Journal of International Economics 108 (2017) 99–116

Contents lists available at ScienceDirect

Journal of International Economics

journal homepage: www.elsevier.com/locate/jie

Global imbalances revisited: The transfer problem and transport costs in monopolistic competition☆

Paolo Epifani[a], Gino Gancia[b,*]

[a] University of Nottingham Ningbo China, 199 Taikang East Road, Ningbo 315100, PR China
[b] CREI, Barcelona GSE and CEPR. Ramon Trias Fargas, 25-27, Barcelona 08005, Spain

ARTICLE INFO

Article history:
Received 9 December 2015
Received in revised form 1 March 2017
Accepted 29 May 2017
Available online 17 June 2017

JEL classification:
F1

Keywords:
Trade imbalances
Trade costs
Monopolistic competition
Intermediate goods

ABSTRACT

We study the welfare effects of trade imbalances in a two-sector model of monopolistic competition. As in perfect competition, a trade surplus involves an income transfer to the deficit country and possibly a terms-of-trade deterioration. Unlike the conventional wisdom, however, trade imbalances do not impose any double burden on surplus countries. This is because of a production-delocation effect, which leads to a reduction in the local price index. In the presence of intermediate goods, new results arise: A trade surplus may lead to an *appreciation* of the exchange rate, to a terms-of-trade *improvement* and even to a welfare *increase*. Numerical simulations show that, under realistic assumptions about preferences and technology, the beneficial price-index effect can significantly reduce the direct cost of the transfer.

1. Introduction

Trade imbalances are a key feature of the latest wave of globalization. Although the Great Recession and the subsequent collapse of international trade led to a significant correction, trade imbalances are still large and on the rise. For instance, as Fig. 1 shows, Germany's total trade surplus in goods and services reached 6.7% of GDP in 2014, thereby exceeding the pre-crisis peak. In the same year, China's trade surplus and the U.S. trade deficit equaled, respectively, 3.7 and 3% of their GDP. Moreover, in current U.S. dollars, China's and Germany's trade surpluses were, respectively, 40 and 15% larger in 2014 than in 2007.

Trade imbalances are not only large, they are also persistent. For instance, the United States have been running trade deficits for 40 years in a row, and Germany and China trade surpluses for more than 20 consecutive years. This is a general and often overlooked feature of trading economies. For instance, in a sample of 70 countries with available data between 1960 and 2014, we have computed the maximum number of consecutive years in which each country experienced an imbalance of the same sign. Strikingly, the median value of this measure of persistence is 27 years (and the mean is nearly 30 years). Moreover, for 6 countries in our sample, imbalances persisted with the same sign over the entire period of analysis (55 years).

Despite their prevalence, the welfare implications of these imbalances are not fully understood, because trade models typically focus on the assumption of balanced trade, while models of international finance often focus on inter-temporal rather intra-temporal trade. This prevents the theory from shedding light on some recurrently debated issues. For instance, China's integration into the world economy was accompanied by large and growing trade surpluses. Did this type of trade opening harm or benefit China and its main trade partners? Similarly, it is widely believed that the creation of the eurozone, and the induced rigidities in the nominal exchange rates, led Germany to accumulate huge trade surpluses. Did this help or undermine the process of European economic integration? More in general, what are the real effects of the international transfers that are so frequent in financially integrated areas such as the eurozone?

Trade theory does provide the tools for answering these questions. However, the dominant approach in the literature on trade

☆ We thank the Editor (Giancarlo Corsetti), two anonymous Referees and the seminar participants at various venues for comments. We acknowledge the financial support from the Barcelona GSE and the Agència de Gestió d'Ajuts Universitaris i de Recerca, 2014 SGR 830.

* Corresponding author.
E-mail addresses: Paolo.Epifani@nottingham.edu.cn (P. Epifani), ggancia@crei.cat (G. Gancia).

http://dx.doi.org/10.1016/j.jinteco.2017.05.010
0022-1996/

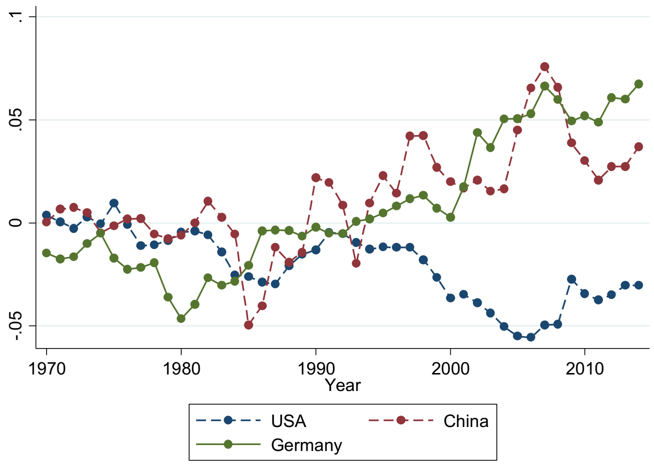

Fig. 1. Trade surplus in goods and services. Source: World Development Indicators.

imbalances builds on the assumptions of perfectly competitive markets and constant returns to scale. This approach, whose intellectual history dates back to the debate between Ohlin and Keynes on the effects of international transfers, was formalized by Samuelson (1954) and Dornbusch et al. (1977), and recently revived by Dekle et al. (2007, 2008). Its main lesson is that a trade surplus is unambiguously welfare reducing because it involves a double burden, i.e., an income transfer to the trading partner and a terms-of-trade deterioration. This conclusion is however at odds with the common wisdom surrounding policy debates. For instance, if trade imbalances *always* benefit deficit countries at the expense of surplus countries, how is it that the U.S. administration often complains that China's large bilateral trade surpluses are harming the U.S. economy? And how is it that China accumulated such large surpluses and tried to postpone as much as possible the rebalancing of its foreign trade? Similarly, how is it that trade imbalances within the eurozone are associated with the economic hegemony of surplus countries (by most macroeconomic indicators) and the stagnation or even the collapse of deficit countries?

In this paper, we challenge the conclusions from the traditional approach and show that the so-called "new trade theory" can provide radically different and so far overlooked answers to old questions. To this purpose, we explore the welfare effects of trade imbalances in the Dixit-Stiglitz-Krugman model of monopolistic competition. Differently from recent attempts at measuring well-known effects of rebalancing (such as the double burden of a trade surplus) using trade models suitable for quantitative analysis, our aim is to highlight some unconventional possibilities. To bring these out with the greatest clarity, the model is stylized. Yet, it builds on standard assumptions and it is useful for illustrating some possibilities that seem to have been largely neglected in earlier discussions. In addition, following the literature on international transfers, we study the effects of an exogenous imbalance without taking a stand on its causes.

We therefore formulate a two-sector, multi-country, general-equilibrium version of the model in Krugman (1980) that is standard in most respects: one sector produces a homogeneous good under perfect competition and constant returns to scale, and the other produces differentiated goods under monopolistic competition and costly trade. The main novelties are that the homogeneous good is nontraded and that trade imbalances arise whenever the exchange rate (i.e., the relative wage) is inconsistent with balanced trade. These are realistic features: the differentiated sector stands for manufacturing production, which is far more traded than services, and trade is not balanced in general. In contrast, many existing models of monopolistic competition (e.g., Helpman and Krugman, 1985; Melitz and Redding, 2014) assume that the homogeneous good is freely traded and that trade is balanced.

As in the traditional theory, in our model a trade surplus involves an income transfer to the deficit country and possibly a terms-of-trade deterioration. Unlike the standard theory, however, trade imbalances do not impose any double burden on surplus countries. This is because the model features a production-delocation effect, in that a trade surplus requires a reallocation of labor towards tradables. In turn, as first shown in Venables (1987), in the presence of trade costs the resulting increase in the number of local manufacturing firms leads to a reduction in the local price index. A striking implication is that a trade surplus always leads to a *reduction* in the real price of traded goods which is *ceteris paribus* beneficial. Thus, a surplus involves an income transfer on the one hand, and a beneficial expansion in the traded sector on the other. The net welfare effect is, in general, ambiguous, and we show that it can be positive when the elasticity of substitution between traded goods is low and trade costs are high. We show, however, that in our baseline setup the net welfare effect is negative for reasonable parameter values.

Next, we consider a richer setup in which we allow for manufacturing intermediates in the production of final goods. We find that intermediate goods, which account for more than two thirds of international trade, can dramatically change our quantitative and qualitative conclusions. In particular, we find that a trade surplus may lead to an *appreciation* of the exchange rate, to a terms-of-trade *improvement* and even to a welfare *increase* under reasonable parameter configurations. We then simulate the model's behavior under two different scenarios replicating the imbalances of China and Germany, the two largest surplus countries in the world. In both cases, the beneficial price-index effect reduces significantly the direct cost of the transfer. This finding is confirmed when we extend our analysis to allow for more general assumptions about preferences and technology, for endogenous labor supply and for variable markups.

Finally, we perform a different but related thought experiment: rather than studying the price effect of an exogenous increase in the transfer, as in most of the literature, we study instead what happens if a government fixes the international relative wage, i.e., the exchange rate. For example, the Chinese government might have been intervening in the international capital markets so as to avoid any deterioration of the country's competitiveness. Since in our model the general-equilibrium relationship between the exchange rate and the transfer is dictated by a trade-imbalance condition, one might suspect that fixing the exchange rate or the transfer is immaterial for the results. We find that, surprisingly, this is not the case in the presence of intermediate goods. The reason is that intermediate goods give rise to agglomeration economies through the cost and demand linkages between producers of intermediate and final goods, as in Krugman and Venables (1995). With fixed relative wages, agglomeration economies imply that, depending on the parameter configurations, the manufacturing sector may tend to concentrate in one country.

These results have far-reaching implications. They may help explain why a country like China, who resists the real appreciation of its currency through the accumulation of foreign reserves and capital controls, can become a 'world factory'.[1] They also revisit

[1] In Song et al. (2011) a constant wage also plays a key role in explaining the Chinese growth miracle. However, in their model it is the result of labor reallocations, and not of government intervention.

some insights from the 'new economic geography' literature (e.g., Fujita et al., 1999). In particular, we find that a crucial condition for agglomeration is the lack of adjustment of relative wages.[2] So long as relative wages are endogenous, the symmetric equilibrium is always stable under balanced trade and agglomeration is impossible. Under a fixed relative wage, instead, the model properties are the same as in Krugman and Venables (1995): the symmetric balanced-trade equilibrium may become unstable, in which case manufacturing firms start to agglomerate in the surplus country.

Besides the literature on the effects of rebalancing already mentioned (especially Dekle et al., 2007 and 2008, and Obstfeld and Rogoff, 2007), our paper is related to the classical debate on how international transfers affect the terms of trade and welfare for the donor and recipient countries. The large research effort that followed the controversy between Ohlin and Keynes has shown that, in theory, the terms-of-trade and welfare effects of a transfer can go either way (e.g., Bhagwati et al., 1983). Although a transfer could conceivably improve the donor's terms of trade so much as to increase its welfare, the conditions for this outcome are considered more stringent than those for immiserizing growth, and this possibility is therefore deemed a theoretical curiosity. In practice, the widespread presumption is that nontraded goods and costly trade generate a home bias in consumption, which implies that a transfer causes a deterioration of the donors' terms of trade and hence a double burden. Our results challenge this conventional view. It is precisely in the presence of trade costs that the entry margin can turn the adverse terms-of-trade effect of the transfer into a favorable change of the price level in the donor country. Moreover, with traded intermediate inputs, production costs can fall so much in the donor country that a rise in wages (hence an improvement in the terms of trade) is needed to restore the equilibrium.

The closest paper to ours is Corsetti et al. (2013), who develop a two-country model of monopolistic competition to study how the entry margin affects the price effects of a transfer. Similarly to us, they find that the implications for prices can be very different when the adjustment occurs at the extensive margin. Differently from us, however, they do not find that entry can lower the real cost of the transfer for the sending country. The main reason for this difference is that they treat varieties and entry symmetrically in the traded and nontraded sector. However, existing evidence (see next section) suggests that scale economies are more prevalent in manufacturing sectors. For this reason, we prefer to model an asymmetry across sector, shutting down the variety effect entirely in the nontraded sector, which is assumed to produce a homogeneous good. A key advantage of our specification is that of making our unconventional results most transparent. Different from Corsetti et al. (2013), in addition, we also consider intermediate goods, which play an important role in our analysis.

