 2 were explicitly motivated by the objective of closing the U.S. trade deficit (see USTR, 2025).

[2]See Navarro (2023), Lighthizer (2023), Pettis and Hogan (2024), and Cass (2024).

[3]See Arkolakis et al. (2012) and Costinot and Rodríguez-Clare (2014).

popular Krugman and Melitz models.[4] A trade deficit shifts labour towards non-traded activities, while a surplus shifts labour towards the traded sector. In the presence of scale economies in traded production, this reduces labour productivity and real income in deficit economies and raises productivity and income in surplus economies. Unlike the terms-of-trade effect, the productivity effect generates an income burden for deficit economies. Moreover, since the equilibrium labour allocation in multi-sector models with scale economies is generally not first-best, imbalances may alleviate underproduction of tradables in surplus economies while exacerbating it in deficit economies.

Armed with these insights, we take a generalised gravity model to recent trade and production data from the OECD Inter-Country Input-Output Database. Initially, in line with common practice in the international trade literature, we treat imbalances as exogenous and explore the macroeconomic impacts of a counterfactual global shift to balanced trade. We use this experiment to asses the relative quantitative importance of the two effects identified above.

Our results show that the terms-of-trade effect is generally small, and easily overturned by the productivity effect when traded-sector scale economies are present. Moreover, when the strength of scale economies is towards the upper end of common parameter calibrations, the productivity effect has a sizeable impact on incomes, causing a significant re-distribution of the gains from trade from deficit to surplus economies. For example, in a gravity model with strong but plausible scale economies and otherwise standard parameter choices, we find that the real income gains from trade to the U.S. are 2.3 percent, but that the U.S. *loses* 1.2 percent of real income due to its trade deficit, wiping out half the gains from trade. By contrast, the gains from trade for China are 1.9 percent, and China gains an *additional* .7 percent from being a surplus economy.

The static quantitative trade model with exogenous imbalances is poorly suited to assessing the welfare consequences of shifting to balanced trade. This is because the shift implies a mechanical increase in *consumption* for surplus economies and corresponding decline for deficit economies—and this exceeds any *income* effects from balancing trade under plausible parameter values. To address this issue, we recast the generalised static gravity model as the steady state of a dynamic model. In this steady state economies' trade balances may differ because of differences in their residents' lifetime income profiles, which gives rise to a non-degenerate steady-state foreign asset distribution.[5] This

[4]See Krugman (1979, 1980) and Melitz (2003).

[5]To ensure that there is a unique steady state independent of initial conditions, the dynamic component of our model assumes an OLG structure in which agents do not have infinite horizons, as in Cuñat and Zymek (2024) and Baqaee and Malmberg (2025).

allows us to model the shift to balanced trade as an endogenous outcome of policy-imposed de facto financial autarky, and to compute the welfare consequences.

The welfare impact of moving to balanced trade depends on the size of an economy's initial trade balance, the strength of scale economies, and the intertemporal elasticity of substitution, which governs individuals' gains from smoothing lifetime consumption. With modest scale economies and standard values of the intertemporal substitution elasticity, economies with a small trade-deficit-to-GDP ratio gain from moving to balanced trade by withdrawing from international asset markets. This group encompasses several major economies, including the U.S. For these economies, the welfare losses from financial autarky are offset by the correction of traded-sector underproduction achieved by closing their trade deficits.

Our paper is most closely related to Dekle et al. (2007, 2008), who use an Eaton-Kortum model to assess the macroeconomic consequences of counterfactually balanced global trade and find small income effects from global imbalances. Our framework nests the Eaton-Kortum model and we show that we can replicate their findings. However, since the standard Eaton-Kortum model assumes constant returns to scale, only the terms-of-trade effect is present. Our generalised gravity framework also features the opposing productivity effect. We highlight that under plausible calibrations of the strength of traded-sector scale economies, the qualitative effect of imbalances on real incomes is the opposite as in Dekle et al. (2007, 2008), and the quantitative effect may be one order of magnitude larger.

The gravity framework we utilise generalises a mechanism first illustrated by Epifani and Gancia (2017). They use a two-country Krugman model to show that a trade surplus increases product variety in the traded sector, which improves the surplus economy's real exchange rate and may overcome the traditional "double burden".[6] Embedding this insight into a generalised gravity framework, we demonstrate that it is germane to a broader class of quantitative trade models. It also enables us to take it to the data in a setting with an arbitrary number of heterogeneous economies, using the now-common "exact hat algebra" to explore counterfactuals relative to observed trade and production patterns. Finally, we complement the static treatment of imbalances in Dekle et al. (2007, 2008) and Epifani and Gancia (2017) with a dynamic bloc of "exact hat" equations that endogenise trade imbalances and allow for a formal analysis of the domestic welfare implications and international spillovers from

[6] Krugman (1987) and Benigno et al. (2025) also establish links between the trade balance, the size of the traded sector, and economies of scale.

trade-balancing policies.

Our generalised gravity framework builds on recent advances in the understanding of the properties, commonalities and peculiarities of gravity trade models. Costinot and Rodríguez-Clare (2014) review the range of microfoundations of the gravity equation, and categorise which assumptions influence the numerical output from trade policy counterfactuals relative to given observables. Kucheryavyy et al. (2023a) establish properties under which gravity models with scale economies remain tractable for arbitrary trade barriers when countries trade in value added, and Kucheryavyy et al. (2023b) generalises to a setting with input-output linkages. Although trade models with scale economies have been widely used since the arrival of the "New Trade Theory", they have recently become popular in understanding the potential benefits of trade and industrial policy. Such models are used in Lashkaripour and Lugovskyy (2023) to examine the usefulness of trade restrictions in correcting sectoral misallocations, in Bartelme et al. (2025) to compute the potential welfare gains from optimal industrial policies in open economies, and in Caliendo et al. (2023) to explore optimal tariff design.

The notion of beggar-thy-neighbour imbalances is generally associated with Keynesian macroeconomics, where a trade surplus may boost demand and income in surplus economies at the expense of the deficit economies.[7] However, in this setting the international spillovers from imbalances arise due to nominal rigidities that can be offset by monetary policy, unless it is constrained (e.g. at the zero lower bound). We show that similar income spillovers arise in trade models with scale economies under fully flexible prices. These persist as long as imbalances are persistent. In turn, the dynamic component of our framework provides one example of a setting in which permanent trade imbalances are a steady-state feature of the global economy.[8]

The remainder of the paper is structured as follows. Section 2 derives a set of equations that can be used to perform trade-balance counterfactuals across a broad range of static quantitative trade models with exogenous imbalances. Section 3 takes these equations to the data and shows that the macroeconomic effects of balancing world trade depend on the strength of scale economies in traded production. Section 4 endogenises imbalances in a steady state equilibrium with international asset markets. Section 5 combines results from the previous sections to assess the welfare impacts from trade-balancing policies.

[7]See Robinson (1952) for a classic treatment, and Obstfeld and Rogoff (1995) for a more contemporary one.

[8]As discussed in Itskhoki and Mukhin (2025), differences in economies' financial positions can give rise to long-run trade deficits in infinite-horizon economies. Ignatenko et al. (2025) recently show that a Melitz model delivers permanent imbalances if the size of fixed exporting costs is destination-specific and at least partially paid in the labour of destination economies.

2 Trade balance shocks with generalised gravity

In this section, we introduce the hat algebra that describes the economic effects of trade balance shocks in a generalised gravity model. It forms the cornerstone of the quantitative analysis performed in the rest of the paper. For concreteness, we derive it from an Armington model with external economies of scale. However, as we show in Appendix A.1 and A.2 respectively, the same expressions could be derived readily from variants of the Krugman and Melitz models. The environment we describe in this section is static, but in Section 4 we embed it in the steady state of a dynamic model.

2.1 An Armington model with external economies of scale

2.1.1 Assumptions

Preferences and endowments

There are many economies, $n \in 1, ..., N$. The representative agent in each economy is endowed with L_n units of labour. She supplies these inelastically in the local labour market at wage W_n. Out of her labour income, the consumer makes an exogenous transfer to the rest of the world, denoted by T_n. Transfers can be positive or negative, and must satisfy $\sum_n T_n = 0$. They thus correspond to trade balances in the static setting of this section.

The consumer derives utility from consumption C_n, which is assembled from the output of two sectors $i \in \{G, S\}$ in Cobb-Douglas fashion:

$$C_n = \left(\frac{C_{Gn}}{1-\sigma}\right)^{1-\sigma} \left(\frac{C_{Sn}}{\sigma}\right)^{\sigma}, \tag{1}$$

where $\sigma \in [0, 1)$. Hence, she maximises (1) subject to:

$$P_{Gn}C_{Gn} + P_{Sn}C_{Sn} \leq W_n L_n - T_n, \tag{2}$$

where P_{in} is the price of sector-i consumption in economy n.

Technologies and market structure

Profit-maximising firms in economy n produces in the two sectors using the technologies:

$$q_{Sn} = Z_{Sn} L_{Sn}, \tag{3}$$

$$q_{Gn} = Z_{Gn} \left(\frac{L_{Gn}}{\nu}\right)^{\nu} \left(\frac{J_{Gn}}{1-\nu}\right)^{1-\nu}, \tag{4}$$

where q_{Sn} is sector-S output; q_{Gn} denotes the output of an economy-n-specific variety in sector G; Z_{in} is productivity; L_{in} denotes the labour input used;

J_{Gn} denotes the use of aggregated sector-G varieties as input in sector G; and $\nu \in (0,1]$. Firms take Z_{Gn} as given, but we allow for the possibility of external economies of scale (EES):

$$Z_{Gn} = A_{Gn} L_{Gn}^{\phi}, \tag{5}$$

where the parameter $\phi \geq 0$ captures the strength of EES; and A_{Gn} is an exogenous shifter. In the special case $\phi = 0$, the model collapses to the standard constant-returns-to-scale Armington setup.

