SAME SAME BUT DIFFERENT: THE ELASTICITIES APPROACH WITH UNBALANCED TRADE

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Same same but different: The elasticities approach with unbalanced trade*

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Abstract

We derive expressions to calculate the effect of an exchange rate depreciation on net exports when trade is unbalanced and there is incomplete pass-through. The conditions for an improvement differ, depending on whether the initial imbalance is denominated in domestic or foreign currency. Applying these conditions to a large set of countries, we find that irrespective of how the initial imbalance is denominated, the predicted sign of the effect of depreciation is the same for most countries, but not for all. We also show analytically that the predicted impact of a 1% currency depreciation on the trade balance measured in local currency will differ from its analogue measured in foreign currency (converted into local currency) by the magnitude of the initial trade imbalance.

Keywords: Exchange rate, trade balance, Marshall-Lerner condition

JEL classification: F40

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1. Introduction

Persistent trade deficits appear to be the norm for many developing countries, with central banks called upon to remedy them by means of currency depreciation.[1] The elasticities approach has been widely used to predict the effects of such depreciation. The standard elasticities approach is captured by the Marshall-Lerner condition (hereafter *ML*) which states that the trade balance will improve if and only if the absolute sum of elasticities of demand for imports and exports exceeds unity. This approach, however, assumes that the initial trade balance is zero; an assumption that appears anomalous in the presence of persistent trade deficits.

The standard approach makes the additional assumptions that the economy is in partial equilibrium, in which there is no interaction between the trade balance and national income and that the supplies of both imports and exports are infinitely elastic at prevailing supply prices. The latter in turn means that the pass through from exchange rates to purchase prices is complete. Quite a lot of attention has been paid to both assumptions, in methodological debates as well as empirical literature, but with some exceptions that we discuss below, the assumption of balanced trade has not received the same level of attention.

Most of the methodological debates around standard *ML* took place during the first half of the 20th century. Bickerdike (1920), Robinson (1937) and Metzler (1948) incorporated finite price elasticities in the supply of exports and imports. Their contributions led to the Bickerdike-Robinson-Metzler (*BRM*) condition, also sometimes referred to as the generalised *ML* condition (see, e.g Rose (1991)). The general equilibrium relationship between the trade balance and national income and expenditure was dealt with in Alexander (1952), giving rise to what is known as the incomes/absorption approach to the balance of payments.

Finally, modifying *ML* to accommodate a non-zero trade balance was addressed by both Robinson (1937) and Hirschman (1949). Robinson (1937) derived the *ML* condition for a non-zero trade balance expressed in domestic currency. Hirschman (1949) extended this by deriving an analogous condition when the trade balance is expressed in foreign currency. He thereby showed that the two conditions were not the same and derived conditions under which the foreign and domestic currency versions of the trade balance could move in opposite directions from each other following devaluation.

While the first two of these three early 20th century extensions of the *ML* condition have been kept alive over the years by successive generations of authors, the third has been

[1] World Bank data on Exports and Imports of Goods and Services show that since 1990, most non-oil and -mineral exporting developing countries have run persistent trade deficits. Over the period 1990-2016, South Asian and sub-Saharan countries in particular have almost unbroken runs of such deficits, at times amounting to 70-90 percent of their total trade.

largely neglected. Bahmani, Harvey and Hegerty (2013) provide a recent survey of the large empirical literature that has tested the *ML* condition under various modifications. While the main focus of the survey is on estimation technique rather than model specification, Table 1, Column 6 of their paper lists additional controls, if any, that have been used in each study. While the list includes many examples of papers which control for either income or supply price effects or both, none appear to have controlled for trade imbalance. Turning to even more recent literature, a keyword search for Marshall-Lerner condition and elasticities approach on *EconLit* returned 28 papers published since 2013. Some of these were in languages other than English, and of the remaining papers, we were able to download 13. Of these, only Buzaushina (2015) considered the issue of unbalanced trade, but without addressing the full methodological and empirical implications of such a starting point.[2]

More recently, Bussière, Gaulier and Steingress (2017) and Leigh et al. (2015) have modified *ML*, using a formulation that incorporates supply-side pricing effects without requiring the estimation of supply-side price elasticities. Both sets of authors, however, restrict their version of *ML* to the benchmark of zero trade balance. Bussière, Gaulier and Steingress (2017) do go on to allow for an initial trade imbalance in deriving an expression that they then use to predict quantitative effects, as opposed to the signs of these effects, arising from currency depreciation but they do so only for the domestic currency variant of *ML*.