This paper also contributes to the growing literature trying to bridge trade theory and international finance. Obstfeld and Rogoff (2000) were among the first to recognize that introducing explicitly trade costs helps explaining various puzzles in international macroeconomics. Ghironi and Melitz (2005) show that adding endogenous varieties contributes at explaining international business cycles. Ghironi and Melitz (2005) study the effect of various shocks when entry and trade costs give rise to a "home-market effect" but without intermediate goods.[3] Our model shows that these ingredients can change significantly the welfare implications of trade imbalances. Since the production-delocation effect implies that a devaluation has a beneficial effect on the price index, it is plausible to conjecture that this mechanism can help in explaining why, as widely believed in policy circles, devaluations can be welfare improving.[4]

Finally, in this paper we model imbalances as exogenous transfers in a static setup with no uncertainty. We do this to preserve comparability to the literature on international transfers and show how the results are affected by firms' location decisions. In more general models, the welfare implications may also depend on whether imbalances arise from intertemporal decisions and on the extent of international financial integration.[5] Interestingly, Corsetti et al. (2007) find that the home-market effect can have different implications with enough risk sharing. In particular, they find, *inter alia*, that a productivity shock leads to smaller price adjustments and larger quantity adjustments under full insurance.[6] This echoes our case with a fixed exchange rate. However, in reality international risk sharing is imperfect and probably more relevant when studying productivity shocks than an exogenous international transfer. In any case, we view the mechanism illustrated in this paper as an important component for a more complete understanding of the macroeconomic effects of trade imbalances.[7]

The rest of the paper is organized as follows. To better motivate our theoretical analysis, we begin in Section 2 by discussing the empirical foundations of our main assumptions. In Section 3 we formulate our baseline model with monopolistic competition and trade costs. In Section 4 we extend the model by adding intermediate goods, endogenous labour supply and variable markups. In Section 5 we study the effects of fixing the relative wage rather than the trade imbalance. Section 6 concludes.

2. Motivating evidence: trade imbalances and production structure

Our theory builds on the assumption that trade imbalances are non-neutral on a country's production structure, and that the latter matters because of important technological asymmetries across sectors. We now discuss the evidence in support of these key assumptions.

To begin with, Fig. 2 plots the industry share of GDP on the vertical axis, which proxies for the importance of tradable goods in total value added, and the trade surplus in goods and services as a share of GDP on the horizontal axis.[8] We measure both variables at current prices and report their five-year average between 2005 and 2009. As the figure shows, trade surpluses are strongly positively correlated with the industry share of GDP, and trade imbalances account for 30% of the cross-country variation in industrial production.[9]

Next we perform a more systematic analysis, so as to also exploit the time variation in our variables of interest. To this purpose, we use a panel of up to 188 countries observed between 1960 and 2014,

[2] Helpman (1998) shows that nontraded goods can weaken agglomeration forces in a very different two-region model with labor mobility.

[3] In the trade literature, Ossa (2011) shows that the "home-market effect" can help rationalize trade policy. See also Bagwell and Staiger (2015) and Campolmi et al. (2013).

[4] The interaction between monetary policy, industry relocations and comparative advantage is studied explicitly in an interesting recent paper by Bergin and Corsetti (2015), who show in a model with monopolistic competition and sunk entry costs that stabilizing policies can foster competitiveness.

[5] See Corsetti et al. (2013) for a case in which the transfer is endogenous.

[6] See also Corsetti et al. (2008) and the recent synthesis in Corsetti et al. (2012) on the role of international financial markets in explaining the effects of productivity shocks on the real exchange rate and the terms of trade.

[7] Trade imbalances may also have additional effects. See for instance Crinò and Epifani (2014) for an analysis of their distributional implications.

[8] In our data, *Industry* corresponds to ISIS divisions 10–45 and includes all manufacturing activities.

[9] The statistics reported in the figure are computed using all the available data, but for expositional purposes we have excluded from the figure a few outliers on the far left. See Tables 1 and 2 below on the influence of outliers on regression results.

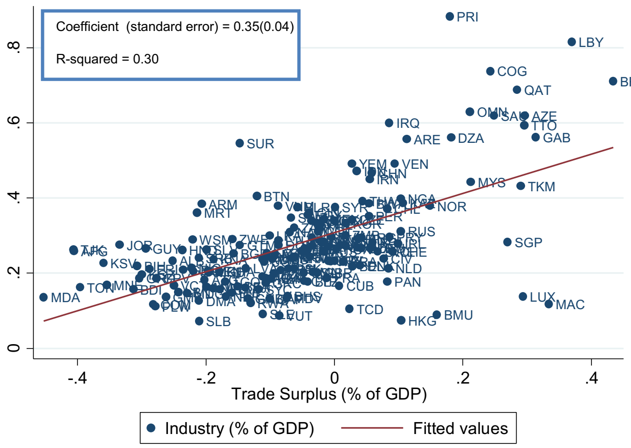

Fig. 2. Trade imbalances and industrial production. Source: WDI.

sourced from the World Bank *World Development Indicators* (WDI). A first set of results is reported in Table 1, where the dependent variable is the industry share of GDP and the key explanatory variable is the trade surplus in goods and services as a share of GDP. In column (1), we show the results of a baseline fixed-effects regression without controls, using annual data; in column (2), we add time dummies and the openness ratio; moreover, following Rodrik (2016), we also control for (the log of) population and per capita income, and their squared terms. In column (3), we add country-specific linear trends to further control for the fact that countries with different income levels may experience different patterns of structural change. In column (4), we trim our sample by excluding observations in the first and 99th percentiles of the distribution of trade imbalances. Across all specifications, the coefficient on the trade surplus is always positive and very precisely estimated.

In columns (5) –(8), we study the sensitivity of our results with respect to the proxy for trade imbalances. In particular, we rerun our most conservative regression specification in column (3) by using alternative measures of imbalances. In column (5) we consider only trade in goods (i.e., we exclude net trade in services); in column (6) we exclude trade in fuels; in columns (7) and (8) we use instead broader measures of imbalances, respectively, the current account and international reserves. Interestingly, the coefficient on these proxies is always very precisely estimated and generally similar in size, suggesting that all these measures of imbalances are associated with a significant change in the production structure.

In columns (9) and (10), we rerun the same regression specifications as in columns (2) and (3) by taking five-year averages of our variables instead of using annual data. This may help to reduce the impact of outliers and measurement error and is informative about the persistence of our correlations beyond the very short run. Interestingly, the results are essentially identical.

As a further robustness check, in Table 2 we rerun the same regression specifications as in Table 1 by measuring our variables in first differences rather than in levels. Specifically, in columns (1)–(8) we take the first differences of annual data, and in columns (9) –(10) the first differences of five-year averages. Note that changes in the trade surplus are strongly positively associated with changes in the production structure, and that the coefficient of interest is always very precisely estimated.

To sum up, our results show a strong correlation between trade imbalances and industrial production, across countries and overtime, using different measures of imbalances and controlling for a number of covariates. These results are also consistent with, and complementary to, some key findings in Rodrik (2008). Specifically, Rodrik shows that a measure of currency undervaluation is strongly positively correlated with the industry share of GDP and with economic growth.

Having argued that trade imbalances are non-neutral on a country's production structure, we now briefly mention some evidence suggesting that a country's production structure matters because of the existence of significant asymmetries between sectors. First, scale

Table 1
Fixed-effects regressions for the industry share of GDP.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline	Adding general controls	Adding country specific trends	Excluding outliers	Excluding services	Excluding fuels	Current account	International reserves	Regression specifications as in columns (2) and (3), using five-year averages	
Trade surplus	0.164	0.170	0.129	0.163	0.135	0.124	0.116	0.073	0.185	0.133
	(0.040)**	(0.037)**	(0.033)**	(0.030)**	(0.040)**	(0.027)**	(0.036)**	(0.023)**	(0.049)**	(0.053)**
Log *population*		0.166	−0.467	−0.569	0.940	−1.425	1.024	−0.726	0.152	−0.476
		(0.116)	(0.553)	(0.539)	(0.464)*	(0.610)*	(0.478)*	(0.587)	(0.115)	(0.550)
Log *population* sq.		−0.001	0.015	0.018	−0.032	0.042	−0.034	0.022	−0.001	0.016
		(0.003)	(0.017)	(0.017)	(0.016)	(0.019)*	(0.017)*	(0.018)	(0.004)	(0.017)
Log *income*		0.180	0.030	0.022	−0.029	−0.002	0.007	0.007	0.197	0.001
		(0.060)**	(0.080)	(0.082)	(0.108)	(0.099)	(0.106)	(0.081)	(0.062)**	(0.086)
Log *income* sq.		−0.009	0.004	0.004	0.009	0.006	0.008	0.005	−0.010	0.005
		(0.004)*	(0.005)	(0.005)	(0.007)	(0.006)	(0.007)	(0.006)	(0.004)*	(0.006)
Openness		0.058	0.072	0.067	0.050	0.058	0.047	0.039	0.054	0.077
		(0.015)**	(0.015)**	(0.015)**	(0.015)**	(0.017)**	(0.014)**	(0.012)**	(0.017)**	(0.020)**
Time dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country trends	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
R^2 (*within*)	0.09	0.31	0.62	0.63	0.57	0.67	0.56	0.60	0.33	0.69
Countries	184	182	182	182	175	174	175	174	182	182
Obs.	6505	6415	6415	6343	4424	4503	4423	5839	1337	1337

Notes. Fixed-effects within regressions with standard errors corrected for clustering within countries in parenthesis. *,** = significant at the 5 and 1% levels, respectively. The dependent variable is the *Industry share of GDP* (at current prices), where *Industry* corresponds to ISIS divisions 10–45. *Trade surplus* is net export of goods and services as a share of GDP (at current prices); *Income* is per capita GDP in constant 2005 US dollars; *Openness* is the ratio of total imports and exports to GDP (at current prices). In column (4), observations in which the trade surplus is greater than 0.8 in absolute value are excluded. In columns (5) and (6), trade in services and fuels, respectively, are netted out from the definition of trade surplus; in columns (7) and (8), the trade surplus is instead replaced, respectively, by the current account and international reserves as a share of GDP (at current prices). In columns (9) and (10), all variables are computed as five-year averages. Source: World Bank *WDI*.

economies are believed to be more prevalent in manufacturing sectors. For instance, Buera and Kaboski (2012) show that average firm scale is much larger in manufacturing than in services, suggesting that fixed costs are larger in the former. Innovation is also heavily concentrated in manufacturing. In particular, the U.S. manufacturing sector accounts for more than two-thirds of R&D spending and more than three-quarters of U.S. corporate patents despite accounting for less than one-tenth of U.S. private non-farm employment (Autor et al., 2016).

Second, backward linkages are also stronger in manufacturing. For instance, using input-output tables, (Yamano and Ahmad, 2006) find that the ratio of manufacturing intermediates to value added plus intermediates is around 0.5 in the manufacturing sector, a value that is ten times higher than the corresponding figure in services. Due to substantial linkages with many other sectors, manufacturing output also stimulates economic activity more than any other sector. For instance, calculations from the BEA input-output tables show that manufacturing output induces three times as much demand in other sectors than retail and wholesale trade. Agglomeration spillovers are also found to be large in manufacturing. For instance, Greenstone et al. (2010) estimate that the opening of a large manufacturing plant has a significant positive impact on total factor productivity of incumbent plants in the same county.

Finally, trade costs are also asymmetric across sectors. It is well known that traded goods mainly consist of industrial products. More in general, trade costs are lower in more R&D-intensive sectors in which intra-industry trade is more prevalent and where the home-market effect is expected to be quantitatively more important (e.g., Davis, 1998).

We now develop a model that builds on these observations, namely, that trade imbalances are associated with a relocation of manufacturing firms which have important spillover effects on the rest of the economy.

3. The price-index effect of trade imbalances

3.1. Baseline setup

3.1.1. Overview

Consider a world consisting of $N+1$ countries: Home, indexed by $i=h$, and N Foreign, each indexed by $i=f$. While Home is allowed to differ from Foreign, for simplicity all the N Foreign are identical to each other. There is one homogenous production factor, labor, with endowments L_h and L_f. All countries produce a homogeneous nontraded good, S, and a differentiated traded good M (henceforth, manufacturing goods). The nontraded good is produced under perfect competition, using one efficiency unit of labor to produce one unit of output. Following Corsetti et al. (2013), we choose the wage per efficiency unit of labor as the numeraire in each country and denote by ϵ the exchange rate, defined as the price of Foreign's numeraire in terms of Home's. According to this convention, a rise of ϵ represents an exchange rate depreciation in Home. Due to symmetry, the exchange rate between any pair of Foreign is one. The traded sector is monopolistically competitive *à la* Dixit and Stiglitz (1977): a large mass of symmetric firms produce differentiated goods using a fixed cost f and a variable cost $1/\theta$ in efficiency units of labor. There are iceberg trade costs: $\tau>1$ units must be shipped in order for one unit to arrive at the destination.

3.1.2. Preferences

Preferences are represented by the following quasi-linear utility function:

$$U_i = C_i(S) + \ln C_i(M), \quad C_i(M) = \left(\int_0^n c_i(z)^{\frac{\sigma-1}{\sigma}} dz\right)^{\frac{\sigma}{\sigma-1}}. \tag{1}$$

$C_i(S)$ is consumption of a nontraded good; $C_i(M)$ is consumption of a CES aggregate of differentiated traded goods, indexed by $z \in n$, where n is the total mass of manufacturing firms in all countries; $\sigma>1$ is the elasticity of substitution between any two traded goods.[10] The ideal price index associated with $C_i(M)$ is:

$$P_i = \left(\int_0^n \tilde{p}_i(z)^{1-\sigma} dz\right)^{\frac{1}{1-\sigma}}, \tag{2}$$

where $\tilde{p}_i(z)$ is the local-currency final price of variety z, gross of any trade cost.

Trade imbalances are modeled as a transfer T_i from the surplus country (Home, i.e., $T_h>0$) to the N deficit countries (Foreign, i.e., $T_f<0$) equal to the value of the trade surplus. Consequently, expenditure per capita equals $Y_i - T_i/L_i$, where Y_i is the labor efficiency of one worker.