Goods and labour markets are perfectly competitive. Labour cannot move between economies, but it can move freely between sectors within economies. Output in sector S is non-tradable. Origin-differentiated varieties in sector G are tradable, but subject to an iceberg trade cost: $\tau_{n'n} \geq 1$ units of the economy-n' variety must be shipped for one unit to arrive in economy n, with $\tau_{nn} = 1$ for all n. Sector-G varieties are then assembled by economy-n firms in CES fashion to produce a sector-G aggregate that is used in consumption and as intermediate input:

$$X_{Gn} = \left(\sum_{n'=1}^{N} x_{Gn'n}^{\frac{\theta}{1+\theta}} \right)^{\frac{1+\theta}{\theta}}, \tag{6}$$

where $1 + \theta > 1$ is the elasticity of substitution between varieties.

Equilibrium definition

Market clearing requires:

$$L_{Sn} + L_{Gn} = L_n, \tag{7}$$

$$q_{Sn} = C_{Sn}, \quad q_{Gn} = \sum_{n'=1}^{N} \tau_{nn'} x_{Gnn'}, \tag{8}$$

$$X_{Gn} = C_{Gn} + J_{Gn}. \tag{9}$$

The equilibrium is then a set of wages and labour allocations $\{W_n, L_{Gn}\}_{n \in N}$ such that consumers and firms satisfy their optimality conditions, and (7)-(9) are satisfied.

2.1.2 Equilibrium characterisation

The equilibrium is fully characterised by the following set of equations:

$$W_n L_n + \frac{\sigma}{1-\sigma} T_n = \sum_{n'=1}^{N} m_{nn'} \left(W_{n'} L_{n'} + \frac{\sigma - \nu}{1 - \sigma} T_{n'} \right); \tag{10}$$

$$L_{Gn} = \left(1 - \sigma + \sigma \frac{T_n}{W_n L_n} \right) L_n; \tag{11}$$

$$m_{n'n} = \frac{\left(\tau_{n'n} m_{n'n'}^{\frac{1-\nu}{\theta\nu}} L_{Gn'}^{-\frac{\phi}{\nu}} W_{n'}/A_{Gn'}^{\frac{1}{\nu}}\right)^{-\theta}}{\sum_{n'=1}^{N}\left(\tau_{n'n} m_{n'n'}^{\frac{1-\nu}{\theta\nu}} L_{Gn'}^{-\frac{\phi}{\nu}} W_{n'}/A_{Gn'}^{\frac{1}{\nu}}\right)^{-\theta}}; \tag{12}$$

$$\sum_{n} W_n L_n = 1; \tag{13}$$

where $m_{n'n}$ denotes the share of spending by economy n on sector-G output from economy n'.

Equation (10) is a market-clearing condition that pins down relative wages as a function of trade balances and bilateral trade shares. Equation (11) determines the equilibrium allocation of labour to tradables production. Equation (12) describes the properties of bilateral trade shares. These take the form common to all gravity models. Economy-n spending on economy-n' output declines with bilateral trade barriers, with θ governing the responsiveness of trade flows to trade barriers. It also declines in the relative price of economy-n' traded output. In turn, that price reflects economy-n' wages and traded-sector labour productivity. In our framework labour productivity in tradables has two endogenous components. The first—captured by $m_{nn}^{(1-\nu)/(\theta\nu)}$—represents the cost of intermediate inputs, a portion of which is imported. The second—captured by $L_{Gn}^{-\phi/\nu}$—reflects potential scale economies in tradable production: everything else constant, the price of an economy's tradable output is lower the larger the scale of production. Finally, we impose the normalisation in (13) to ensure that trade balances can be interpreted in terms of fixed shares of world GDP.[9]

Following Arkolakis et al. (2012) and Costinot and Rodríguez-Clare (2014), we can write:

$$C_n = Y_n \left(1 - \frac{T_n}{W_n L_n}\right), \tag{14}$$

$$Y_n \equiv \frac{W_n L_n}{P_n} = \left(m_{nn}^{-\frac{1}{\theta}} L_{Gn}^{\phi}\right)^{\frac{1-\sigma}{\nu}} A_n L_n, \tag{15}$$

where Y_n represents the real GDP of economy n; $P_n \equiv P_{Gn}^{1-\sigma} P_{Sn}^{\sigma}$; and $A_n \equiv A_{Gn}^{\frac{1-\sigma}{\nu}} Z_{Sn}^{\sigma}$.

Equation (15) encapsulates the two channels through which imbalances affect real incomes. The first is what we call the *terms-of-trade effect*. To see it, note that we can write $m_{nn} = (1 + S_n^{-\theta})^{-1}$, where S_n is a measure of the price of economy-n exports compared to the price of its imports—the terms of trade. The terms of trade depend on economies relative wages, as can be seen from equation (12). It follows from (10) that with some home bias in spending, a trade deficit in economy n shifts demand from foreign

[9] It is straightforward to prove that there is a unique set of labour allocations and wages consistent with (10)-(13) by following the steps described in Kucheryavyy et al. (2023b).

labour towards economy-n labour.[10] In equilibrium, this raises the relative wage of economy n and improves its terms of trade. Conversely, a trade surplus reduces the economy's relative wage and worsens its terms of trade. Via terms-of-trade-induced changes of m_{nn} in equation (15), trade imbalances thus raise real income in deficit economies, and lower it in surplus economies.

The second channel is what we call the *productivity effect*. Everything else constant, an improvement in the trade balance of economy n shifts labour to the traded sector, as can be seen from equation (11). In turn, this raises aggregate productivity and real income via L_{Gn} in equation (15) if there are scale economies ($\phi > 0$).

2.1.3 A note on efficiency

It should be evident that the equilibrium characterised by (10)-(12) is not Pareto efficient if $\phi > 0$. Since firms do not internalise the effect of their production choices on traded-sector productivity, the share of labour allocated to trade production is too low in the presence of scale economies. While this is trivial in the case of our two-sector Armington model with EES, it is also a generic feature of multi-sector models with scale economies. The market equilibrium in these models delivers underproduction in high-returns-to-scale industries.[11] The second-best nature of the market equilibrium explains why we find in Section 5 that *introducing* market frictions can be welfare-improving for some economies when scale economies in traded production are strong.

2.2 Exact hat algebra

2.2.1 General trade balance shocks

Consider an initial equilibrium of the model described in Section 2.1 that corresponds to the empirically observed patterns of trade, production, imbalances and incomes. Now suppose we impose a new set of trade balances, $\{\tilde{T}_n\}_n$. For any endogenous variable U, let $\hat{U} \equiv \tilde{U}/U$ denote its change relative to the status-quo equilibrium. Then:

$$\hat{W}_n y_n + \frac{\sigma}{1-\sigma}\tilde{T}_n = \sum_{n'} \hat{m}_{nn'} m_{nn'} \left(\hat{W}_{n'} y_{n'} - \frac{\nu - \sigma}{1-\sigma}\tilde{T}_{n'} \right); \tag{16}$$

$$\hat{L}_{Gn} = \frac{y_n + \frac{\sigma}{1-\sigma}\frac{\tilde{T}_n}{\hat{W}_n}}{y_n + \frac{\sigma}{1-\sigma}T_n}; \tag{17}$$

[10] There are two sources of home bias in our framework: the assumption that a share of output is non-tradable ($\sigma > 0$) and the presence of iceberg trade barriers in the traded sector which cause tradables spending to be biased towards an economy's own goods.

[11] For example, see Lashkaripour and Lugovskyy (2023) for a recent discussion.

$$\hat{m}_{n'n} = \frac{\left(\hat{m}_{nn}^{\frac{1-\nu}{\theta\nu}}\hat{L}_{Gn'}^{-\frac{\phi}{\nu}}\hat{W}_n\right)^{-\theta}}{\sum_n \left(\hat{m}_{nn}^{\frac{1-\nu}{\theta\nu}}\hat{L}_{Gn'}^{-\frac{\phi}{\nu}}\hat{W}_n\right)^{-\theta} m_{nn'}}; \tag{18}$$

$$\hat{C}_n = \hat{Y}_n \frac{y_n - \tilde{T}_n/\hat{W}_n}{y_n - T_n}; \quad \hat{Y}_n = \left(\hat{m}_{nn}^{-\frac{1}{\theta}}\hat{L}_{Gn'}^{\phi}\right)^{\frac{1-\sigma}{\nu}}; \tag{19}$$

$$\sum_n \hat{W}_n y_n = 1; \tag{20}$$

where $y_n \equiv W_n L_n / \sum_n W_n L_n$ denotes the share of economy n in world GDP in the initial equilibrium.

Dekle et al. (2007) derive (16), (18) and (19) under the assumption that production and trade in sector G follows the Eaton-Kortum model, which corresponds to the special case of $\phi = 0$.[12] This is isomorphic to the constant-returns-to-scale Armington model. In Appendices A.1 and A.2 we show that (16)-(19) can also be derived from variants of the Krugman and Melitz models, where generally $\phi > 0$.