In this paper, we aim to reintroduce the insight of Hirschman (1949) into the literature, by extending it theoretically and establishing its empirical relevance. We use the approach taken by Bussière, Gaulier and Steingress (2017) as a starting point from which we modify *ML* for both incomplete pass through and an arbitrary trade balance. Following Hirschman (1949), we derive not one but two *ML* conditions which depend on whether the expression for the initial balance is in domestic or foreign currency units. We label the domestic currency version as Robinson-*ML* and the foreign currency version as Hirschman-*ML*, in acknowledgment of their respective methodological contributions. The two conditions coincide only when the initial trade balance is zero. When it is non-zero, the possibility arises that an exchange rate depreciation will improve the trade balance in one currency while deteriorating it in the other currency. Even if this qualitative reversal does not occur, the predicted change in the trade balance will vary between the domestic currency formulation and its foreign currency counterpart by an amount which equals the magnitude of the initial imbalance.

This paper is motivated not just by the fact that Hirschman (1949) appears to have been lost to the modern literature, but because it has an empirical relevance now that might

[2]There is another strand of the literature that relates exchange rate to trade balance by regressing trade balance on exchange rate and home and foreign incomes (see e.g., Rose (1991). Inference about the impact of exchange rate depreciation on trade balance requires no assumption about trade balance and is made on the basis of the sign and statistical significance of the coefficient of the exchange rate.

not have been as compelling when it first appeared. Hirschman himself was motivated by methodological considerations. Apart from a few empirical conjectures, he restricted himself to theoretical analysis.[3] The modern literature is far more concerned with empirical relevance, especially when the subject has direct relevance to policymakers, as is the case with exchange rate policy. We therefore go further than Hirschman (1949) in investigating the empirical implications of his methodological insight .

Focusing on the conditions under which a sign reversal is possible between the two different expressions for the trade balance, we show that these conditions depend on a combination of three variables: the size of the initial imbalance as expressed by the ratio of imports to exports, and the elasticities of imports and exports, which in our case represent reduced forms that combine both demand and supply side effects. By placing empirically plausible upper and lower bounds on the import:export ratio, based on observed data, we show that the combination of import and export elasticities that could generate a sign reversal need to belong to such a narrow range of values that sign reversals are unlikely to occur in practice. We go on to derive an expression for the difference in the *quantitative* effects that devaluation might have on both versions of the trade balance, as distinct from its qualitative effects.

To empirically evaluate these conjectures, we use the elasticity estimates of Bussière, Gaulier and Steingress (2017) for 51 countries and of Leigh et al. (2015) for 39 countries, along with trade data from the IMF. We find that as expected, sign reversals are quite rare, although they do happen.

We outline our derivation in section 2 and apply the findings to elasticity estimates in Section 3. Section 4 concludes.

2. The Adjusted Marshall-Lerner Condition:

The trade balance in domestic currency:

$$B = P^X X(\tilde{P}^X) - e\tilde{P}^M M(P^M)$$

where B is the trade balance in domestic currency; e is the exchange rate (units of domestic currency per unit foreign currency); P^X is the domestic price of exports and $\tilde{P}^X = P^X/e$ its foreign currency equivalent, $\tilde{P}^M$ is the foreign price of imports and $P^M = e\tilde{P}^M$ its domestic currency equivalent, X and M are export and import functions depending respectively on

[3] The lack of empirical evidence for evaluating debates around the elasticities approach was noted by Metzler (1948): “Almost no information is available concerning supply elasticities, and estimates of demand elasticities are available only for a few countries” (pg.227).