Maximization of Eq. (1) implies that $C_i(M)P_i = 1$. Consumption of the nontraded good therefore equals:[11]

$$C_i(S) = Y_i - 1 - T_i/L_i.$$

Substituting $C_i(S)$ and $C_i(M) = 1/P_i$ into Eq. (1) yields the indirect utility function:[12]

$$V_i = Y_i - 1 - T_i/L_i - \ln P_i. \tag{3}$$

Evidently, welfare is decreasing in the transfer and in the price index of manufacturing goods, as both lead to a reduction in consumption. Recall that in standard models with perfect competition a trade surplus involves a transfer T_i and a higher price index P_i (due to the induced terms-of-trade deterioration) and is therefore unambiguously welfare reducing. As shown below, matters are more interesting in monopolistic competition.

3.1.3. Price indexes

Goods-market equilibrium in Home requires the equality between supply and demand for each traded good:

$$q_h = d_h + \tau N x_h, \tag{4}$$

where q_h is the output; d_h and x_h are, respectively, the domestic and export demand for a good produced in Home.[13] Similarly, for each Foreign-produced good:

$$q_f = d_f + \tau x_{fh} + (N-1)\tau x_{ff}, \tag{5}$$

[10] The above preferences imply that total expenditure on manufacturing goods is exogenous. The latter will be endogenized in the next section, in which we assume that manufacturing goods are used both as final goods and as intermediates in the production of other manufacturing goods. In a robustness check we also study how the results are affected when preferences are Cobb-Douglas rather than quasi linear.

[11] Note that an interior equilibrium in which the nontraded good is produced in all countries requires $C_i(S)>0 \iff Y_i - 1 > T_i/L_i$, a condition always satisfied for Y_i sufficiently high.

[12] For later use, note that total nominal income equals Y_iL_i and that the share allocated to manufacturing is $1/Y_i$.

[13] Note that we have dropped the variety index z as goods are symmetric, and have multiplied export demand by τ to account for the iceberg nature of trade costs.

Table 2
Fixed-effects regressions for the industry share of GDP (first differences).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline	Adding general controls	Adding country specific trends	Excluding outliers	Excluding services	Excluding fuels	Current account	International reserves	Regression specifications as in columns (2) and (3), using first differences of five-year averages	
Δ *Trade surplus*	0.091	0.105	0.105	0.099	0.102	0.082	0.071	0.028	0.120	0.126
	(0.021)**	(0.017)**	(0.017)**	(0.020)**	(0.025)**	(0.016)**	(0.024)**	(0.011)**	(0.034)**	(0.034)**
Δ log *population*		−0.084	−0.046	−0.187	0.682	0.278	0.794	0.497	−0.162	0.299
		(0.449)	(0.765)	(0.737)	(0.764)	(1.060)	(0.699)	(0.595)	(0.420)	(0.722)
Δ log *population* sq.		0.003	0.001	0.006	−0.021	−0.012	−0.024	−0.019	0.005	−0.012
		(0.015)	(0.026)	(0.025)	(0.025)	(0.035)	(0.023)	(0.020)	(0.013)	(0.024)
Δ log *income*		−0.026	−0.042	0.011	−0.149	−0.028	−0.053	−0.040	−0.021	−0.151
		(0.084)	(0.091)	(0.073)	(0.131)	(0.066)	(0.093)	(0.082)	(0.073)	(0.101)
Δ log *income* sq.		0.008	0.010	0.005	0.013	0.005	0.008	0.007	0.007	0.017
		(0.005)	(0.006)	(0.005)	(0.008)	(0.004)	(0.006)	(0.006)	(0.005)	(0.007)**
Δ *Openness*		0.042	0.041	0.034	0.034	0.041	0.029	0.027	0.068	0.066
		(0.009)**	(0.009)**	(0.008)**	(0.011)**	(0.010)**	(0.011)**	(0.007)**	(0.013)**	(0.015)**
Time dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country trends	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
R^2 (*within*)	0.05	0.14	0.16	0.13	0.18	0.16	0.16	0.11	0.22	0.38
Countries	184	182	182	182	174	168	174	174	180	180
Obs.	6311	6224	6224	6117	4237	4133	4235	5653	1152	1152

Notes. Fixed-effects within regressions with standard errors corrected for clustering within countries in parenthesis. *,** = significant at the 5 and 1% levels, respectively. All variables are computed as first differences, of yearly values in column (1)–(8), and of five-year averages in columns (9)–(10). The dependent variable is the change in the *Industry Share of GDP* (at current prices), where *Industry* corresponds to ISIS divisions 10-45. *Trade Surplus* is net export of goods and services as a share of GDP (at current prices); *Income* is per capita GDP in constant 2005 US dollars; *Openness* is the ratio of total imports and exports to GDP (at current prices). In column (4), observations in which Δ *Trade Surplus* is greater than 0.2 in absolute value are excluded. In columns (5) and (6), trade in services and fuels, respectively, are netted out from the definition of trade surplus; in columns (7) and (8), the trade surplus is instead replaced, respectively, by the current account and international reserves as a share of GDP (at current prices). Source: World Bank *WDI*.

where d_f is local demand, x_{fh} is demand from Home and x_{ff} is demand from the other $(N-1)$ Foreign. Utility maximization implies:

$$d_i = \frac{P_i^{\sigma-1}E_i}{p_i^{\sigma}}, \quad x_h = \frac{P_f^{\sigma-1}E_f}{(\tau p_h/\epsilon)^{\sigma}}, \quad x_{fh} = \frac{P_h^{\sigma-1}E_h}{(\tau p_f \epsilon)^{\sigma}}, \quad x_{ff} = \frac{P_f^{\sigma-1}E_f}{(\tau p_f)^{\sigma}}, \tag{6}$$

where p_i is the local-currency price of a locally produced good, and $E_i = L_i$ is the total expenditure on manufacturing goods in country i. As usual, demand for a given good is increasing in the price index P_i and decreasing in its own price, with an elasticity equal to σ. Hence, a depreciation (a rise of ϵ) increases Home firms' exports at the expense of Foreign's.

Profit maximization and symmetry in θ imply $p_h = p_f = p = \sigma/[(\sigma-1)\theta]$. The Home terms of trade, defined as the common-currency price of imports in terms of exports, are therefore equal to ϵ in this baseline model. Free entry and symmetry in f imply instead a break-even level of output equal to $q_h = q_f = q = f(\sigma-1)\theta$. Without loss of generality, from now on we normalize $p = 1$ and $q = 1$. Thus, using Eq. (6) in Eqs. (4) and (5) yields:

$$\begin{aligned} 1 &= P_h^{\sigma-1}E_h + \phi\epsilon^{\sigma}P_f^{\sigma-1}NE_f, \\ 1 &= P_f^{\sigma-1}E_f[1+\phi(N-1)] + \phi\epsilon^{-\sigma}P_h^{\sigma-1}E_h, \end{aligned} \tag{7}$$

where $\phi \equiv \tau^{1-\sigma} \in (0,1)$ is a measure of trade freeness. These free-entry conditions imply a negative relationship between P_h and P_f: to keep sales unchanged, a fall in Foreign demand must be compensated by a rise in Home demand. Moreover, since firms do not have to pay the transport cost to sell in their domestic market, the Home market is relatively more important to Home firms than it is to Foreign firms.

Solving Eq. (7) for P_h and P_f yields an expression for the two price indexes:

$$\begin{aligned} P_h^{\sigma-1} &= \frac{1-\phi+N\phi-N\phi\epsilon^{\sigma}}{E_h(1-\phi)(1+N\phi)}, \\ P_f^{\sigma-1} &= \frac{1-\phi\epsilon^{-\sigma}}{E_f(1-\phi)(1+N\phi)}. \end{aligned} \tag{8}$$

Strikingly, P_h is monotonically decreasing in ϵ and P_f is monotonically increasing in ϵ in the feasible range. Thus, a depreciation of Home's exchange rate (a rise of ϵ) leads to a reduction in the Home price index and to an increase in the Foreign price index. The intuition for this result is as follows. An increase in ϵ makes Home producers relatively more competitive. To restore free entry, demand must fall for Home firms and rise for Foreign firms. Since Home firms are relatively more sensitive to local demand, the adjustment can only happen through a reduction in P_h and an increase in P_f.[14]

The fall in the local price index after a depreciation may sound paradoxical at first. After all, an increase in ϵ makes imported varieties more expensive and this tends to increase the price index. So, how can the adjustment take place? The answer, as we show formally next, is through a change in the mass of Home and Foreign firms.

[14] Notice also that Home firms are more sensitive to changes in the local price index the larger the size of the local market E_h. Hence, for a given depreciation, the fall in the local price index will be smaller in a large country.

3.1.4. Mass of firms

We now determine the equilibrium mass of Home and Foreign firms, n_h and n_f respectively. Using Eq. (2) yields:

$$P_h^{\sigma-1} = [n_h + \phi\epsilon^{1-\sigma} N n_f]^{-1},$$
$$P_f^{\sigma-1} = [\phi\epsilon^{\sigma-1} n_h + n_f (1-\phi+N\phi)]^{-1}. \quad (9)$$

As Eq. (9) makes it clear, keeping the number of firms constant, an increase in ϵ raises P_h. However, entry tends to lower the price index. Solving Eq. (9) for n_h and n_f, and using Eq. (8), yields:

$$n_h = \frac{E_h(1-\phi+N\phi)}{1-\phi+N\phi-N\phi\epsilon^{\sigma}} - \frac{E_f N\phi\epsilon^{1-\sigma}}{1-\phi\epsilon^{-\sigma}},$$
$$n_f = \frac{E_f}{1-\phi\epsilon^{-\sigma}} - \frac{E_h\phi\epsilon^{\sigma-1}}{1-\phi+N\phi-N\phi\epsilon^{\sigma}}. \quad (10)$$

Note that n_h is increasing in ϵ and n_f decreasing: a depreciation, by increasing the profitability of Home firms at the expense of Foreign firms, induces firm delocation from Foreign to Home, implying that home consumers save the trade cost on the varieties whose production has moved from the Foreign country. As demonstrated by Eq. (8), this second effect through entry dominates, because an increase in ϵ lowers the price index in Home and rises it in Foreign. This result, that a devaluation lowers the price index due to the change in the number of firms, is similar to the production-delocation effect first noticed by Venables (1987) in the context of an iceberg import tariff.[15]

3.1.5. Trade imbalances

The local-currency value of Home's exports (gross of trade costs) equals $X_h = p_h \tau x_h N n_h$. Thus, using Eq. (6),

$$X_h = N E_f \epsilon^{\sigma} \phi P_f^{\sigma-1} n_h.$$

Similarly, the gross exports of the N Foreign countries to Home are:

$$X_f = N E_h \epsilon^{-\sigma} \phi P_h^{\sigma-1} n_f.$$

Hence, the local-currency value of Home's trade surplus, $T_h = X_h - \epsilon X_f$, equals:

$$T_h = \phi N \left(E_f \epsilon^{\sigma} P_f^{\sigma-1} n_h - E_h \epsilon^{1-\sigma} P_h^{\sigma-1} n_f \right). \quad (11)$$

[15] For a constant number of firms, the result that a devaluation lowers the domestic price index would not hold. Nevertheless, a devaluation can have a beneficial effect through a different channel: without entry, the higher competitiveness of firms in the devaluing country would translate into positive profits. This profit-shifting effect is studied, for example, in Ossa (2012). We explore the quantitative importance of entry in Section 4.4.

Using Eqs. (8) and (10) in Eq. (11) yields our key trade-imbalance condition:

$$T_h = \phi N \left(\frac{\epsilon^{\sigma} E_h}{1-\phi+N\phi-N\phi\epsilon^{\sigma}} - \frac{E_f \epsilon^{1-\sigma}}{1-\phi\epsilon^{-\sigma}} \right). \quad (12)$$

Importantly, Eq. (12) dictates the general equilibrium relationship between T_h and ϵ. Simple inspection reveals that T_h is increasing in ϵ: hence, a trade surplus leads to a depreciation of the exchange rate in this baseline model.

Notice that, imposing $T_h = 0$, Eq. (12) pins down the exchange rate ϵ, and thus the terms of trade, consistent with balanced trade. It is easy to show that, if countries are symmetric, then $T_h = 0$ implies $\epsilon = 1$. In the presence of asymmetries, instead, the relative wage and the terms of trade will tend to be higher in the country with a larger domestic market (high L_i). The latter result is a consequence of the familiar "home market effect" .