2.2.2 Special case of shift to balanced trade

Suppose now the shock is a shift to balanced trade for economy n. Then we can write (19) to a first-order approximation as:

$$\ln \hat{C}_n \simeq t_n + \ln \tilde{Y}_n \simeq t_n + \frac{(1-\sigma)(1-m_{nn})}{\nu} \ln \hat{S}_n - \frac{\sigma\phi}{\nu} t_n, \tag{21}$$

where $t_n \equiv T_n/(W_n L_n)$. The first term on the right-hand-side of (21) represents the direct impact on consumption of removing the trade balance; the second term the indirect income effect via the terms of trade; and the third term the indirect income effect via productivity.

Equation (21) provides a useful preview of some of our quantitative findings below. First, if the non-traded sector is large (large σ) and trade barriers are generally high (m_{nn} close to 1), the effect of changes in the terms of trade on real income and consumption is quantitatively small. Second, the strength of the productivity effect increases in the strength of scale economies (large ϕ), the size of the non-traded sector (large σ), and the importance of input-output linkages (small ν). Third, the magnitude of the trade elasticity does not play a first-order role in shaping the income responses in a shift to balanced trade.

[12] If $\phi = 0$, equation (17) is redundant for analysing the income and consumption effects from changes in imbalances.

3 Global rebalancing with gravity, revisited

Below, we take the hat algebra introduced in the previous section to recent data on production, trade patterns and trade imbalances. We use it to explore the effects on real incomes of a global shift to balanced trade. This exercise is in the spirit of Dekle et al. (2007, 2008) but, unlike in their model, we now allow for the possibility of scale economies in traded production consistent with several prominent microfoundations of gravity in international trade.

3.1 Data and calibration

We calibrate our framework to data for 65 individual economies and the rest of the world from the OECD Inter-Country Input-Output Database (OECD, 2023). The data is averaged for the years 2017-19. Table 1 gives an overview of the main parameter values used in our baseline experiments. Further details and discussion can be found in Appendix B.1.

Table 1: Calibration

Object	Description	Value
σ	Share of non-traded output in world final absorption	.49
ν	Share of value added in world traded production	.44
θ	Trade elasticity	4.00
ϕ	Scale elasticity	$\in [0,.50]$

Parameters σ and ν are calibrated based on data from the OECD Inter-Country Input Output Database, averaged for the period 2017-2019. Sectors D, E, F, L, O, P, Q, R, S and T are defined as non-traded. The range of trade elasticities based on empirical estimates. The range of scale elasticities is based on model parameter relationships and empirical estimates. See text for details.

Most of our parameters are conventionally calibrated, and only the range of values for the scale elasticity merits some further discussion. There is not yet a consensus estimate of the strength of scale economies in traded production. We include the limit case of $\phi = 0$ for comparison with Dekle et al. (2007, 2008). In Appendix B.1, we reference some recent work that empirically estimates the scale elasticity and suggests $\phi \approx .25$. We also argue that a strict "textbook" calibration of popular models delivers a strength of scale economies up to $\phi = .50$. To reflect the uncertainty about the appropriate choice of parameter values, we experiment with different values, designating $\phi = .50$ as a plausible upper bound.

3.2 Main results

3.2.1 Major economies

Table 2: Main counterfactuals output, major economies

Panel (a): $\theta = 4; \phi = 0$

		Log change in		Log real GDP impact from	
	t_n	Real cons.	Real GDP	ToT effect	Prod. effect
China	0.014	0.015	0.001	0.001	
Germany	0.076	0.086	0.008	0.008	
India	-0.029	-0.033	-0.004	-0.004	
Japan	-0.005	-0.005	-0.001	-0.001	
United States	-0.028	-0.031	-0.004	-0.004	

Panel (b): $\theta = 4; \phi = .25$

		Log change in		Log real GDP impact from	
	t_n	Real cons.	Real GDP	ToT effect	Prod. effect
China	0.014	0.011	-0.003	0.001	-0.004
Germany	0.076	0.067	-0.012	0.008	-0.020
India	-0.029	-0.025	0.004	-0.005	0.008
Japan	-0.005	-0.004	0.000	-0.001	0.001
United States	-0.028	-0.023	0.004	-0.004	0.008

Panel (c): $\theta = 4; \phi = .50$

		Log change in		Log real GDP impact from	
	t_n	Real cons.	Real GDP	ToT effect	Prod. effect
China	0.014	0.008	-0.007	0.001	-0.008
Germany	0.076	0.047	-0.031	0.009	-0.041
India	-0.029	-0.017	0.012	-0.005	0.017
Japan	-0.005	-0.003	0.002	-0.001	0.003
United States	-0.028	-0.016	0.012	-0.004	0.016

Table shows counterfactual consumption and income effects from balancing global trade, derived by applying the hat algebra from Section 2.2 to the economy sample described in Section 3.1.1. Unless otherwise specified, all parameters are calibrated as discussed in Section 3.1.2. t_n denotes the initial trade balance as share of economy-n GDP.

Our main experiment involves setting the trade balances for the 65 sample economies and the rest of the world to zero: $\tilde{T}_n = 0$ for all n. Table 2 gives an overview of the impact on major economies under different parameterisations of the trade and scale elasticities.

Panel (a) replicates the analysis of Dekle et al. (2007, 2008) under the assumption of constant returns to scale in traded production. In this setting, only the terms-of-trade effect operates. Deficit economies like the India and the U.S. see demand shift away from their output as global trade moves to balance, causing a deterioration in their terms of trade that reduces their real

GDPs. Conversely, surplus economies like the China and Germany experience a terms-of-trade appreciation that bolsters their real incomes. However, the terms-of-trade effect is small, and dwarfed by the mechanical reallocation of consumption as economies' external "transfers" are removed.

Table 3: Main counterfactuals output, all economies

Panel (a): $\theta = 4; \phi = 0$

	N / t_n		Log change in: Real cons.	Log change in: Real GDP	Log real GDP impact from: ToT effect	Log real GDP impact from: Prod. effect
Surplus	34					
Median		0.032	0.036	0.003	0.003	
75th pctile.		0.065	0.074	0.006	0.006	
Deficit	32					
Median		-0.026	-0.030	-0.004	-0.004	
25th pctile		-0.063	-0.069	-0.009	-0.009	

Panel (b): $\theta = 4; \phi = .25$

	N / t_n		Log change in: Real cons.	Log change in: Real GDP	Log real GDP impact from: ToT effect	Log real GDP impact from: Prod. effect
Surplus	34					
Median		0.032	0.027	-0.005	0.003	-0.009
75th pctile.		0.065	0.057	-0.011	0.007	-0.018
Deficit	32					
Median		-0.026	-0.023	0.003	-0.004	0.007
25th pctile		-0.063	-0.052	0.009	-0.010	0.018

Panel (c): $\theta = 4; \phi = .50$

	N / t_n		Log change in: Real cons.	Log change in: Real GDP	Log real GDP impact from: ToT effect	Log real GDP impact from: Prod. effect
Surplus	34					
Median		0.032	0.018	-0.014	0.003	-0.018
75th pctile.		0.065	0.040	-0.028	0.008	-0.035
Deficit	32					
Median		-0.026	-0.016	0.009	-0.005	0.015
25th pctile		-0.063	-0.035	0.026	-0.011	0.036

Table shows counterfactual consumption and income effects from balancing global trade, derived by applying the hat algebra from Section 2.2 to the economy sample described in Section 3.1.1. Unless otherwise specified, all parameters are calibrated as discussed in Section 3.1.2. t_n denotes the initial trade balance as share of economy-n GDP.

Panel (b) introduces modest scale economies in traded production. This activates the productivity effect, which operates in the opposite direction of the terms-of-trade effect: as global trade moves to balance, former deficit economies allocate more labour to traded production and this raises labour productivity and incomes. Conversely, former surplus economies see their traded sector shrink and experience a productivity loss as their gains from scale diminish. With modest scale economies, the productivity effect is small—but it is sufficiently powerful to overcome the terms-of-trade effect. This reproduces the main finding of Epifani and Gancia (2017) in a more general setting.[13]

Finally, panel (c) allows for strong but plausible scale economies. This has little impact on the terms-of-trade effect but magnifies the productivity effect. The United States now experiences as permanent 1.2 percent real GDP gain from the removal of its deficit. At the other end of the spectrum, Germany experiences a 3.1 percent permanent GDP loss from seeing its surplus disappear. These strong real GDP responses offset nearly half the consumption loss to the U.S. from balanced trade, and nearly half the consumption gains for China and Germany.