We summarize the main comparative statics to a change in T_h in the following Proposition:

Proposition 1. *A transfer T_h from Home to Foreign leads to: a) a depreciation of the exchange rate ϵ (a reduction in Home's relative wage and a terms-of-trade deterioration), b) an increase in the mass of manufacturing firms n_h, and c) a reduction in the price index P_h, i.e.,*

$$\frac{d\epsilon}{dT_h} > 0; \quad \frac{dn_h}{dT_h} > 0; \quad \frac{dP_h}{dT_h} < 0.$$

When $N = L_h = L_h = 1$:

$$\frac{d\epsilon}{dT_h} = \frac{(1-\phi)^2}{[2\sigma-(1-\phi)]\phi}; \quad \frac{d\ln n_h}{dT_h} = \frac{\phi[2\sigma-(1-\phi)]}{1-\phi^2}\frac{d\epsilon}{dT_h};$$
$$\frac{d\ln P_h}{dT_h} = -\frac{\phi}{1-\phi}\frac{\sigma}{\sigma-1}\frac{d\epsilon}{dT_h}.$$

3.2. The transfer problem revisited

We are now in the position to discuss the welfare effects of a transfer T_h from Home to Foreign. Home transfers tradable varieties for a value T_h to Foreign. Given quasi-linear preferences, at constant prices this additional income would be absorbed entirely by an increase in consumption of the Foreign nontraded good, which requires a reallocation of Foreign labor away from the traded sectors. Similarly, the fall in Home income would be absorbed by lowering consumption of the nontraded good, which requires a reallocation of Home labor to the traded sector. Given that firm size is fixed, n_h rises and n_f falls. In the absence of trade costs, this substitution of firms would not affect prices, and this would be the end of the story. However, in the presence of trade costs, the relocation of production reduces the price index in the Home country, where there are now more active firms, and raises it in the Foreign country, where fewer firms are left. In turn, the fall in P_h and the rise in P_f lower the demand for Home goods and raise the demand for Foreign goods. To restore the equilibrium, the Home wage must fall relative to Foreign, which corresponds to a depreciation of the exchange rate (higher ϵ). The effect of a small transfer on the total number of varieties is in general ambiguous as it depends on the nature of country asymmetries. If the countries are symmetric, however, the fall in P_h is exactly compensated by the rise in P_f and the total number of firms does not change.

Notice that, similarly to standard models, the transfer leads to a terms-of-trade deterioration for the sending country. However, contrary to those models, the variety effect implies that this terms-of-trade deterioration is, in itself, *welfare improving* for the sending countries. Thus, what has been so far considered a “double burden” can actually alleviate the welfare cost of a transfer.

More formally, recall that Home welfare is given by:

$$V_h = Y_h - 1 - T_h/L_h - \ln P_h.$$

The change in Home welfare after a transfer T_h is

$$\Delta V_h = -\frac{T_h}{L_h} + \ln \frac{P_{h,0}}{P_{h,T}},$$

where $P_{h,0}$ and $P_{h,T}$ are the Home price indexes with $T_h = 0$ and $T_h > 0$, respectively. The first term is the direct cost of the transfer, the second is the effect due to the change in the price index. In turn, the latter effect can be expressed as

$$\ln \frac{P_{h,0}}{P_{h,T}} = \frac{1}{\sigma - 1} \ln \frac{1 - \phi + N\phi - N\phi\epsilon_0^{\sigma}}{1 - \phi + N\phi - N\phi\epsilon_T^{\sigma}}.$$

Let $\Delta\tilde{V}_h = -T_h/L_h$ be the hypothetical welfare cost of the transfer at constant prices. Hence, the real cost of the transfer relative to a model with no price index effect, denoted by T_R, is

$$T_R \equiv \frac{\Delta V_h}{\Delta\tilde{V}_h} = 1 - \frac{L_h}{T_h(\sigma - 1)} \ln \left(\frac{1 - \phi + N\phi - N\phi\epsilon_0^{\sigma}}{1 - \phi + N\phi - N\phi\epsilon_T^{\sigma}} \right).$$

We will use T_R as a metric to assess by how much the price index effect can lower the real cost of a given transfer. In particular, notice that $T_R = 1$ if $\epsilon_0 = \epsilon_T$, that is, when relative wages do not move. As long as $\epsilon_T > \epsilon_0$, the depreciation in Home is associated with a lower price index, which reduces the real cost of the transfer by the factor $T_R < 1$.

Can the price index effect be so large as to make the transfer welfare improving for the surplus country? In other words, can T_R turn negative? The striking answer is yes, as stated formally below:

Proposition 2. *The effect on Home welfare of a transfer T_h to Foreign is ambiguous:*

$$\frac{dV_h}{dT_h} = -1/L_h - \frac{d \ln P_h}{d\epsilon} \frac{d\epsilon}{dT_h}.$$

When $N = L_h = L_h = 1$, in a neighborhood of $T_h = 0$:

$$\frac{dV_h}{dT_h} > 0 \quad iff \quad \frac{\sigma}{\sigma - 1} \frac{1 - \phi}{2\sigma + \phi - 1} > 1.$$

In the special case of $N = 1$ (two countries) and no asymmetries between Home and Foreign, the determinants of the beneficial price-index effect can be easily characterized analytically: a transfer is more likely to be welfare increasing for low values of σ and high trade costs, τ. For standard parameter values the net welfare effect is negative. As we show in the next section through numerical simulations, however, the positive price-index effect can be significant.

So far, we have seen that a trade surplus leads to a fall in prices which increases the purchasing power in Home. Besides being derived from conventional assumptions, this result is also realistic. For instance, the fact that Chinese consumers benefited from the relocation of industrial production to their home country is hard to dispute. Yet, this is probably the less important part of the story. As we show in the next section, in the presence of traded intermediates, agglomeration of industrial production is not just beneficial for consumers, it also improves the competitiveness of Chinese firms.

4. Imbalances with intermediate goods

Intermediate goods play a prominent role in international trade. As already noted by Ethier (1982) more than thirty years ago, “I cannot resist the temptation to point out that producers' goods are in fact much more prominent in trade than are consumers' goods”. Recent estimates confirm his insight: by now, intermediate products account for about two-thirds of the volume of world trade. In the rest of the paper we therefore consider a more general setup in which differentiated intermediate goods are used in the production of final goods.

4.1. The model with intermediates

To model intermediate goods, we follow Krugman and Venables (1995). Specifically, we assume that the total cost function (in units of local currency) of a manufacturing firm located in country *i* is

$$TC_i = \left(f + \frac{q}{\theta} \right) P_i^{\mu} w_i^{1-\mu}, \tag{13}$$

where $w_i = 1$ is the wage and P_i is the price index of manufacturing goods. This formulation implies that manufacturing goods enter the production function for other manufacturing goods (as intermediates) and the utility function (as final goods) through the same CES aggregator. The price and marginal cost of a manufacturing good are now decreasing in the local price index:

$$p_i = \frac{\sigma}{\sigma - 1} \frac{P_i^{\mu}}{\theta} = P_i^{\mu}, \tag{14}$$

where the latter equality follows from our normalization.

This formulation gives rise to agglomeration economies through the *cost linkages* between producers of intermediates and final goods. This is because agglomeration allows local producers of final goods to save on the trade costs of intermediate inputs, which reduces P_i and therefore increases, ceteris paribus, the revenue and profits of manufacturing firms.

Eq. (13) also implies that in each country the total expenditure on intermediate goods is a constant share μ of the value of local manufacturing production. As a consequence, country i's total expenditure on manufacturing goods is now endogenous and is given by:

$$E_i = L_i + \mu p_i n_i. \tag{15}$$

Eq. (15) gives rise to agglomeration economies through the *demand linkages* between producers of intermediates and final goods. This is because agglomeration leads to an increase in firms' sales of intermediate inputs and therefore increases, ceteris paribus, their revenue and profits.

As in the previous section, using Eq. (14) in Eqs. (6) and (4) we can solve for the price indexes:

$$P_h^{\sigma-1} = \frac{p_h^\sigma (1-\phi+N\phi) - N\phi\epsilon^\sigma p_f^\sigma}{E_h (1-\phi)(1+N\phi)},$$
$$P_f^{\sigma-1} = \frac{p_f^\sigma - \phi\epsilon^{-\sigma} p_h^\sigma}{E_f (1-\phi)(1+N\phi)}. \tag{16}$$

To express the equilibrium mass of Home and Foreign firms, we solve for n_h and n_f from the price index (2):

$$n_h = p_h^{\sigma-1}\left[\frac{E_h(1-\phi+N\phi)}{p_h^\sigma(1-\phi+N\phi)-N\phi\epsilon^\sigma p_f^\sigma} - \frac{E_f\phi\epsilon^{1-\sigma}N}{p_f^\sigma-\phi\epsilon^{-\sigma}p_h^\sigma}\right],$$
$$n_f = p_f^{\sigma-1}\left[\frac{E_f}{p_f^\sigma-\phi\epsilon^{-\sigma}p_h^\sigma} - \frac{E_h\phi\epsilon^{\sigma-1}}{p_h^\sigma(1-\phi+N\phi)-N\phi\epsilon^\sigma p_f^\sigma}\right]. \tag{17}$$

Finally, the local-currency value of Home's trade surplus equals $T_h = X_h - \epsilon X_f$, where $X_h = p_h \tau x_h N n_h$ and $X_f = p_f \tau x_f N n_f$. Hence, using Eq. (17) we obtain:

$$T_h = \phi N\left[\frac{p_f^\sigma \epsilon^\sigma E_h}{p_h^\sigma(1-\phi+N\phi)-N\phi\epsilon^\sigma p_f^\sigma} - \frac{p_h^\sigma\epsilon^{1-\sigma}E_f}{p_f^\sigma-\phi\epsilon^{-\sigma}p_h^\sigma}\right]. \tag{18}$$

Using Eq. (14) in Eqs. (15), (16), (17), and (18) yields a system of 5 equations in P_h, P_f, E_h, E_f and ϵ.

4.2. Transfer and prices: analytic results

The above system is highly nonlinear and does not admit in general analytic solutions. Hence, to gain insight on the model's mechanics, we begin by considering a simplified symmetric two-country version of the model in which we study the comparative-statics effects of a small transfer in neighborhood of the symmetric, zero transfer, equilibrium. The analysis is greatly simplified because the symmetric equilibrium (with $T_i = 0$) is easy to characterize. Linearizing the system we can prove (see the Appendix) the following results:

Proposition 3. *Assume that $\sigma(1-\mu) > 1$ and $N = L_h = L_f = 1$. Then, in a neighborhood of $T_i = 0$, a small transfer from Home to Foreign lowers the price index in Home:*

$$\frac{d\ln P_h}{dT_h} < 0.$$

The effect of the transfer on the exchange rate (Home's relative wage) is instead ambiguous:

$$\frac{d\ln\epsilon}{dT_h} < 0 \quad iff \quad \tau^{\sigma-1} < \frac{(1+\mu)(\sigma+\sigma\mu-1)}{(1-\mu)(\sigma-\sigma\mu-1)}.$$

Thus, as in the baseline model, a trade surplus leads to a reduction in the price index in the relevant range (i.e., for $\sigma(1-\mu) > 1$).[16] However, unlike in the baseline model, the sign of $d\epsilon/dT_h$ is now in general ambiguous. In particular, $d\epsilon/dT_h$ turns negative when agglomeration forces are strong enough, namely, when μ is sufficiently large, or σ and τ are sufficiently low. The intuition for this surprising result is simple: by inducing the expansion in the traded sector, a trade surplus strengthens agglomeration forces, and when these are strong enough, they are the key determinant of a country's competitiveness. It follows that the push to competitiveness given by agglomeration forces may require an offsetting appreciation, rather than a depreciation, of the exchange rate.

4.3. Simulations

We now turn to numerical examples. To start with, we show the effects of non-infinitesimal transfers in the symmetric case. Panel a) of Fig. 3 plots $V_{h,T} - V_{h,0}$, where $V_{h,0}$ is Home welfare in $T_h = 0$, as a function of T_h for different values of μ, the key parameter regulating the strength of agglomeration forces in our model.[17] In all cases we set $\sigma = 3$ and $\tau = 2.7$. Note that, for $\mu = 0$, we are back in the baseline setup and welfare is monotonically decreasing in the trade surplus relative to the balanced-trade equilibrium. For $\mu = 0.3$ and $\mu = 0.4$ the qualitative results are unchanged, but the curve is less steep, the more so the higher is μ. Finally, for $\mu = 0.5$ the results are reversed: welfare is now an inverted-U function of T_h. In other words, when agglomeration forces are strong enough, a small transfer is welfare improving and there is an interior level of T_h that maximizes Home utility. This non-monotonicity of welfare with respect to the transfer is due to the endogenous response of the exchange rate to T_h: as shown in panel b), when agglomeration forces are strong, an increase in the transfer leads to a large appreciation of the exchange rate for high T_h ; in turn, a fall of ϵ leads, *ceteris paribus*, to an increase in the price index that adversely affects welfare.

Finally, Panel c) plots the terms of trade, i.e., the common-currency price of imported relative to exported goods, which are now equal to $\epsilon p_f/p_h = \epsilon(P_f/P_h)^\mu$. Note that, for $\mu = 0.5$, a trade surplus leads to a terms-of-trade improvement. Thus, when agglomeration forces are strong enough, a trade surplus may involve a terms-of-trade appreciation and a welfare increase: the implications of the standard trade theory are now completely reversed!