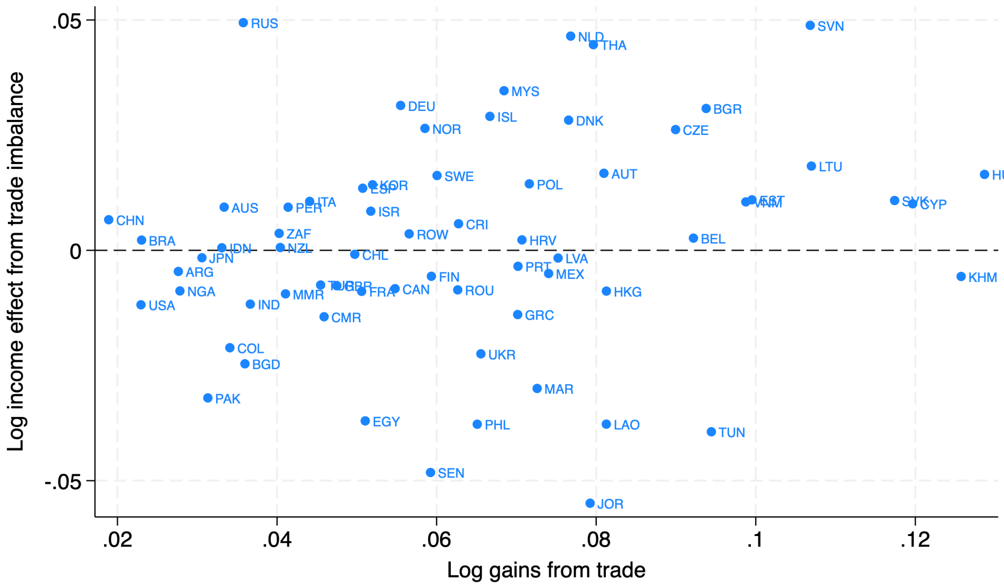
3.2.2 All economies

Table 3 gives an overview of the macroeconomic impacts of balanced trade across all sample economies for the three different strengths of scale economies. The table conveys two main points. First, the patterns described for the major economies in Table 2 are qualitatively typical for the broader sample of economies. Second, the GDP and consumption impacts in major economies are quantitatively in line with the sample median. Put differently, there is a significant number of smaller economies that experience larger consumption and GDP impacts from moving to balanced trade than do the major economies. This is because the status-quo trade imbalances of some smaller economies are much more sizeable on their own terms. This point bears emphasising: while major economies tend to dominate the policy debate about global trade imbalances—since their trade balances are large relative to *world* GDP—, many smaller economies experience much more unbalanced trade relative to their *own* GDPs.

One way to contextualise the size of the income effects from imbalances is to compare them to the income effects of trade openness. In our framework, the latter are captured by $m_{nn}^{-(1-\sigma)/(\theta\nu)}$, an incarnation of the typical "gains from trade" sufficient statistic in gravity models. Figure 1 correlates the real income effects of imbalances with the gains from trade. The income effects from imbalances are defined as -1 times the impact on real GDP from moving to balanced trade in Table 3. The figure focuses on the upper-bound case in which the scale economies are strong.

[13] In their more stylised two-economy model, Epifani and Gancia (2017) show that there are some combinations of parameters under which the productivity effect is strong enough to lower not just real income but even *consumption* in former surplus economies. Calibrating our general gravity framework to observed trade patterns, we cannot replicate this result unless the scale elasticity significantly beyond the upper end of the plausible range of values discussed in Section 3.1.2.

Figure 1: Income effect from trade imbalance versus gains from trade



The real income effects from imbalances are defined as −1 times the impact on real GDP from moving to balanced trade. This impact is derived by applying the hat algebra from Section 2.2 to the economy sample described in Section 3.1.1, with $\theta = 4$ and $\phi = .50$. All other parameters are calibrated as discussed in Section 3.1.2. The gains from trade are defined as $m_{nn}^{-(1-\sigma)/(\theta\nu)}$. See text for details.

As would be expected, the figure shows that the gains from trade are always positive, while the income effects of imbalances may be positive or negative. What is more striking is that the *ranges* of the two are similar when scale economies are strong. A corollary of these two observations is that trade imbalances under strong scale economies cause a significant re-distribution of the gains from trade. The example of the U.S. and China is illustrative. In this calibration of our framework, the U.S. gains from trade are 2.3 percent. However, half of these income gains are wiped out by the U.S. trade deficit. Conversely, China's gains from trade are 1.9 percent, but its real income is boosted by a further .7 percent due to its trade surplus.

3.2.3 Additional and alternative counterfactuals

Some additional and alternative counterfactuals are discussed in Appendix C. There we show that varying the trade elasticity does not have a major impact on our results (Appendix C.1), but that the strength of input-output linkages in traded production is an important amplifying mechanism for the productivity effect of trade imbalances in the presence of scale economies (Appendix C.2).

4 International assets and endogenous imbalances

We now re-cast the static framework from Section 2 as the steady state of a dynamic model in which imbalances arise in the steady-state equilibrium of international asset markets. This delivers a dynamic block of exact-hat equations that are modular to the previous set of exact-hat equations describing goods and labour market equilibrium.

4.1 A model of lifetime consumption smoothing

4.1.1 Assumptions

International asset markets and interest rates

There is no aggregate uncertainty and the world economy is assumed to be in a zero-growth steady state, with all real aggregate quantities and prices constant.[14] Time subscripts on aggregate variables can thus be omitted, and we do so for notational ease.

Individuals can freely trade in a one-period international bond that yields a steady-state gross interest rate R. Let B_n denote the net international assets of economy n. International asset market clearing requires that R satisfies

$$\sum_{n=1}^{N} B_n = 0. \tag{22}$$

The government of economy n may subsidise saving and tax borrowing at a rate δ_n that may be positive or negative. If $\delta_n < 0$, the government taxes savings and subsidises borrowing. As a result, the effective interest rate in n is $R_n = R(1+\delta_n)$. Governments are assumed to distribute the net revenue D_n from this policy to their residents proportionally labour income.

Additional assumptions about preferences and endowments

Economies are populated by overlapping generations of individuals with unit mass and fixed lifetime of two periods, period 0 ("youth") and period 1 ("old age"). Individuals in economy n receive $\epsilon_n L_n$ units of labour in youth and $(1-\epsilon_n)L_n$ in old age, where $\epsilon_n \in [0,1]$ is exogenous. The total labour supply of the economy thus remains L_n as in Section 2.

Individuals choose their international assets at the end of youth to max-

[14] It would be easy to introduce some constant, common rate of exogenous productivity growth without materially affecting any of the derivations below. Therefore, all aggregate variables in the model can be considered as the de-trended equivalents of their data counterparts.

imise lifetime utility:

$$\max_{B_n} V_n = \left(C_{n0}^{\frac{\gamma-1}{\gamma}} + C_{n1}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}} \tag{23}$$

subject to

$$P_n C_{n0} = \epsilon_n \left(W_n L_n + D_n \right) - B_n, \tag{24}$$

$$P_n C_{n1} = \left(1 - \epsilon_n\right) \left(W_n L_n + D_n \right) + R_n B_n, \tag{25}$$

where $\gamma > 0$ is the intertemporal elasticity of substitution.

4.1.2 Trade balances and welfare in steady state equilibrium

Steady state equilibrium in asset markets is described by:

$$e_n = \frac{1}{1 + \left[\left(1 + \delta_n\right) R \right]^{\gamma-1}}; \tag{26}$$

$$d_n \equiv \frac{D_n}{W_n L_n} = -\delta_n \frac{R B_n}{W_n L_n}; \tag{27}$$

$$B_n = \left[\left(1 - e_n\right) \epsilon_n - \frac{e_n \left(1 - \epsilon_n\right)}{\left(1 + \delta_n\right) R} \right] \left(1 + d_n\right) W_n L_n; \tag{28}$$

together with the asset market clearing condition in (22). Equation (26) describes the behaviour of e_n—the share of her lifetime income an agent in economy n allocated to consumption in youth. It decreases in the economy-n effective interest rate. Equation (27) links net government revenue to the economy's foreign asset position. Finally, equation (28) represents the net foreign asset supply of economy n. Using (26) and (27), it is easy to show that foreign asset supply may be positive or negative, and is strictly increasing in R. Consequently, for given world income shares, lifetime income profiles and subsidies $\{W_n L_n, \epsilon_n, \delta_n\}_n$, there is a unique international bond interest rate that clears asset markets. The economy-n trade balance is then given by:

$$T_n = W_n L_n - P_n \left(C_{n0} + C_{n1} \right) = W_n L_n - P_n C_n = -\left(R - 1\right) B_n. \tag{29}$$

We can now express the lifetime welfare of an agent born in economy n as follows:

$$V_n = v_n \left(1 + d_n\right) Y_n; \tag{30}$$

$$v_n \equiv \frac{\epsilon_n}{e_n^{\frac{1}{\gamma-1}}} + \frac{1 - \epsilon_n}{\left(1 - e_n\right)^{\frac{1}{\gamma-1}}}. \tag{31}$$

Equations (30) and (31) show that lifetime welfare corresponds to an economy's real income multiplied by two terms. The first captures the welfare gains from agents' ability to smooth lifetime consumption through international capital markets. The second captures welfare gains or losses from the tax policy implemented by the economy's government.

4.2 Additional exact hat algebra: dynamic block

4.2.1 General shocks to financial integration

For the remainder of our analysis, we assume that laissez-faire prevails in international asset markets in the initial steady state. The shock we consider is the introduction of a set of asset subsidies or taxes $\{\tilde{\delta}_n\}_n$ that alters the distribution of foreign asset positions and trade balances. The change relative to the status-quo steady state due to this shock is then captured by equations (16)-(20) and:

$$\hat{e}_n^{-1} = \left\{ e + (1-e) \left[\left(1+\tilde{\delta}_n\right) \hat{R} \right]^{\gamma-1} \right\}^{-1}; \tag{32}$$

$$\tilde{d}_n = \tilde{\delta}_n \frac{R\hat{R}}{R\hat{R}-1} \frac{\tilde{T}_n}{\hat{W}_n y_n}; \tag{33}$$

$$\tilde{T}_n = -\left(R\hat{R}-1\right) \left[(1-e\hat{e}_n)\,\epsilon_n - \frac{e\hat{e}_n\,(1-\epsilon_n)}{\left(1+\tilde{\delta}_n\right)\hat{R}R} \right] \left(1+\tilde{d}_n\right) \hat{W}_n y_n; \tag{34}$$

$$0 = \sum_{n=1}^{N} \frac{\tilde{T}_n}{R\hat{R}-1}; \tag{35}$$

$$\hat{V}_n = \hat{v}_n \left(1+\tilde{d}_n\right) \hat{Y}_n; \quad \hat{v}_n = \frac{\epsilon_n \,(e\hat{e}_n)^{-\frac{1}{\gamma-1}} + (1-\epsilon_n)\,(1-e\hat{e}_n)^{-\frac{1}{\gamma-1}}}{\epsilon_n e^{-\frac{1}{\gamma-1}} + (1-\epsilon_n)\,(1-e)^{-\frac{1}{\gamma-1}}}, \tag{36}$$

where $e = (1+R^{\gamma-1})^{-1}$.