After having understood the qualitative properties and the range of admissible outcomes, we now simulate the model under two scenarios that account for more realistic asymmetries across countries. In the first scenario, we consider a surplus country (Home) with the economic size of China trading with two countries (Foreign) that capture broadly the United States and Europe. We normalize the labor

[16] This is the so-called no-black-hole condition (see, e.g., Fujita et al., 1999, p. 58). It is equivalent to assuming that agglomeration forces are not too strong. Note also that, in the presence of intermediate goods, the monopolistic distortion is captured by the term $[\sigma(1-\mu)-1]^{-1}$, and that the latter becomes negative when the no-black-hole condition is violated, a case arguably difficult to interpret. This provides a further justification for the standard assumption that $\sigma(1-\mu) > 1$.

[17] Note that, ignoring exogenous terms, $V_{h,0} = -\ln P_{h,0} = -\frac{1}{\sigma(1-\mu)-1}\ln\frac{1-\mu}{1+\phi}$ (see the Appendix).

force of China to one, $L_h = 1$, and set $L_f = 0.5$, so as to match the observation that the non-rural labor force in China is roughly equal to the combined labor force of the United States and Europe. We then set $Y_h = 3.3$, roughly consistent with the observation that the manufacturing share of GDP in China is 0.31 (World Bank). We also set $Y_f = 2 * Y_h$ so that China, Europe and the United States have approximately the same aggregate economic size. With these parameters, we study the effect of a transfer from Home equal to 2% of its GDP.

In the second scenario, we consider a surplus country (Home) with the economic size of Germany trading with twenty-seven countries (Foreign) that capture the other EU member states. We normalize the labor force of Germany to one, $L_h = 1$, and set $L_f = 0.2$ so as to match the fact that Germany accounts for about 16% of the combined EU population. We then set $Y_h = 6$ to obtain a manufacturing share of 0.16, consistent with the EU average, and $Y_f = 4.5$. The latter figure matches the observation that GDP per capita in the average EU country is about 75% of the German level. In the case of Germany, we study the effect of a transfer from Home equal to 4% of its GDP.

Regarding the remaining parameters, we experiment with various combinations. To assess the role of intermediate inputs, we consider the version of the model with no intermediates, $\mu = 0$, and the more realistic case in which their cost share is $\mu = 0.51$, which is consistent with the U.S. input-output table.[18] As for the elasticity of substitution between product varieties, we consider two values: $\sigma = 3$, which is close to the "macro" estimates often used in studies on current account adjustments, and $\sigma = 5$, which is closer to the "micro" estimates often used in the trade literature. Finally, we use two values also for the iceberg trade cost: $\tau = 2.7$, consistent with Anderson and van Wincoop's (2004) tax-equivalent estimate of overall trade costs of 170% for industrialized countries; and a more moderate level $\tau = 1.7$, as in Melitz and Redding (2015). For each configuration of parameters, we will compute the value of export as a share of GDP in the surplus country. This will help us to gauge which combination of σ and τ yields more realistic volumes of trade, and also how the price-index effect depends on the export share.

The main effects of the transfer in the first scenario are reported in Table 3. It shows: the real cost of one unit of the transfer, T_R; the percentage change in the exchange rate, $\Delta\%\epsilon$; the percentage change in the number of Home and Foreign manufacturing firms, $\Delta\%n_h$ and $\Delta\%n_f$, respectively; and the value of export as a percentage of GDP in Home in the equilibrium with the transfer. Recall that $T_R = 1$ in the absence of price effects, and that an increase in ϵ (a depreciation of Home's exchange rate) also corresponds to a reduction in Home's relative wage. In all cases, the fall in the Home price index has significant favorable effects on Home welfare, although the magnitude varies notably across the parameter space. The price effect is weakest in column (1), corresponding to no intermediates, low trade costs and high elasticity. Yet, even in this case, the price effect lowers the cost of the transfer to 87% of its value. Either a lower value of σ or higher trade costs can cut the cost to almost 80% (columns 2 and 3) and to 75% if both holds (column 4). The effects are much larger in the presence of intermediate inputs. The price effect is now likely to reduce by about half the cost of the transfer (columns 5, 6 and 7). In the most extreme case (column 8), corresponding nonetheless to parameter values used in the literature, the transfer is actually welfare improving for the sending country!

Looking at the impact on the exchange rate, Table 3 shows significant heterogeneity across specifications. Without intermediate goods, the transfer leads to a fall in the Home relative wage by between 1% and 23% (columns 1–4). However, if we exclude the case $\sigma = 5$, $\tau = 2.7$, which is probably not the most realistic combination as it implies a very low volume of trade, the wage adjustment is of a few percentage points. With intermediate goods, instead, the transfer typically leads to a *rise* in the Home relative wage (again, excluding the case $\sigma = 5, \tau = 2.7$). The appreciation ranges from 2.5% to 11%. In all cases, the transfer triggers a large relocation of firms from Foreign to Home, of an order of magnitude around 6% – 13% of existing firms. The relocation effect is especially strong in the presence of intermediate goods. Finally, except for the case $\sigma = 5$, $\tau = 2.7$, the model generates export volumes that are in the ballpark of the observed data, especially in the presence of intermediate goods. For comparison, the volume of exports from China to the United States and Europe reached a peak of around 12% of GDP in 2007, and fell below 8% in 2015. Hence, a sizable price effect is compatible with realistic levels of home bias in consumption.

The effect of the transfer in the second scenario is reported in Table 4. Compared to the previous case, all price effects are now smaller. This is because Germany is smaller than China, and hence a given surplus (as a share of GDP) involves smaller general equilibrium effects. Yet, given the lower manufacturing share in this scenario, the change in the number of Home firms is now larger and, as a result, the price index effect can still lower significantly the cost of the transfer, to 92%–35% of its value. The last row confirms that, excluding the extreme case $\sigma = 5, \tau = 2.7$, the model with intermediate goods generates realistic values for the export share from Germany to the remaining 27 EU partners, which varies in the data within the range of 18%–22% of GDP.

4.4. Robustness

So far, we have deliberately relied on a number of simplifying assumptions in order to put our results in sharper relief and make our analysis more transparent. We are now in the position to discuss how relaxing some of these assumptions affects the main results.

4.4.1. Preferences and Technology

We have assumed that preferences are nonhomothetic and quasi-linear, in this following a large theoretical literature on trade policy. Quasi-linear preferences are analytically convenient but somewhat restrictive, as they imply no income effects in the demand for manufacturing goods, and a constant marginal utility from consumption of the nontraded good.

We now assume, instead, that preferences are homothetic and Cobb-Douglas.[19] This tends to weaken our results for two main reasons. First, they imply a decreasing (rather than a constant) marginal utility from consumption of the nontraded good, and therefore an increasing opportunity cost of expanding the manufacturing sector after a trade surplus. Second, with Cobb-Douglas preferences a trade surplus implies, ceteris paribus, a fall of (rather than a constant) expenditure on manufacturing goods, and therefore a smaller size of the domestic market and weaker agglomeration forces. In this section we therefore want to quantify by how much our results are weakened under reasonable parameter configurations when preferences are Cobb-Douglas rather than quasi-linear.

[18] This figure is the ratio of manufacturing intermediates to value added plus intermediates, from Yamano and Ahmad (2006). Manufacturing intermediates are not used in the nontraded sector, consistently with the observation that services use intermediate inputs much less intensively. We relax this assumption in the next section.

[19] Although commonly used, Cobb-Douglas preferences are not necessarily more realistic as they counterfactually imply constant expenditure shares across countries.

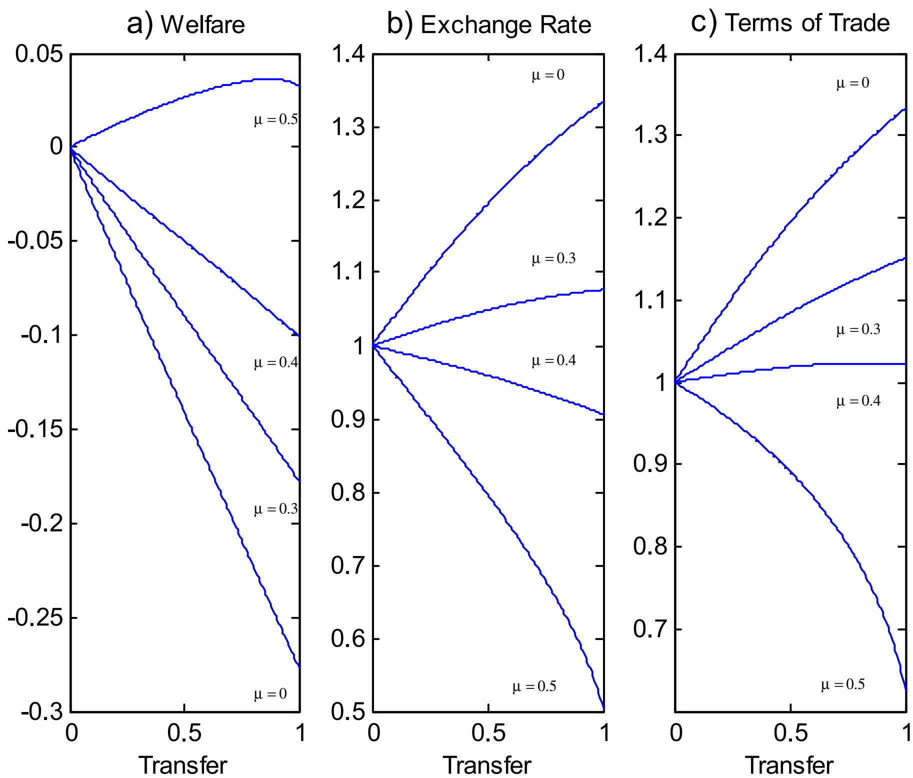

Fig. 3. Imbalances, welfare and prices. Home welfare (panel a), exchange rate (panel b) and Home's terms of trade (panel c) as a function of T_h, starting from the symmetric equilibrium.

Moreover, so far we have assumed that manufacturing intermediate goods are used only in the production of manufacturing goods. Although this is a reasonable approximation, allowing for traded manufacturing inputs in the production function for the nontraded good should weaken our results, as this reduces the asymmetry between the traded and nontraded sector. The question that we would like to address now is by how much. To this end, in this section we assume that the local-currency price and unit cost of the nontraded good in country i is

$$P_i(S) = P_i^{\mu_s} w_i^{1-\mu_s} = P_i^{\mu_s},$$

where $w_i = 1$ is the wage, P_i the price index of manufacturing goods, and μ_s is the cost and revenue share of manufacturing intermediates in the nontraded sector.[20] The production function for good S assumed so far is therefore a special case of this more general formulation for $\mu_s = 0$.

Formally, with Cobb-Douglas preferences the utility function in Eq. (1) is replaced by:

$$U_i = (1-\alpha)\ln\frac{C_i(S)}{1-\alpha} + \alpha\ln\frac{C_i(M)}{\alpha}, \quad C_i(M) = \left(\int_0^n c_i(z)^{\frac{\sigma-1}{\sigma}} dz\right)^{\frac{\sigma}{\sigma-1}}, \tag{19}$$

where $\alpha \in (0,1)$ now represents the exogenous consumption expenditure share of manufacturing goods. Maximization of Eq. (19) yields:

$$C_i(M) = \frac{\alpha\,(Y_i - T_i/L_i)}{P_i}, \quad C_i(S) = \frac{(1-\alpha)\,(Y_i - T_i/L_i)}{P_i(S)}, \tag{20}$$

where, as before, $Y_i - T_i/L_i$ is the expenditure per capita in country i (with $T_h > 0$ and $T_f = -T_h/(N\epsilon) < 0$), and Y_i is the labor efficiency of one worker. Using Eq. (20) in Eq. (19), and noting that $\ln P_i(S) = \mu_s \ln P_i$, yields a new expression for Home's indirect utility function:

$$V_h = \ln(Y_h - T_h/L_h) - [\alpha + \mu_s(1-\alpha)]\ln P_h. \tag{21}$$

Note also that expenditure on traded goods E_i now comes from the Cobb-Douglas final demand in Eq. (20), and from the intermediate demand by the two sectors, i.e., $\mu p_i n_i + \mu_s P_i(S) C_i(S)$. Thus, Eq. (15) is now replaced by the following expressions:

$$\begin{aligned} E_h &= [\alpha + \mu_s(1-\alpha)](Y_h L_h - T_h) + \mu p_h n_h, \\ E_f &= [\alpha + \mu_s(1-\alpha)](Y_f L_f + T_i/(N\epsilon)) + \mu p_f n_f. \end{aligned} \tag{22}$$

The rest of the model is unchanged. Thus, using Eqs. (22) and (14) in Eqs. (16), (17), and (18) yields a system of 5 equations in P_h, P_f, E_h, E_f and ϵ that can be easily solved numerically.

By Eq. (21), the change in Home welfare after a transfer T_h is

$$\Delta V_h = \ln\left(1 - \frac{T_h}{Y_h L_h}\right) + [\alpha + \mu_s(1-\alpha)]\ln\frac{P_{h,0}}{P_{h,T}},$$

[20] Note that this formulation implies that now manufacturing goods enter the production function for traded *and* nontraded goods and the utility function through the same CES aggregator.

Table 3
Numerical simulations, China.