4.2.2 Special case of shift to financial autarky

Moving to financial autarky from laissez-faire requires the government of economy n to implement:

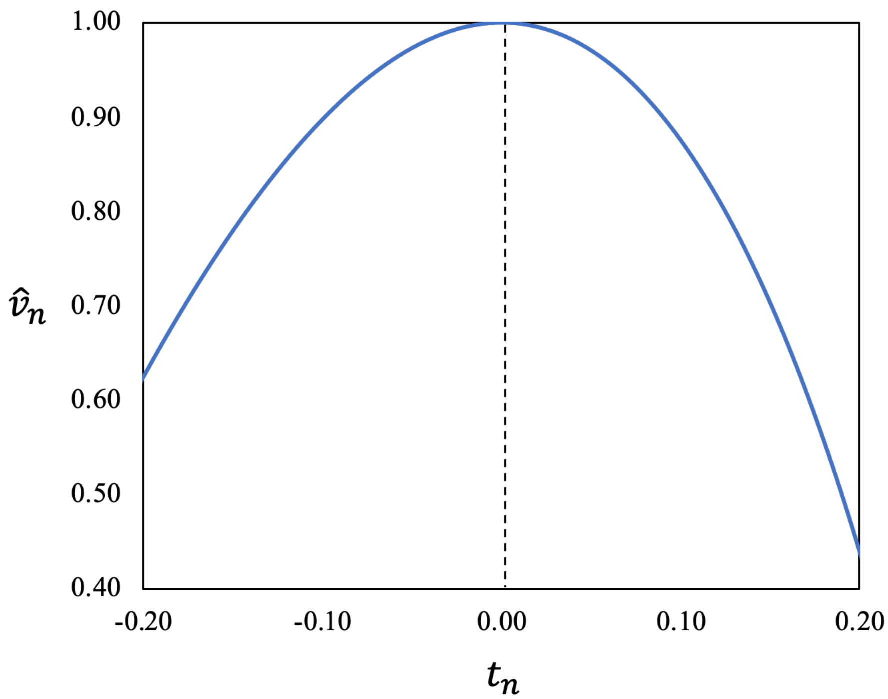
$$1+\tilde{\delta}_n = \frac{1}{\hat{R}R} \left(\frac{1-\epsilon_n}{\epsilon_n}\right)^{\frac{1}{\gamma}}. \tag{37}$$

This delivers $\tilde{T}_n = \tilde{d}_n = 0$, and the welfare impact from losing the opportunity to smooth lifetime consumption can be computed as:

$$\hat{V}_n = \hat{v}_n \hat{Y}_n \tag{38}$$

$$\hat{v}_n = \frac{\left[\epsilon_n^{\frac{\gamma-1}{\gamma}} + (1-\epsilon_n)^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}}}{\epsilon_n e^{-\frac{1}{\gamma-1}} + (1-\epsilon_n)(1-e)^{-\frac{1}{\gamma-1}}}. \tag{39}$$

Figure 2: Trade balance and gains from lifetime consumption smoothing



Computed using (26), (28), (29) and (39), and imposing $\delta_n = 0$, $R = 1.02^{30}$ and $\gamma = .50$. $\hat{v}_n$ the lifetime welfare penalty from shutting down international asset trade relative to a laissez-faire steady state. t_n denotes the initial trade balance as share of economy-n GDP.

Figure 2 illustrates how this welfare impact relates to the economy's trade balance in initial equilibrium. From (29), an economy with a large trade surplus relative to GDP also holds large foreign debts in steady state. An economy with a large trade deficit holds large foreign assets. Both such economies benefit significantly from the consumption smoothing facilitated by international asset markets. Hence, they experience larger welfare losses from financial autarky than an economy with a smaller trade imbalance. The closer an economy is to balanced trade in the initial equilibrium, the smaller the consumption smoothing benefits it receives from trade in international asset markets.

In a world of endowment economies, equation (39) would be sufficient to describe the welfare impact on economy n from moving to financial autarky.[15] However, this is not the case in our framework because—as discussed in Sections 2 and 3—moving to balanced trade also impacts welfare by changing an economy's real income. In the next section, we explore quantitatively how these two effects interact for different economies.

[15]This is nested in our model as the limit case $\theta \to \infty$, $\phi = 0$.

5 Welfare effects of global rebalancing

We now re-visit the static analysis performed in Section 3, but use the results from Section 4 to let the global shift to balance trade arise as an endogenous steady-state outcome of government policies that limit the use of international asset markets. This has no bearing on the *income effects* of balancing trade quantified in Section 3. However, it allows to weigh their impact on *welfare* formally against the loss from a reduced ability to smooth lifetime consumptions.

5.1 Additional calibration

We conservatively set the intertemporal elasticity of substitution $\gamma = 0.5$, and we impose $R = 1.81$, roughly corresponding to a 2-percent annual interest rate with a model period representing 30 years. Appendix B.2 provides some further discussion of these parameter choices. It also shows that they allow us to back out $\{\epsilon_n\}_n$ from observed trade balances in an initial laissez-faire steady state. This gives us all that is needed to operationalise (32)-(36).

5.2 Results

5.2.1 Major economies

We focus on the most interesting case in which scale economies are strong ($\phi = .50$). Table (4) reproduces most of panel (c) of Table (2), but replaces the consumption impact of balancing global trade with the welfare impact. Given (38) and (39), the welfare impact is the sum of the real GDP impact and the loss from removing the consumption smoothing opportunities available under laissez-faire.

Table 4: Welfare effects of global rebalancing, major economies

Key parameters: $\theta = 4; \phi = .50; \gamma = .50$

		Log change in		Log real GDP impact from	
	t_n	Welfare	Real GDP	ToT effect	Prod. effect
China	0.014	-0.009	-0.007	0.001	-0.008
Germany	0.076	-0.104	-0.031	0.009	-0.041
India	-0.029	0.002	0.012	-0.005	0.017
Japan	-0.005	0.001	0.002	-0.001	0.003
United States	-0.028	0.003	0.012	-0.004	0.016

Table shows counterfactual welfare and income effects from balancing global trade through appropriate choice of $\{\tilde{\delta}_n\}_n$, derived by applying the hat algebra from Sections 2.2 and 4.2 to the economy sample described in Section 3.1.1. Unless otherwise specified, all parameters are calibrated as discussed in Sections 3.1.2 and 5.1. t_n denotes the initial trade balance as share of economy-n GDP.

There are two striking contrasts with panel (c) of Table (2). First, the major surplus economies are *unambiguously* worse off under balanced trade, even though their aggregate consumption is increased. This is because a negative income impact from balancing trade—due to the dominant productivity effect−combines with a loss of consumption smoothing. Germany is especially adversely affected, with a permanent welfare loss of 10.4 percent.

Second, the major deficit economies are marginally better off under balanced trade. This is because their income gains from exploiting scale economies in traded production under balanced trade offset the loss from moving to de facto financial autarky. For the U.S., the balanced-trade steady state implies a permanent 0.3 percent welfare gain.

The reason for this unconventional finding is the second-best nature of the initial equilibrium. As explained in Section 2.1.3, in multi-sector models there is generally underproduction in high-returns-to-scale sectors. Under the calibration used here, the welfare gains from using international asset markets for the U.S. and India are sufficiently small as to be outweighed be the partial correction of traded-sector underproduction in a the counterfactual balanced-trade steady state.

5.2.2 All economies

Figure 3 highlights that the major deficit economies are not representative of the broader set of economies in our sample. The distribution of welfare impacts inherits the shape of the distribution of consumption smoothing losses from Figure 2. However, it is shifted north west through the origin due to the income transfer from surplus to deficit economies caused by the productivity effect. Consequently, economies in the tails of the distribution of trade balances are made worse off by the move to balanced trade. This includes *all* surplus economies. It also includes many economies with large trade deficits relative to their GDPs. Several low-income economies, such as Senegal and Laos, are especially adversely affected.

To benefit from the move to balanced trade, an economy needs to have a small trade deficit in steady state relative to its own GDP. It is no coincidence that several major economies satisfy this criterion. Since the laissez-faire international bond interest rate is weighted average of economies' lifetime income profiles, it is necessarily similar to the autarky interest rates of the largest economies. A corollary is that large economies benefit least from consumption smoothing in international asset markets, and this is reflected in small foreign asset positions and imbalances relative to their GDPs.