	$\mu = 0$				$\mu = 0.51$			
	$\sigma = 5$		$\sigma = 3$		$\sigma = 5$		$\sigma = 3$	
	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_R	0.876	0.816	0.836	0.748	0.585	0.446	0 .434	−0.045
$\Delta\%\epsilon$	3.28	23.19	1.01	4.96	−2.53	8 .92	−5.84	−11.24
$\Delta\%n_h$	6.66	6.66	6.66	6.66	8.18	8.69	8 .73	10.51
$\Delta\%n_f$	−6.87	−5.83	−7.09	−7.08	−10.69	−10.43	−13.02	−21.32
X_h/Y_h	5.18	2.29	9.65	5.57	8.25	2.70	15 .28	7.11

Note: transfer equal to 2% of Y_h, $L_h = 1$, $L_f = 0.5$, $N = 2$, $Y_h = 3.3$, $Y_f = 6.6$.

Table 4
Numerical simulations, Germany.

	$\mu = 0$				$\mu = 0.51$			
	$\sigma = 5$		$\sigma = 3$		$\sigma = 5$		$\sigma = 3$	
	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_R	0.919	0.858	0.917	0.840	0.729	0.543	0 .721	0.351
$\Delta\%\epsilon$	1.33	10.67	0.36	2.00	−4.64	−2.51	−5.26	−12.61
$\Delta\%n_h$	24.00	24.00	24.00	24.00	28.18	31 .13	28.31	34.25
$\Delta\%n_f$	−4.76	−4.66	−4.70	−4.97	−7.35	−10.57	−7.01	−13.29
X_h/Y_h	10.58	5.44	14.27	10.92	17.68	6.77	25 .74	15.71

Note: transfer equal to 4% of Y_h, $L_h = 1$, $L_f = 0.2$, $N = 27$, $Y_h = 6$, $Y_f = 4.5$.

where $P_{h,0}$ and $P_{h,T}$ are the Home price indexes of manufacturing goods with $T_h = 0$ and $T_h > 0$, respectively, and

$$\Delta\tilde{V}_h = \ln\left(1 - \frac{T_h}{Y_h L_h}\right)$$

is the hypothetical welfare change at constant prices. Thus, the real cost of the transfer relative to a model with no price index effect is:

$$T_R \equiv \frac{\Delta V_h}{\Delta\tilde{V}_h} = \frac{\Delta V_h}{\ln\left(1 - \frac{T_h}{Y_h L_h}\right)}.$$

We now simulate the extended model using the same baseline parameters values as in the previous section. To save space, however, we only focus on the scenario corresponding to China trading with the United States and Europe. Regarding the cost share of manufacturing intermediates in the nontraded sector, we set $\mu_s = 0.05$, consistent with the U.S. input-output tables.[21] As for the share of manufacturing goods in consumption expenditure, using the manufacturing share of GDP as a proxy we obtain an α equal to 0.12 in the United States and 0.31 in China. We therefore simulate the model in both cases $\alpha = 0.12$ and $\alpha = 0.31$ to have a sense of how the results change when considering the plausible range of values for this parameter. The results are reported in Table 5.

Comparing the new simulations in Table 5 to those in Table 3, we see that the beneficial price index effect is now weaker but still significant, with T_R ranging from 0.77 to 0.16. The average across simulations implies that the price effect can lower the real cost of the transfer to 56% of its value. Moreover, we confirm the previous finding that, excluding the case $\sigma = 5$ and $\tau = 2.7$, the transfer leads to a *rise* in the Home relative wage, and the appreciation is of the same order of magnitude as before. Finally, in all cases, the transfer still triggers a large relocation of firms from Foreign to Home and the size of the phenomenon is similar to the previous simulations.

4.4.2. Endogenous labor supply

Another interesting question, explored for example in Corsetti et al. (2013), is how the income transfer and the implied changes in relative prices affect the supply of labor, and what are its welfare consequences. To isolate the firm relocation effect, in our benchmark case we assumed labor effort to be fixed. However, it is not difficult to relax this assumption. Doing so will show that the transfer induces agents to work more in the surplus country and less in the receiving country, thereby amplifying the production relocation effect.

Following Corsetti et al. (2013), we generalize preferences by adding disutility from labor:

$$U_i = (1-\alpha)\ln\frac{C_i(S)}{1-\alpha} + \alpha\ln\frac{C_i(M)}{\alpha} - \frac{1}{1+\xi} l_i^{1+\xi},$$

where l_i is the supply of labor of the representative agent and ξ is the inverse of the Frisch elasticity. Substituting $C_i(M)$ and $C_i(S)$ from Eq. (20) after taking into account that labor income is now $Y_i l_i$ yields:

$$U_i = \ln(Y_i l_i - T_i/L_i) - \ln\left[P_i(S)^{1-\alpha} P_i^{\alpha}\right] - \frac{1}{1+\xi} l_i^{1+\xi}.$$

The first-order condition for labor effort, l_i, is:

$$\frac{Y_i}{Y_i l_i - T_i/L_i} = l_i^{\xi}. \qquad (23)$$

[21] Results are not very sensitive to this parameter.

Table 5
Robustness, Cobb-Douglas preferences and intermediates in services.

	$\alpha = 0.31$				$\alpha = 0.12$			
	$\sigma = 5$		$\sigma = 3$		$\sigma = 5$		$\sigma = 3$	
	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_R	0.770	0.689	0.677	0.391	0.679	0.561	0 .560	0.164
$\Delta\%\epsilon$	−0.31	6.11	−1.47	−1.97	−1.89	10 .05	−4.70	−7.12
$\Delta\%n_h$	4.52	4.77	4.81	5.71	12.44	13.27	13.29	16.14
$\Delta\%n_f$	−2.24	−2.15	−2.41	−2.83	−6.16	−5.59	−6.80	−8.16
X_h/Y_h	14.69	3.82	29.82	16.12	7.59	2.63	14 .74	8.14

Note: $T_h = 2\%$ of GDP, $L_h = 1$, $L_f = 0.5$, $N = 2$, $Y_h = 3.3$, $Y_f = 6.6$, $\mu = 0.51$, $\mu_s = 0.05$.

Clearly, l_i increases with the transfer. The intuition is that the transfer lowers income and hence raises the marginal utility from consumption, which increases the value of working. Note also that, without the transfer, Eq. (23) yields $l_i = 1$, as before. Moreover, the extended model nests the benchmark case with exogenous labor supply, which corresponds to the limit $\xi \to \infty$.

Home's indirect utility function generalizes to:

$$V_h = \ln(Y_h l_h - T_h/L_h) - [\alpha + \mu_s(1-\alpha)]\ln P_h - \frac{1}{1+\xi} l_i^{1+\xi}.$$

Expenditures on traded goods are still given by Eq. (22) after replacing total labor income with $Y_i l_i L_i$. Following the same steps as before, define ΔV_h the change in Home welfare after a transfer T_h and $\Delta\tilde{V}_h$ the hypothetical welfare change at constant prices. Then, the real cost of the transfer relative to a model with no price index effect is now

$$T_R \equiv \frac{\Delta V_h}{\Delta \tilde{V}_h} = \frac{\Delta V_h}{\ln\left(\frac{Y_h l_{h,T} - T_h/L_h}{Y_h}\right) - \frac{1}{1+\xi}\left(l_{h,T}^{1+\xi} - 1\right)}.$$

With these new expressions, we now replicate the simulations in Table 6. Following Gali et al. (2007) and the benchmark case in Corsetti et al. (2013), we set $\xi = 1$, which implies that the transfer increases labor supply in the Home country by 1%. The results are shown in Table 6. Comparing $\Delta\%n_h$ and $\Delta\%n_f$ in Table 6 and in Table 3 we see that, given the increase in the hours worked in the surplus country and its contraction in deficit countries, the relocation of firms from Foreign to Home is now larger. The reduction in the Home price index due to the increase in employment more than compensate the higher disutility from labor, or else agents would not have chosen to work more hours. Hence, the real cost of the transfer is lower than in the case with exogenous labor supply.

4.4.3. Intensive margin and variable markups

In the model studied so far firm size is fixed, so that the adjustment in production can only occur through a change in the number of operating firms, i.e., along the extensive margin. Given the importance of the number of firms for welfare, we would like to know how much our quantitative results could change if firms can also adjust their scale, i.e., when the intensive margin is also active. Recall that firm size is pinned down by the free entry condition, $q = f(\sigma - 1)\theta$. As it is well known, q is constant if markups do not vary. However, firm size will adjust endogenously in the presence of pro-competitive effects. A simple way of allowing for this possibility, inspired to Krugman (1979), is to postulate that the demand elasticity perceived by a firm, σ_i, is a function of the number of local competitors:

$$\sigma_i = \sigma(n_i + 1)^{\varsigma},$$

where the new parameter ς regulates the strength of the pro-competitive effect. The benchmark model corresponds to $\varsigma = 0$. The equilibrium quantity and price of a variety are:

$$q_i = f(\sigma_i - 1)\theta \quad \text{and} \quad p_i = \frac{\sigma_i}{\sigma_i - 1}\frac{P_i^{\mu}}{\theta}.$$

With this formulation, an increase in the number of firms in a given location raises the competitive pressure and induces firms to lower their markup and expand their size. Hence, total production adjusts both along the intensive and the extensive margin. While the literature has proposed many micro-foundations for this effect, we captures it in a simple and flexible way.

We now replicate the simulation in Table 6 assuming $\varsigma = 1$, which under our parametrization implies that the extensive margin is roughly twice as reactive than the intensive margin. This is consistent with the finding in Hummels and Klenow (2005) that the

Table 6
Robustness, endogenous labor supply.

	$\alpha = 0.31$				$\alpha = 0.12$			
	$\sigma = 5$		$\sigma = 3$		$\sigma = 5$		$\sigma = 3$	
	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_R	0.680	0.578	0.556	0.164	0.638	0.509	0.504	0.059
$\Delta\%\epsilon$	−0.88	5.38	−2.22	−3.36	−2.45	9 .32	−5.44	−8.47
$\Delta\%n_h$	5.81	6.14	6.20	7.45	13.75	14.67	14.70	17.94
$\Delta\%n_f$	−2.89	−2.79	−3.13	−3.73	−6.84	−6.23	−7.57	−9.17
$X_h/Y_h l_h$	14.54	3.78	29.52	15.90	7.52	2 .60	14.58	8.03

Note: $\xi = 1$; all other parameters as in Table 5.

extensive margin accounts for two-thirds of the greater exports of larger economies. On the other hand, it also implies a rather strong change in markups. The results are shown in Table 7, which also reports the change in firm size in Home ($\Delta\%q_h$). Compared to Table 6, firm relocations and hence the price effect are weaker. Nevertheless, even in this case the real cost of the transfer is reduced significantly, to 85%–49 % of its value.

5. Imbalances and agglomeration

So far we have treated the transfer T_h as exogenous and the exchange rate ϵ as endogenous. That is, we have implicitly assumed that the transfer is determined outside the model, either by the saving decision of agents as in the intertemporal approach to the current account (see e.g., Obstfeld and Rogoff, 1995); or by the active intervention of a government, for example by imposing capital controls and accumulating reserves (e.g., Benigno and Fornaro, 2012). We have then studied the implications of the transfer on prices, including the exchange rate, and welfare.

Although this is a scenario that has received significant attention in the literature, it is not the only relevant case. Rather than choosing T_h, a government could equally choose a value for ϵ, and adjust actively the transfer in order to reach its target. For example, the Chinese government might have been intervening in the international capital markets so as to avoid any deterioration of the country's competitiveness.

Since the general equilibrium relationship between T_h and ϵ is dictated by a trade-imbalance condition, one may expect that treating T_h or ϵ as exogenous should not affect the results. This is indeed the case in our baseline model without intermediate goods. Interestingly, however, this is not necessarily true in the presence of intermediate goods, as the latter give rise to agglomeration economies and the possibility of multiple equilibria (see, e.g., Fujita et al., 1999). As a consequence, fixing T_h or fixing ϵ may make a difference for the results. This is because fixing the size of the transfer is also equivalent to preventing agglomeration forces from fully deploying the circular and cumulative causation processes that lead to agglomeration. In contrast, fixing the exchange rate (or relative wages) can unleash agglomeration forces, because it prevents offsetting relative price changes.

To make our point, we use the model with intermediate goods to compare two scenarios: in the first the transfer is exogenously fixed at $T_h = 0$; in the second, the exchange rate is exogenously fixed at the balanced-trade level. Moreover, to obtain analytical results and simplify the comparison with Krugman and Venables (1995) and Fujita et al. (1999), we focus on two symmetric countries. This implies that in both cases a symmetric equilibrium always exists. The key question is therefore whether the symmetric equilibrium is also stable. The main result will be to show that keeping relative wages fixed can turn the symmetric equilibrium unstable, leading to agglomeration of manufacturing in the country that starts to run a trade surplus.

To study the stability properties of the symmetric equilibrium, we closely follow Krugman and Venables (1995) and Fujita et al. (1999). Specifically, we denote by w_i the maximum wage (in local currency) that a manufacturing firm can pay and break even and we study how it varies out of equilibrium as a function of manufacturing employment, denoted by λ_i. Recall that, as in the previous section, the wage paid by the nontraded sector in each country is the numeraire and ϵ is the exchange rate between the two numeraires. In equilibrium, $w_i = 1$ in both countries under our assumption that the nontraded good is always produced in both countries. Yet, if we perturb the equilibrium by moving some firms from one country to the other, i.e., by changing λ_i, then w_i will change as well. Then, the relationship between w_i and λ_i can be used to study the stability of the symmetric equilibrium. If this relationship is negative, it means that an expansion of the manufacturing sector requires firms to pay a wage below the wage paid by the nontraded sector. That is, firms are losing profitability and hence the equilibrium is stable. Conversely, a positive relationship between w_i and λ_i implies that agglomeration (an increase in λ_i) allows firms to pay higher wages and hence attract workers from the nontraded sector. In this case, firm profitability increases with the size of the manufacturing sector and hence the equilibrium is unstable.