Figure 3: Welfare effects of global rebalancing, all economies

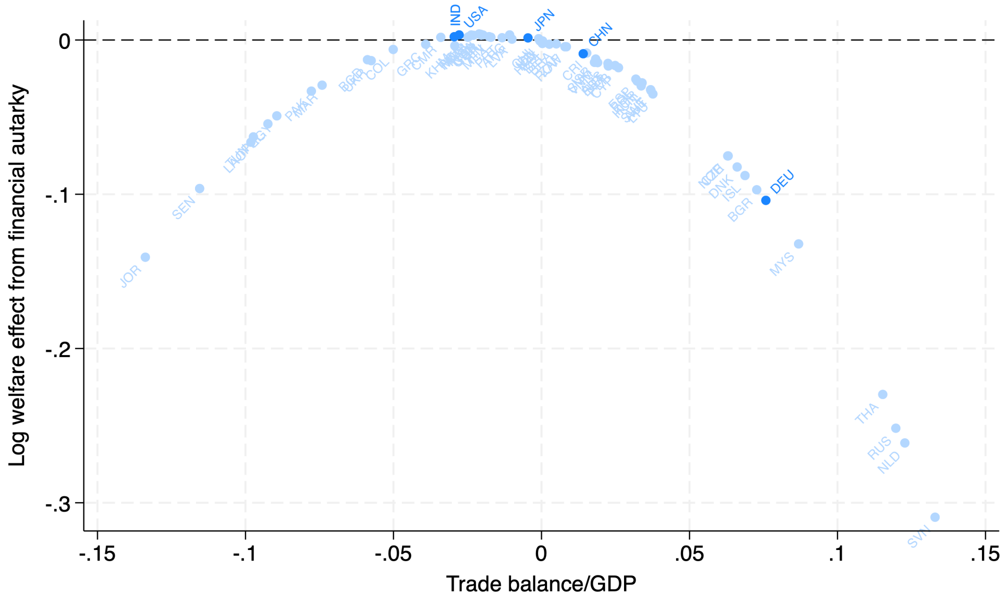


Figure shows counterfactual welfare effects from balancing global trade through appropriate choice of $\{\tilde{\delta}_n\}_n$, derived by applying the hat algebra from Sections 2.2 and 4.2 to the economy sample described in Section 3.1.1, with $\theta = 4$, $\phi = .50$ and $\gamma = .50$. Unless otherwise specified, all parameters are calibrated as discussed in Sections 3.1.2 and 5.1.

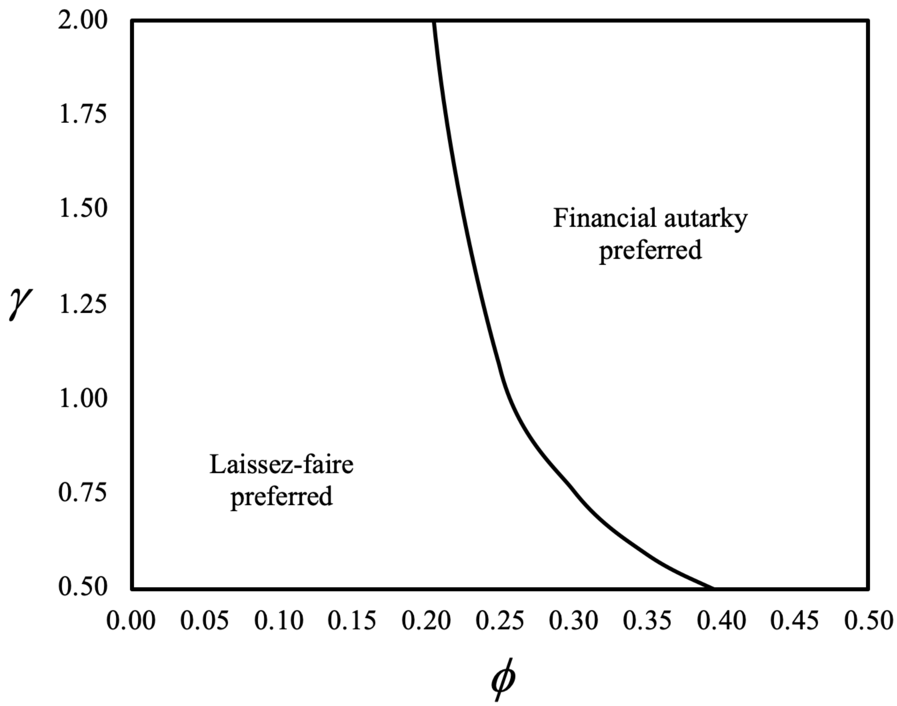
5.2.3 Alternative parameter calibrations

The extent to which (some) deficit economies may benefit from moving to balanced trade is governed by two key parameters: the scale elasticity ϕ, and the intertemporal elasticity of substitution γ. If the scale elasticity is large, the productivity effect is strong and reducing a trade deficit has a large positive effect on real income. If the intertemporal substitution elasticity is large, the welfare gains from consumption smoothing are low. We illustrate this in Figure 4 using the example of the U.S. economy.

As discussed in the previous section, the U.S. is better off under financial autarky than in the laissez-faire steady state with $\phi = \gamma = .5$. Holding γ constant, the U.S. prefers the laissez-faire steady state if ϕ falls below .4. However, the U.S. may prefer financial autarky in the face of weak scale economies if the intertemporal substitution elasticity is higher. With $\gamma > 1$, the U.S. would prefer financial autarky even for a modest scale parameter of $\phi = .25$.

No matter what the intertemporal substitution elasticity is, financial autarky is never preferred for values of $\phi < .2$. The reason is that the terms-of-trade effect from balancing trade dominates the productivity effect beyond this point. In this case, a deficit economy suffers a real income *loss* from financial autarky, making laissez-faire preferable even if $\gamma \to \infty$ and the gains from consumption smoothing tend to zero.

Figure 4: Different parameter configurations, U.S. economy



Computed by applying the hat algebra from Sections 2.2 and 4.2, with $\theta = 4$. Unless otherwise specified, all parameters are calibrated as discussed in Sections 3.1.2 and 5.1.

6 Conclusion

Standard trade models can accommodate the view that trade imbalances have a beggar-thy-neighbour quality, improving the incomes of surplus economies at the expense of deficit economies. This requires the presence of scale economies in the production of traded goods, a feature of many prominent gravity models. Under plausible calibrations of the strength of these scale economies, trade imbalances lead to a significant redistribution of the gains from trade from deficit towards surplus economies. When observed imbalances are interpreted as the steady state outcome of consumption smoothing via international asset markets, some major deficit economies—including the U.S.—may benefit from retreating into financial autarky. This is because their deficits exacerbate the second-best underproduction of traded goods in the face of scale economies.

There is no consensus yet about the empirical magnitude of the scale elasticity in tradables production. Our work highlights that further efforts to quantify it may be critical for assessing the macroeconomic consequences of trade imbalances. We also show that an important subclass of gravity models is compatible with significant macroeconomic spillovers from economies' international savings decisions. This opens the door to fresh analyses of the global coordinating mechanisms required to limit such spillovers.

References

[1] Acemoglu, D., Aghion, P., Burszstyn, L., and D. Hemous, 2012. "The Environment and Directed Technical Change," *American Economic Review*, 102, 1, pp. 131-166.

[2] Arkolakis, C., Costinot, A., and A. Rodríguez-Clare, 2012. "New Trade Models, Same Old Gains?," *American Economic Review*, 102, 1, pp. 94-130.

[3] Baqaee, D., and H. Malmberg, 2025. "Long-Run Effects of Trade Wars," NBER Working Paper No. 33702, April 2025.

[4] Bartelme, D., Costinot, A., Donaldson, D., and A. Rodríguez-Clare, 2025. "The Textbook Case for Industrial Policy: Theory Meets Data," *Journal of Political Economy*, 133, 5, pp. 1527-1573.

[5] Benigno, G., Fornaro, L., and M. Wolf, 2025. "The Global Financial Resource Curse," *American Economic Review,* 115(1), pp. 220-262.

[6] Boehm, C. E., Levchenko, A. A., and N. Pandalai-Nayar, 2023. "The Long and Short (Run) of Trade Elasticities," *American Economic Review*, 113, 4, pp. 861-905.

[7] Bonadio, B., Huo, Z., Levchenko, A., and N. Pandalai-Nayar, 2023. "User Manual for the Bonadio-Huo-Levchenko-Pandalai-Nayar (BHLP) Global Network Model: Version 1.0," September 2023, available here.

[8] Caliendo, L., Feenstra, R. C., Romalis, J., and A. M. Taylor, 2023. "A Second-Best Argument for Low Optimal Tariffs on Intermediate Inputs," *Journal of International Economics*, 145, 103824.

[9] Cass, O., 2024. "Trump's Most Misunderstood Policy Proposal: Economists Aren't Telling the Whole Truth about Tariffs." *The Atlantic*, September 2024.

[10] Costinot, A., and A. Rodríguez-Clare, 2014. "Trade Theory with Numbers: Quantifying the Consequences of Globalization," in G. Gopinath, E. Helpman and K. S. Rogoff (eds.), *Handbook of International Economics*, 4, chapter 4, pp. 197-261.

[11] Cuñat, A., and R. Zymek, 2024. "Bilateral Trade Imbalances," *Review of Economic Studies*, 91, 3, pp. 1537-1583.

[12] Dekle, R., Eaton, J., and S. Kortum, 2007. "Unbalanced Trade," *American Economic Review*, 97, 2, pp. 351-355.

[13] Dekle, R., Eaton, J., and S. Kortum, 2008. "Global Rebalancing with Gravity: Measuring the Burden of Adjustment," *IMF Staff Papers*, 55, 3, pp. 511-540.