Formally, Eq. (13) implies that the manufacturing wage bill is a constant share of revenue, i.e., $w_i\lambda_i = (1-\mu)n_ip_i$. This allows us to express the mass of manufacturing firms and manufacturing revenue in terms of manufacturing wages and employment:

$$n_i = \frac{w_i\lambda_i}{p_i(1-\mu)} \Rightarrow \frac{n_hp_h}{n_fp_f} = \frac{w_h\lambda_h}{w_f\lambda_f}. \tag{24}$$

Next, recall that total expenditure on manufacturing goods equals $E_i = 1 + \mu n_ip_i$, which can we rewritten using Eq. (24) as

$$E_i = 1 + \frac{\mu}{1-\mu}w_i\lambda_i. \tag{25}$$

The remaining equilibrium conditions needed to track the relationship between w_i and λ_i are, first, the expression for the price index:

$$P_h^{1-\sigma}(1-\mu) = \lambda_h w_h^{1-\sigma(1-\mu)}P_h^{-\sigma\mu} + \phi\epsilon^{1-\sigma}\lambda_f w_f^{1-\sigma(1-\mu)}P_f^{-\sigma\mu}, \tag{26}$$

in which n_i and p_i have been substituted out; and, second, the market clearing condition for a firm:

$$1 = q_h = \left(w_h^{1-\mu}P_h^{\mu}\right)^{-\sigma}\left[P_h^{\sigma-1}E_h + \phi\epsilon^{\sigma}P_f^{\sigma-1}E_f\right]. \tag{27}$$

Given ϵ and λ_i, these equations can be solved for P_i, E_i and w_h.

We are now in the position to study the stability property of the equilibrium. As a preliminary step, we verify that when $T_h = 0$

Table 7
Robustness, intensive margin and variable markups.

	$\alpha = 0.31$				$\alpha = 0.12$			
	$\sigma = 5$		$\sigma = 3$		$\sigma = 5$		$\sigma = 3$	
	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$	$\tau = 1.7$	$\tau = 2.7$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T_R	0.863	0.777	0.848	0.681	0.788	0.675	0 .725	0.487
$\Delta\%\epsilon$	1.48	11.13	1.17	2.24	1.45	15 .72	0.45	0.71
$\Delta\%n_h$	3.15	3.33	3.10	3.46	8.16	8.72	8 .28	9.57
$\Delta\%n_f$	−0.76	−0.67	−0.77	−0.76	−1.41	−1.18	−1.29	−1.18
$\Delta\%q_h$	1.67	1.74	1.97	2.09	3.17	3.29	3 .85	4.03
X_h/Y_hl_h	9.94	3.01	17.88	10.34	6.35	2.45	11.41	7.15

Note: $\xi = 1$ and $\varsigma = 1$; all other parameters as in Table 5.

and ϵ adjusts endogenously, as in the previous section, the (unique) equilibrium is always stable. To show this, note that Home expenditure on traded goods is equal to domestic sales plus imports:

$$E_h = n_h p_h d_h + \epsilon n_f p_f x_f \tau.$$

Since trade is balanced, the volume of import is equal to the volume of export: $\epsilon n_f p_f x_f = n_h p_h x_h$. Hence,

$$E_h = n_h p_h d_h + n_h p_h x_h \tau.$$

But this is equal to the revenue of the traded sector in Home (domestic sales plus export): $E_h = n_h p_h$. Then, using Eq. (24), we get:

$$\frac{w_h \lambda_h}{w_f \lambda_f} = \frac{E_h}{E_f}.$$

Finally, substituting Eq. (25) yields $w_h = w_f \lambda_f / \lambda_h$. If Foreign is in equilibrium, $w_f = 1$, then the relationship between λ_h and w_h is negative. Hence:

Proposition 4. *Assume that $\sigma(1-\mu) > 1$ and $N = L_h = L_f = 1$. Then, under $T_h = 0$, the unique symmetric equilibrium is stable:*

$$\frac{dw_h}{d\lambda_h} < 0.$$

Starting at the symmetric equilibrium, in which $w_h = w_f = 1$, a reallocation of manufacturing workers from Foreign to Home reduces the Home manufacturing wage below the wage paid by the nontraded sector, thereby implying that the symmetric equilibrium is globally stable. Thus, unlike in the standard new economic geography literature in our model agglomeration is impossible when T_h is fixed. The intuition for this result is simple: independent of how strong agglomeration forces are, any incipient competitive advantage induced by the operation of agglomeration forces is offset by an appreciation of the exchange rate.

Suppose now that the exchange rate is fixed at $\epsilon = 1$, i.e., at the symmetric equilibrium, and that the trade surplus T_h adjusts according to Eq. (18). In this case, we obtain a system of equations almost identical to that studied in Krugman and Venables (1995).[22] As in that paper, by linearizing the system of equations in the symmetric equilibrium we can obtain an analytical expression for $dw_h/d\lambda_h$. This yields the following Proposition (proof in the Appendix):

Proposition 5. *Assume that $\sigma(1-\mu) > 1$ and $N = L_h = L_f = 1$. Assume also that $\epsilon = 1$. Then, in a neighborhood of $T_i = 0$,*

$$\frac{dw_h}{d\lambda_h} > 0 \quad \textit{iff} \quad \tau^{\sigma-1} < \frac{(1+\mu)(\sigma+\sigma\mu-1)}{(1-\mu)(\sigma-\sigma\mu-1)}.$$

The condition in Proposition 5, which is identical to the one found in Krugman and Venables (1995), shows that the symmetric equilibrium can become unstable if μ is high and σ and τ low. When the symmetric equilibrium becomes unstable, manufacturing firms start to agglomerate in one country and that country runs a trade surplus. Interestingly, the condition in Proposition 5 is the same as the condition needed for the transfer to trigger an appreciation in Home, an outcome that is not unlikely in our previous simulations.[23]

Our analysis suggests a possible reinterpretation of some results in the new economic geography literature. According to the latter, agglomeration is triggered by a change in the structural parameters, such as a reduction in trade costs or an increase in the importance of intermediate goods in manufacturing production. Yet, as we have shown, agglomeration is impossible under balanced trade whenever wages adjust. Our model suggests instead that trade imbalances might be the key: if agglomeration forces are strong enough, a country can become the "world factory" if able and willing to make a large transfer to its trading partners.

6. Conclusion

In this paper we have studied the welfare effects of trade imbalances, treated as an income transfer, in the Dixit-Stiglitz-Krugman model of monopolistic competition. This model is the workhorse of trade economists, and most recent developments in trade theory build on it. It is therefore surprising that trade imbalances have received little attention in this setup. The main goal of this paper was to fill this gap, and in doing so we found new results that stand in sharp contrast with the conventional wisdom.

We have shown that trade imbalances have a large impact on the international location of manufacturing firms. A transfer increases the demand for nontraded goods for the recipient and lowers it for the donor. Hence, manufacturing firms move from the deficit to the surplus country. In the presence of trade costs, the relocation of production reduces the price index for the donor and raises it for the recipient. This price index effect is beneficial for consumers in the surplus country and, in the presence of intermediate goods, it also increases the competitiveness of manufacturing firms. If wages do not adjust, this mechanism generates a force towards agglomeration of manufacturing in the surplus country.

Realistic calibrations suggest that the price index effect can lower significantly the cost of the transfer. The exact magnitude of the effect depends crucially on parameters that are difficult to measure empirically, like the elasticity of substitution between varieties and trade costs. In all the cases, however, we find that a surplus is associated with a sharp increase in the size of the manufacturing sector.

Although derived in a relatively stylized model, these results can help explain several puzzling observations. For instance, the price-index effect can help rationalize why policy makers are often so worried about the decline in manufacturing employment. Our model is also consistent with the observation that developing countries experiencing a productivity take-off in their tradable sectors tend to accumulate foreign assets, i.e., the so called "allocation puzzle" (Gourinchas and Jeanne, 2013). However, it would point to causality running from foreign asset accumulation to productivity growth.[24] A careful empirical investigation of these mechanisms is still missing and seems an important challenge for future research in international finance and trade.

[22] The only marginal difference is quasi-linear instead of Cobb-Douglas utility.

[23] This is not by accident. When ϵ is exogenous, agglomeration forces make the symmetric equilibrium unstable, as in Krugman and Venables (1995). When T is exogenous, instead, the symmetric equilibrium is always stable, and agglomeration forces show up in an appreciation of the exchange rate.

[24] Benigno and Fornaro (2012) put forward a similar hypothesis assuming a knowledge externality in the tradeable sector. Also, Rodrik (2008) finds that real exchange rate depreciations stimulate growth in developing countries and that this effect is increasing in the size of the tradeable sector. Our model provides a microfoundation for these effects.

Appendix A

A.1. Proof of Proposition 3

Note first that, when $N = L_h = L_f = 1$, the model in Section 3 boils down to the following equations:

$$E_i = 1 + \mu P_i^{\mu} n_i, \tag{28}$$

$$P_h^{\sigma-1} = \frac{P_h^{\mu\sigma} - \phi\epsilon^{\sigma} P_f^{\mu\sigma}}{E_h\left(1-\phi^2\right)}, \quad P_f^{\sigma-1} = \frac{P_f^{\mu\sigma} - \phi\epsilon^{-\sigma} P_h^{\mu\sigma}}{E_f\left(1-\phi^2\right)}, \tag{29}$$

$$n_h = P_h^{\mu(\sigma-1)}\left(\frac{E_h}{P_h^{\mu\sigma} - \phi\epsilon^{\sigma} P_f^{\mu\sigma}} - \frac{E_f\phi\epsilon}{\epsilon^{\sigma} P_f^{\mu\sigma} - \phi P_h^{\mu\sigma}}\right), \tag{30}$$

$$n_f = P_f^{\mu(\sigma-1)}\left(\frac{E_f}{P_f^{\mu\sigma} - \phi\epsilon^{-\sigma} P_h^{\mu\sigma}} - \frac{\phi\epsilon^{-1} E_h}{\epsilon^{-\sigma} P_h^{\mu\sigma} - \phi P_f^{\mu\sigma}}\right), \tag{31}$$

$$T_h = \phi\left(\frac{P_f^{\mu\sigma}\epsilon^{\sigma} E_h}{P_h^{\mu\sigma} - \phi\epsilon^{\sigma} P_f^{\mu\sigma}} - \frac{P_h^{\mu\sigma}\epsilon E_f}{\epsilon^{\sigma} P_f^{\mu\sigma} - \phi P_h^{\mu\sigma}}\right). \tag{32}$$

To study the comparative-statics effects of a small transfer and prove the results in Proposition 3, we linearize the above system in the neighborhood of the symmetric balanced-trade point, i.e., we totally differentiate (28)–(32) with respect to T_h in $T_h = 0$. We define $\hat{y} \equiv y'/y$, where $y' \equiv dy/dT_h|_{T_h=0}$ is the total derivative of a variable in $T_h = 0$. Moreover, we exploit country symmetry, which implies that $\hat{y}_f = -\hat{y}_h$.

In the symmetric balanced-trade equilibrium: $\epsilon = 1$, $n_h = n_f = n$, $E_h = E_f = E$ and $P_h = P_f = P$. Using these in Eqs. (28)–(30) we obtain:

$$n = EP^{-\mu}, \quad E = \frac{1}{1-\mu}, \quad P^{\sigma(1-\mu)-1} = \frac{1-\mu}{1+\phi}. \tag{33}$$

Totally differentiating Eq. (28) and using Eq. (33) yields:

$$\hat{E}_h = \mu^2\hat{P}_h + \mu\hat{n}_h. \tag{34}$$

Totally differentiating Eq. (29), using Eq. (33) and $\hat{P}_f = -\hat{P}_h$, yields:

$$(\sigma-1)\hat{P}_h = \frac{\mu\sigma\hat{P}_h - \phi\left(\sigma\hat{\epsilon} + \mu\sigma\hat{P}_f\right)}{1-\phi} - \hat{E}_h$$
$$\Rightarrow \hat{P}_h = -\frac{\phi\sigma\hat{\epsilon} + (1-\phi)\hat{E}_h}{(\sigma-1)(1-\phi) - \mu\sigma(1+\phi)}. \tag{35}$$

Similarly, totally differentiating Eq. (30), using Eq. (33) and exploiting country symmetry yields:

$$\hat{n}_h = \frac{1+\phi}{1-\phi}\hat{E}_h + \frac{\phi}{1-\phi}\left(\frac{2\sigma}{1-\phi} - 1\right)\hat{\epsilon} - \mu\left[\frac{4\phi\sigma}{(1-\phi)^2} + 1\right]\hat{P}_h. \tag{36}$$

Finally, totally differentiating Eq. (32), using Eq. (33) and again exploiting symmetry yields:

$$\left(\frac{2\sigma}{1-\phi} - 1\right)\hat{\epsilon} = \frac{(1-\phi)(1-\mu)}{\phi} + \frac{4\mu\sigma}{1-\phi}\hat{P}_h - 2\hat{E}_h. \tag{37}$$

Next, using Eq. (36) to eliminate $\hat{n}_h$ from Eq. (34) yields:

$$\hat{E}_h = \mu^2\hat{P}_h + \frac{1+\phi}{1-\phi}\mu\hat{E}_h + \frac{\phi}{1-\phi}\mu\left(\frac{2\sigma}{1-\phi} - 1\right)\hat{\epsilon} - \mu^2\left[\frac{4\phi\sigma}{(1-\phi)^2} + 1\right]\hat{P}_h$$
$$\Rightarrow \hat{E}_h = \frac{\phi\mu(2\sigma - 1 + \phi)\hat{\epsilon} - 4\phi\sigma\mu^2\hat{P}_h}{(1-\phi)[1-\phi-\mu(1+\phi)]}. \tag{38}$$

Using Eq. (38) to eliminate $\hat{E}_h$ from Eqs. (37) and (35) yields:

$$\widehat{\epsilon} = \frac{1-\phi}{\phi}\frac{1-\phi-\mu(1+\phi)}{2\sigma-1+\phi} + \frac{4\sigma\mu}{2\sigma-1+\phi}\hat{P}_h,$$
$$\hat{P}_h = -\frac{\mu(1-\phi)+\sigma\phi\widehat{\epsilon}}{(\sigma-1)(1-\phi)-\mu\sigma(1+\phi)}.$$

Solving for $\hat{P}_h$ and $\widehat{\epsilon}$ we finally obtain:

$$\hat{P}_h = -\frac{(1-\phi)[\sigma+\mu(\sigma-1)]}{2\sigma[\sigma(1-\mu)-1]+\mu\sigma(1+\phi)-(\sigma-1)(1-\phi)}, \tag{39}$$

$$\widehat{\epsilon} = \frac{(1-\phi)^2[\phi(1+\mu)(\sigma+\mu\sigma-1)-(1-\mu)(\sigma-\mu\sigma-1)]}{\phi\{(2\sigma-1+\phi)[(\sigma-1)(1-\phi)-\mu\sigma(1+\phi)]+4\phi\sigma^2\mu\}}. \tag{40}$$

Note that $\hat{P}_h < 0$ for $\sigma(1-\mu) > 1 \Longleftrightarrow \mu < \frac{\sigma-1}{\sigma}$. Note also that $\widehat{\epsilon} = \frac{1-\phi}{\phi}\frac{1-\phi}{2\sigma-1+\phi} > 0$ for $\mu = 0$ and $\lim_{\mu\to\frac{\sigma-1}{\sigma}}\widehat{\epsilon} = -\frac{1-\phi}{\phi}\frac{2\sigma-1}{\sigma} < 0$. Hence the sign of $\widehat{\epsilon}$ switches from positive to negative in the relevant range of μ. In particular, recalling that $\phi = \tau^{1-\sigma}$, we have that

$$\widehat{\epsilon} < 0 \text{ iff } \mu > \frac{(2\sigma-1)(1+\phi)-\sqrt{(1+\phi)^2+16\sigma\phi(\sigma-1)}}{2\sigma(1-\phi)} \Longleftrightarrow \tau^{\sigma-1} < \frac{(1+\mu)(\sigma+\sigma\mu-1)}{(1-\mu)(\sigma-\sigma\mu-1)}. \tag{41}$$

A.2. Proof of Proposition 5

To prove the results in Proposition 5, we totally differentiate Eqs. (25)–(27) with respect to T_h in $T_h = 0$ under the assumption that the exchange rate is exogenously fixed at $\epsilon = 1$. Moreover, as in the previous Appendix, we define $\hat{y} \equiv y'/y$, where $y' \equiv dy/dT_h|_{T_h=0}$ is the total derivative of a variable in $T_h = 0$, and we exploit country symmetry, which implies that $\hat{y}_f = -\hat{y}_h$.

Recall that in the symmetric balanced-trade equilibrium:

$$\lambda_h = \lambda_f = w_h = w_f = 1,\ E_h = E_f = \frac{1}{1-\mu}. \tag{42}$$

Thus, totally differentiating Eq. (25) and using Eq. (42) yields:

$$\hat{E}_h = \mu(\widehat{w}_h + 1). \tag{43}$$

Totally differentiating Eq. (26) and using Eq. (42) yields:

$$(1-\sigma)\hat{P}_h = \frac{1-\phi}{1+\phi}\left(1+[1-\sigma(1-\mu)]\widehat{w}_h - \sigma\mu\hat{P}_h\right)$$
$$\Rightarrow \hat{P}_h = \frac{(1-\phi)[\sigma(1-\mu)-1]\widehat{w}_h-(1-\phi)}{(\sigma-1)(1+\phi)-(1-\phi)\sigma\mu}. \tag{44}$$

Totally differentiating Eq. (27) and using Eq. (42) yields:

$$(1-\mu)\sigma\widehat{w}_h + \mu\sigma\hat{P}_h = \frac{1-\phi}{1+\phi}\left[(\sigma-1)\hat{P}_h + \hat{E}_h\right]$$
$$\Rightarrow \widehat{w}_h = \frac{[(1-\phi)(\sigma-1)-\mu\sigma(1+\phi)]\hat{P}_h+(1-\phi)\hat{E}_h}{(1-\mu)(1+\phi)\sigma}.$$

Using Eqs. (43) and (44) to eliminate $\hat{E}_h$ and $\hat{P}_h$ from $\widehat{w}_h$ finally yields:

$$\widehat{w}_h = -\frac{\phi(1+\mu)(\sigma+\mu\sigma-1)-(1-\mu)(\sigma-\mu\sigma-1)}{(1-\phi)\left\{\left[\sigma(1-\mu)\frac{1+\phi}{1-\phi}-\mu\right]\left[(\sigma-1)\frac{1+\phi}{1-\phi}-\mu\sigma\right]-[\sigma(1-\mu)-1]\left(\sigma-1-\mu\sigma\frac{1+\phi}{1-\phi}\right)\right\}}.$$

Note that the denominator of $\widehat{w}_h$ is greater than zero for $\sigma(1-\mu) > 1$. Moreover, the numerator of $\widehat{w}_h$ is identical to the expression in square brackets on the numerator of $\widehat{\epsilon}$ in Eq. (40), which implies that $\widehat{w}_h > 0$ whenever Eq. (41) holds, i.e., $\tau^{\sigma-1} < \frac{(1+\mu)(\sigma+\sigma\mu-1)}{(1-\mu)(\sigma-\sigma\mu-1)}$.

References

Anderson, J.E., van Wincoop, E., 2004. Trade costs. J. Econ. Lit. 42, 691–751.

Autor, D., David, D., Gordon, H., Pisano, G., Shu, P., 2016. Foreign Competition and Domestic Innovation: Evidence from U.S. Patents. NBER WP22879.

Bagwell, K., Staiger, R., 2015. Delocation and trade agreements in imperfectly competitive markets. Res. Econ. 69 (2), 132–156.

Benigno, G., Fornaro, L., 2012. Reserve accumulation, growth and financial crises. Working Paper.

Bergin, P.R., Corsetti, G., 2015. Beyond competitive devaluations: the monetary dimension of comparative advantage. Working Paper.

Bhagwati, J.N., Brecher, R.A., Hatta, T., 1983. The generalized theory of transfers and welfare: bilateral transfers in a multilateral world. Am. Econ. Rev. 73 (4), 606–618.

Buera, F.J., Kaboski, J.P., 2012. Scale and the origins of structural change. J. Econ. Theory 147 (2), 684–712.

Campolmi, A., Fadinger, H., Forlati, C., 2013. Trade policy: home market effect versus terms-of-trade externality. J. Int. Econ. 93 (1), 92–107.

Corsetti, G., Dedola, L., Leduc, S., 2008. International risk sharing and the transmission of productivity shocks. Rev. Econ. Stud. 75, 443–473.

Corsetti, G., Dedola, L., Viani, F., 2012. Traded and nontraded goods prices, and international risk sharing: an empirical investigation. NBER International Seminar on Macroeconomics, vol. 8(1). University of Chicago Press., pp. 403–466.

Corsetti, G., Martin, P., Pesenti, P., 2007. Productivity, terms of trade and the 'home market effect'. J. Int. Econ. 73 (1), 99–127.

Corsetti, G., Martin, P., Pesenti, P., 2013. Varieties and the transfer problem. J. Int. Econ. 89, 1–12.

Crinò, R., Epifani, P., 2014. Trade imbalances, export structure and wage inequality. Econ. J. 124, 507–539.

Davis, D.R., 1998. The home market, trade, and industrial structure. Am. Econ. Rev. 88 (5), 1264–1276.

Dixit, A., Stiglitz, J., 1977. Monopolistic competition and optimum product diversity. Am. Econ. Rev. 67 (3), 297–308.

Dekle, R., Eaton, J., Kortum, S., 2007. Unbalanced trade. Am. Econ. Rev. P&P 97 (2), 351–355.

Dekle, R., Eaton, J., Kortum, S., 2008. Global rebalancing with gravity: measuring the burden of adjustment. IMF Staff. Pap. 55 (3), 511–540.

Dornbusch, R., Fischer, S., Samuelson, P., 1977. Comparative advantage, trade and payments in a Ricardian model with a continuum of goods. Am. Econ. Rev. 67 (5), 823–839.

Ethier, W., 1982. National and international returns to scale in the modern theory of international trade. Am. Econ. Rev. 72, 389–405.

Fujita, M., Krugman, P., Venables, A., 1999. The Spatial Economy. MIT Press.

Gali, J., Gertler, M., López-Salido, D., 2007. Markups, gaps, and the welfare costs of economic fluctuations. Rev. Econ. Stat. 89 (1), 44–59.

Ghironi, F., Melitz, M., 2005. International trade and macroeconomic dynamics with heterogeneous firms. Q. J. Econ. 120, 865–915.

Gourinchas, P.-O., Jeanne, O., 2013. Capital flows to developing countries: the allocation puzzle. Rev. Econ. Stud. 80, 1484–1515.

Greenstone, M., Hornbeck, R., Moretti, E., 2010. Identifying agglomeration spillovers: evidence from winners and losers of large plant openings. J. Polit. Econ. 118 (3), 536–598.

Helpman, E., 1998. The size of regions. In: Pines, D., Sadka, E., Zilcha (Eds.), I., Topics in Public Economics. Theoretical and Applied Analysis. Cambridge University Press, pp. 33–54.

Helpman, E., Krugman, P., 1985. Market Structure and Foreign Trade. MIT Press.

Hummels, D., Klenow, P., 2005. The variety and quality of a nation's exports. Am. Econ. Rev. 95 (3), 704–723.

Krugman, P., 1979. Increasing returns, monopolistic competition, and international trade. J. Int. Econ. 9 (4), 469–479.

Krugman, P., 1980. Scale economies, product differentiation and the pattern of trade. Am. Econ. Rev. 70 (5), 950–959.

Krugman, P., Venables, A., 1995. Globalization and the inequality of nations. Q. J. Econ. 110, 857–880.

Melitz, M.J., Redding, S.J., 2014. Heterogeneous firms and trade. Handbook of International Economics. pp. 1–54.

Melitz, M., Redding, S., 2015. New trade models, new welfare implications. Am. Econ. Rev. 105 (3), 1105–1146.

Obstfeld, M., Rogoff, K., 1995. The intertemporal approach to the current account. Handbook of International Economics. pp. 1731–1799.

Obstfeld, M., Rogoff, K., 2000. The six major puzzles in international macroeconomics: Is there a common cause? In: Bernanke, B.S., Kenneth (Eds.), R., NBER Macroeconomics Annual. vol. 15. pp. 339–412.

Obstfeld, M., Rogoff, K., 2007. The unsustainable U.S. current account position revisited. In: Clarida (Ed.), R., G7 Current Account Imbalances: sustainability and Adjustment. University of Chicago Press, Chicago IL, pp. 339–376.

Ossa, R., 2011. A 'new trade' theory of GATT/WTO negotiations. J. Polit. Econ. 119, 122–152.

Ossa, R., 2012. Profits in the 'New Trade' approach to trade negotiations. Am. Econ. Rev. Pap. Proc. 102 (3), 466–469.

Rodrik, D., 2008. The real exchange rate and economic growth. Brook. Pap. Econ. Act. 365–412.

Rodrik, D., 2016. Premature deindustrialization. J. Econ. Growth 21 (1), 1–33.

Samuelson, P., 1954. The transfer problem and transport costs: analysis of effects of trade impediments. Econ. J. 64, 264–289.

Song, Z., Storesletten, K., Zilibotti, F., 2011. Growing like China. Am. Econ. Rev. 101 (1), 196–233.

Venables, A., 1987. Trade and trade policy with differentiated products: a Chamberlinian-Ricardian model. Econ. J. 97, 700–717.

Yamano, N., Ahmad, N., 2006. The OECD input-output database, 2006 edition. OECD STI Working Paper 2006/8.