[14] Epifani, P., and G. Gancia, 2017. "Global Imbalances Revisited: The Transfer Problem and Transport Costs in Monopolistic Competition," *Journal of International Economics*, 108, pp. 99-116.

[15] Ignatenko, A., Lashkaripour, A., Macedoni, L., and I. Simonovska, 2025. "Making America Great Again? The Economic Impacts of Liberation Day Tariffs," NBER Working Paper No. 33771, May 2025.

[16] Itskhoki, O., and D. Mukhin, 2025. "The Optimal Macro Tariff," NBER Working Paper No. 33839, May 2025.

[17] Keynes, J. M., "The German Transfer Problem," "The Reparation Problem: A Discussion. II. A Rejoinder," "Views on The Transfer Problem. III. A Reply," *Economic Journal* 39 (March 1929), pp. 1-7, (June 1929), pp. 172-178, (Sept. 1929), pp. 404-408.

[18] Krugman, P., 1979. "Increasing Returns, Monopolistic Competition and International Trade." *Journal of International Economics*, 9, 4, pp. 469–479.

[19] Krugman, P., 1980. "Scale Economies, Product differentiation, and the Pattern of Trade." *American Economic Review*, 70, 5, pp. 950–959.

[20] Krugman, P., 1987. "The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher: Notes on Trade in the Presence of Dynamic Scale Economies," *Journal of Development Economics*, 27, pp. 41-55.

[21] Kucheryavyy, K., Lyn, G., and A. Rodríguez-Clare, 2023a. "Grounded by Gravity: A Well-Behaved Trade Model with Industry-Level Economies of Scale," *American Economic Journal: Macroeconomics*, 15, 22, pp. 372-412.

[22] Kucheryavyy, K., Bartelme, D., Jiang, Y., and A. Rodríguez-Clare, 2023b. "The Quantitative New Trade Model: Equilibrium and Welfare Analysis," mimeo.

[23] Lashkaripour, A., and V. Lugovskyy, 2023. "Profits, Scale Economies, and the Gains from Trade and Industrial Policy," *American Economic Review*, 113, 10, pp.2759-2808.

[24] Lighthizer, R., 2023. *No Trade Is Free: Changing Course, Taking on China, and Helping America's Workers*. New York: Broadside Books.

[25] Melitz, M. J., 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica*, 71, 6, pp. 1695–1725.

[26] Navarro, P., 2023. "The Case for Fair Trade." in *Mandate for Leadership: The Conservative Promise*. Washington, D.C.: Heritage Foundation.

[27] Obstfeld, M., and K. S. Rogoff, 1995. "Exchange Rate Dynamics Redux," *Journal of Political Economy*, 103, 3, pp. 624-660.

[28] OECD, 2023. "Development of the OECD Inter-Country Input-Output Database 2023," *OECD Science, Technology and Industry Working Papers*, 2023/08, November 2023.

[29] Pettis, M., and E. Hogan, 2024. *Trade Intervention for Freer Trade*. Washington, D.C.: Carnegie Endowment for International Peace.

[30] Robinson, R., 1952. "A Graphical Analysis of the Foreign Trade Multiplier," *Economic Journal*, 247, pp. 546-564.

[31] Simonovska, I,, and M. E. Waugh, 2014. "The Elasticity of Trade: Estimates and Evidence," *Journal of International Economics*, 92, 1, pp. 34-50.

[32] USTR, 2025. "Reciprocal Tariff Calculations," at: https://ustr.gov/trade-topics/presidential-tariff-actions (retrieved 14 June 2025).

[33] Weitzman, M. L., 2007. "A Review of *The Stern Review on the Economics of Climate Change*," *Journal of Economic Literature*, XLV, pp. 703-724.

Appendix

A Microfoundations of general gravity

A.1 Krugman model

A.1.1 Model description

Technologies and market structure

Most assumptions are as in the Armington model of Section 2. The only difference is with respect to (4): q_{Gn} is now assembled from an endogenous mass Ω_n of non-tradable symmetric input varieties:[16]

$$q_{Gn} = \left[\int_{\omega \in \Omega_n} q_{Gn}^{\frac{\chi-1}{\chi}}(\omega)\, d\omega\right]^{\frac{\chi}{\chi-1}}, \quad \chi > 1. \tag{40}$$

Production of a variety involves a fixed cost of F_n units in terms of domestic labour; producing one unit of each variety requires one unit of non-traded input x_n, which has production function:

$$x_n = A_{Gn}\left(\frac{l_{Gn}}{\nu}\right)^{\nu}\left(\frac{J_{Gn}}{1-\nu}\right)^{1-\nu}. \tag{41}$$

The market for input varieties is monopolistically competitive. All other markets are perfectly competitive.

Pricing and entry

By symmetry, optimal pricing of each variety ω implies:

$$p_{Gn} = \Omega_n^{\frac{1}{1-\chi}}\bar{\chi}\frac{W_n^{\nu}P_{Gn}^{1-\nu}}{A_{Gn}}, \tag{42}$$

where $\bar{\chi} \equiv \chi/(\chi-1)$ is the markup over marginal cost.

By free entry, total profits net of fixed costs in the monopolistically competitive industry must be zero:

$$\frac{\boldsymbol{X_{Gn}}}{\chi} - W_n\Omega_n F_n = 0, \tag{43}$$

where $\boldsymbol{X_{Gn}} \equiv \sum_{n'=1}^{N} m_{nn'}P_{Gn'}X_{Gn'}$ and $m_{nn'} \equiv (\tau_{nn'}p_{Gn}/P_{Gn'})^{-\theta}$. Total rev-

[16] We abuse notation by using Ω_n to denote both the set and the mass of varieties produced in economy n.

enues $\boldsymbol{X_{Gn}}$ must equal payments to inputs and fixed costs of entry:

$$\boldsymbol{X_{Gn}} = \frac{\boldsymbol{X_{Gn}}}{\bar{\chi}} + W_n \Omega_n F_n. \tag{44}$$

Total payments to labour in sector G are

$$W_n L_{Gn} = \nu \frac{\boldsymbol{X_{Gn}}}{\bar{\chi}} + \Omega_n W_n F_n = \frac{\nu(\chi - 1) + 1}{\chi} \boldsymbol{X_{Gn}}, \tag{45}$$

which yields

$$\Omega_n = \frac{1}{\nu(\chi - 1) + 1} \frac{L_{Gn}}{F_n}. \tag{46}$$

Plugging this expression in (42) yields:

$$p_{Gn} = \frac{\bar{\chi}}{A_{Gn} \left[(\nu(\chi - 1) + 1) F_n\right]^{\frac{1}{1-\chi}} L_{Gn}^{\frac{1}{\chi - 1}}} W_n^{\nu} P_{Gn}^{1-\nu}. \tag{47}$$

A.1.2 Exact hat algebra

Showing that this model delivers the same hat algebra as the Armington model with $1/(\chi - 1) = \phi$ is immediate.

A.2 Melitz model

[TO BE COMPLETED]

B Data and calibration

B.1 Static global rebalancing

B.1.1 Data

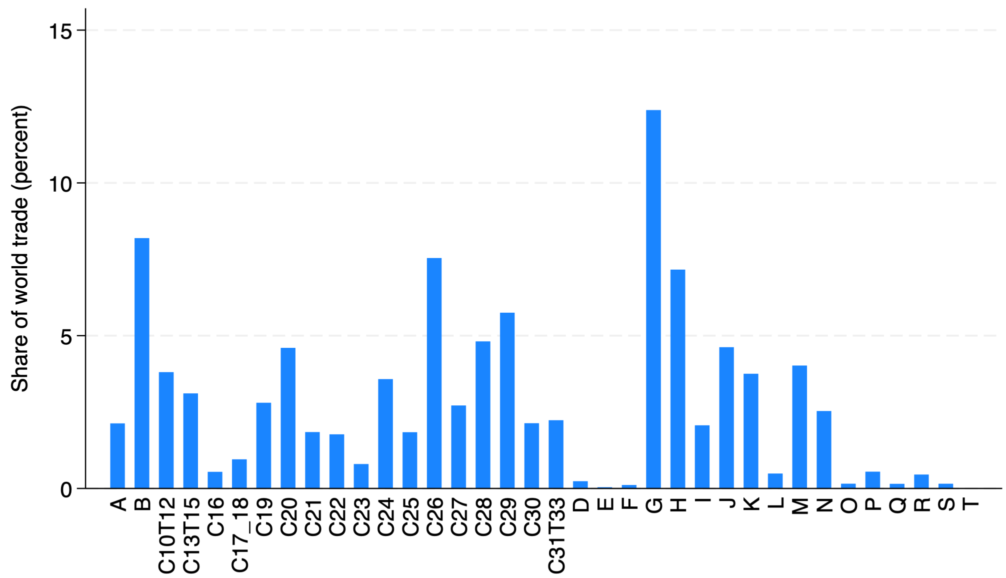
We take data from the OECD Inter-Country Input-Output Database (OECD, 2023), averaged for the years 2017-2019. These are the latest available years that do not coincide with the Covid-19 pandemic. We use a three-year average to smooth out short-run fluctuations in the values of trade balances, output and trade shares.

The OECD Database provides us with a matrix of bilateral expenditure shares $\{m_{n'n}\}_{n',n}$, a vector of world GDP shares $\{y_n\}$, and a vector of trade balances relative to world GDP $\{T_n\}$ for 76 individual economies and a residual rest-of-the-world region.[17] We fold the six economies with the highest oil share of exports (Brunei, Belarus, Côte d'Ivoire, Kazakhstan, Saudi Arabia

[17]The full list of economies can be found on the OECD website.

and Singapore) and five small, highly service-dependent economies with exceptionally large imbalances (Ireland, Luxembourg, Malta, Taiwan and Switzerland) into the rest of the world. This leaves us with a sample of 65 individual economies.

Figure B1: Sector contributions to world trade



World totals from the OECD Inter-Country Input-Output Database (OECD, 2023), averaged for the period 2017-19. Sector codes based on ISIC Rev. 4.

B.1.2 Calibration

Non-traded sector

Figure (B1) shows the contribution of different broad ISIC sectors to world trade. Based on this, we identify as non-traded sectors D (electricity, gas), E (water supply), F (construction), L (real estate), O (public administration), P (education), Q (health), R (arts, entertainment), S (other services) and T (activities of households as employers). Together these sectors account for less than 2.5 percent of world trade in 2017-19. However, their share of world final spending is .49 in the OECD Database, and we use this value to parameterise σ. We treat all other sectors as traded.

Input-output linkages in traded production

Having identified the set of traded sectors, we compute the share of value added in their total global output. This yields .44 as the baseline value for ν.

Trade elasticity

For the aggregate trade elasticity θ, the value 4 is commonly used in quantitative work based on estimates by Simonovska and Waugh (2014). We adopt this value as our baseline, but experiment with an alternative, lower value in Appendix C.1.

Scale elasticity

[TO BE COMPLETED]

B.1.3 Initial world GDP shares

Equation (10) implies a particular equilibrium relationship between status-quo trade shares, trade balances and world GDP shares for given values of σ and ν. This relationship may not be satisfied in the data, because the production structure assumed in our framework is a much-simplified version of actual trade and production linkages. Following the convention established in other quantitative work, we therefore first run the hat algebra in (16)-(20) with the status quo trade balances: $\tilde{T}_n = T_n$ for all n.[18] This delivers a new set of world GDP shares, and we adopt this set as our initial shares for all trade-balance counterfactuals.

These initial world GDP shares are highly, but not perfectly, correlated with world GDP shares in the OECD Database. However, they vary across the different calibrations of σ and ν. As a result, the cross-economy distribution of trade balances shares in own GDP (t_n) shown in Table (C2)—assuming a counterfactually low intermediate input share—is different from the baseline distribution shown in Table (3).

B.2 Additional calibration for steady state global rebalancing

Intertemporal elasticity of substitution

The typical calibration of the intertemporal elasticity of substitution in macroeconomics is in the range 1-2. However, this in the context of models that represent data at quarterly or annual frequencies. In our OLG setting, a period instead represents multiple decades. In this case, lower values of the intertemporal elasticity are sometimes used. For example, studies of long-run growth in the context of climate change have tended to use elasticities as low as .50 (Weitzman, 2007; Acemoglu et al., 2012).

[18] For example, see Bonadio et al. (2023).

We adopt $\gamma = .50$ as our baseline value. This is conservative: the higher the intertemporal elasticity of substitution, the lower the gains from lifetime consumption smoothing via international asset markets. Therefore, our baseline parametrisation raises the bar for overturning the gains from permitting unbalanced trade. We illustrate this by exploring alternative parameter values in Section 5.2.3.

Lifetime income profiles and world interest rate
From (26)-(29), in an initial laissez-faire steady state:

$$t_n = -\frac{R-1}{R}\frac{\left(R^{\gamma}+1\right)\epsilon_n - 1}{1+R^{\gamma-1}}. \tag{48}$$

Given values for γ and R, we can readily back out $\{\epsilon_n\}_n$ from data on trade balances.

We impose $R = 1.02^{30} \approx 1.81$, corresponding to an annual interest rate of 2 percent with a model period representing 30 years.[19] From (22) and (28):

$$R = \left[\sum_n \left(1-\epsilon_n\right) y_n / \sum_n \epsilon_n y_n\right]^{1/\gamma}, \tag{49}$$

so fixing γ and R amounts to calibrating the weighted average lifetime income profile across economies. Our parameter choices imply that in the "average" economy, agents get 57 percent of their income in the first half of their lives.

C Additional and alternative counterfactuals

C.1 Varying the trade elasticity

C.1.1 Results

In our experiments in Section 3.2, we keep the trade elasticity fixed at $\theta = 4$. Here, we discuss the implications of imposing a lower trade elasticity of $\theta = 2$. This is the value often imposed in open-economy macroeconomics and, more recently, Boehm et al. (2023) provide evidence that the trade elasticity tends to this value in the long run.

The comparison of Table C1 with Table 3 reveals that a lower trade elasticity strengthens the terms-of-trade effect a little, while leaving the productivity

[19]Since our model can be interpreted as the de-trended equivalent of a model with a constant, common exogenous growth rate, strictly speaking the value of R represents the interest-growth *differential*. For example, with an annual productivity growth rate of 1 percent, our calibration would imply a long-run real interest rate of 3 percent.

Table C1: Low trade elasticity, all economies

Panel (a): $\theta = 2; \phi = 0$

	N	t_n	Log change in		Log real GDP impact from	
			Real cons.	Real GDP	ToT effect	Prod. effect
Surplus	34					
Median		0.032	0.038	0.006	0.006	
75th pctile.		0.065	0.078	0.011	0.011	
Deficit	32					
Median		-0.026	-0.033	-0.007	-0.007	
25th pctile		-0.063	-0.076	-0.016	-0.016	

Panel (b): $\theta = 2; \phi = .25$

	N	t_n	Log change in		Log real GDP impact from	
			Real cons.	Real GDP	ToT effect	Prod. effect
Surplus	34					
Median		0.032	0.029	-0.004	0.006	-0.009
75th pctile.		0.065	0.061	-0.006	0.012	-0.018
Deficit	32					
Median		-0.026	-0.026	0.000	-0.008	0.007
25th pctile		-0.063	-0.060	0.001	-0.018	0.018

Panel (c): $\theta = 2; \phi = .50$

	N	t_n	Log change in		Log real GDP impact from	
			Real cons.	Real GDP	ToT effect	Prod. effect
Surplus	34					
Median		0.032	0.020	-0.011	0.006	-0.018
75th pctile.		0.065	0.045	-0.023	0.013	-0.035
Deficit	32					
Median		-0.026	-0.020	0.006	-0.009	0.015
25th pctile		-0.063	-0.044	0.018	-0.020	0.036

Table shows counterfactual consumption and income effects from balancing global trade, derived by applying the hat algebra from Section 2.2 to the economy sample described in Section 3.1.1. Unless otherwise specified, all parameters are calibrated as discussed in Section 3.1.2. t_n denotes the initial trade balance as share of economy-n GDP.

effect unchanged. The productivity effect remains dominant, but the overall impact of imbalances on real incomes is reduced. This impact nevertheless remains sizeable. If scale economies are strong ($\phi = .50$), half of surplus economies see a real GDP decline greater than 1.1 percent from shifting to balanced trade, while half of deficit economies experience an increase greater than .6 percent.

C.2 Varying the strength of input-output linkages

Our baseline calibration parameterises the strength of input-output linkages in the traded sector based on international input-output data. In this subsection,

Table C2: Weak input-output linkages, all economies

Panel (a): $\nu = .72; \phi = 0$

	N / t_n	Log change in		Log real GDP impact from	
		Real cons.	Real GDP	ToT effect	Prod. effect
Surplus	34				
Median	0.038	0.042	0.003	0.003	
75th pctile.	0.084	0.095	0.006	0.006	
Deficit	32				
Median	-0.025	-0.029	-0.004	-0.004	
25th pctile	-0.056	-0.063	-0.009	-0.009	

Panel (b): $\nu = .72; \phi = .25$

	N / t_n	Log change in		Log real GDP impact from	
		Real cons.	Real GDP	ToT effect	Prod. effect
Surplus	34				
Median	0.038	0.035	-0.004	0.003	-0.006
75th pctile.	0.084	0.081	-0.007	0.007	-0.014
Deficit	32				
Median	-0.025	-0.025	0.000	-0.004	0.004
25th pctile	-0.056	-0.053	0.001	-0.009	0.010

Panel (c): $\nu = .72; \phi = .50$

	N / t_n	Log change in		Log real GDP impact from	
		Real cons.	Real GDP	ToT effect	Prod. effect
Surplus	34				
Median	0.038	0.029	-0.009	0.003	-0.013
75th pctile.	0.084	0.068	-0.020	0.007	-0.028
Deficit	32				
Median	-0.025	-0.020	0.004	-0.004	0.009
25th pctile	-0.056	-0.044	0.010	-0.009	0.019

Table shows counterfactual consumption and income effects from balancing global trade, derived by applying the hat algebra from Section 2.2 to the economy sample described in Section 3.1.1. Unless otherwise specified, all parameters are calibrated as discussed in Section 3.1.2. t_n denotes the initial trade balance as share of economy-n GDP.

we illustrate that these input-output linkages are an important amplifying mechanism for the productivity effect of trade imbalances in the presence of scale economies. We do this by reducing by one half the share of intermediate inputs in production $1 - \nu$, and then re-running our main trade-balancing experiment. The results are presented in Table C2.

Compared with Table 3 the productivity effect is significantly weaker, with minimal impacts on the terms-of-trade effect. This is consistent with the discussion in Section 2.2.2. The intuition is that an increase in output raises labour productivity, which also reduces the cost of inputs (for given trade shares). In turn, this raises productivity further, further reducing input costs, and so forth. The weaker is input reliance, the weaker this amplification effect.