the foreign price of exports and the domestic currency price of imports.[4] With suitable manipulation it can be shown that

$$\frac{\partial B}{\partial e} = [\delta^X(1-\eta^X)+\eta^X]\frac{V^X}{e} + [\{\tilde{\delta}^M(1-\eta^M)+\eta^M\}-1]\frac{V^M}{e} \tag{1}$$

where

$$\begin{aligned} \delta^X &= \frac{\partial P^X}{\partial e}\frac{e}{P^X} \in [0,1] \qquad & \tilde{\delta}^M &= -\frac{\partial \tilde{P}^M}{\partial e}\frac{e}{\tilde{P}^M} \in [0,1]; \\ \eta^X &= -\left[\frac{\partial X}{\partial \tilde{P}^X}\right]\left[\frac{\tilde{P}^X}{X}\right] > 0; \qquad & \eta^M &= -\left[\frac{\partial M}{\partial P^M}\right]\left[\frac{P^M}{M}\right] > 0; \\ V^X &= P^X X; \qquad & V^M &= e\tilde{P}^M M \end{aligned}$$

which can be simplified to

$$\frac{\partial B}{\partial e} \geq 0 \ \ \textit{iff} \ \ [\delta^X(1-\eta^X)+\eta^X]\frac{V^X}{V^M} + [\{\tilde{\delta}^M(1-\eta^M)+\eta^M\}-1] \geq 0. \tag{2}$$

Next define the trade balance in foreign currency:

$$\tilde{B} = \frac{P^X}{e}X(\tilde{P}^X) - \tilde{P}^M M(P^M)$$

Again, with suitable manipulation it can be shown that

$$\frac{\partial \tilde{B}}{\partial e} = [\{\delta^X(1-\eta^X)+\eta^X\}-1]\frac{\tilde{V}^X}{e} + [\tilde{\delta}^M(1-\eta^M)+\eta^M]\frac{\tilde{V}^M}{e} \tag{3}$$

which also simplifies to

$$\frac{\partial \tilde{B}}{\partial e} \geq 0 \ \ \textit{iff} \ \ [\{\delta^X(1-\eta^X)\}+\eta^X-1] + [\tilde{\delta}^M(1-\eta^M)+\eta^M]\frac{\tilde{V}^M}{\tilde{V}^X} \geq 0 \tag{4}$$

where $\tilde{V}^i$, $i = \{X, M\}$ represents the foreign currency value of exports and imports respectively.

Equation (4) will differ from equation (2), except when trade is balanced. This is because of different *impact* effects, by which we mean the change in the trade balance that would occur if there were no changes in either trade prices or trade volumes. In that case the only effects would be that the local currency cost of imports would increase, deteriorating B,

[4] Other macroeconomic variables, such as national income, that might affect the trade balance are omitted in the elasticities approach, so given our focus on the *ML* condition which is associated mainly with the latter approach we shall treat such variables as exogenous.

while the foreign currency revenue from exports would decrease, deteriorating $\tilde{B}$. It is the subsequent change in trade volumes that can help ameliorate these impact effects but these in turn will be attenuated by possible increases in the local currency price of exports and decrease in foreign currency price of imports.

With balanced trade, the conditions for an improvement in the trade balance would become identical, resulting in the standard *ML* formula, albeit adjusted for supply-side effects.[5] The above formulas also incorporate supply-side effects and extend the ones proposed by Robinson (1937) and Hirschman (1949). We shall therefore refer to the formulas of equations (2) and (4) as the Robinson-modified and the Hirschman-modified *ML* respectively.

Letting $\theta^X \equiv [\delta^X(1-\eta^X)+\eta^X]$; $\theta^M \equiv [\tilde{\delta}^M(1-\eta^M)+\eta^M]$ and $\phi \equiv V^M/V^X$ the Robinson- and Hirschman- modifications can be respectively expressed as

$$\text{sign}\left[\frac{\partial B}{\partial e}\right] = \text{sign}\left[\frac{\theta^X}{\phi}+\theta^M-1\right] \tag{5}$$

$$\text{sign}\left[\frac{\partial \tilde{B}}{\partial e}\right] = \text{sign}\left[\theta^X+\theta^M\phi-1\right]. \tag{6}$$

Equations (5) and (6) nest the case in which supply-side price effects are ignored; in that case θ^X and θ^M are the simple elasticities of demand for exports and imports.

Fluctuations in the import:export ratio will affect the trade balance differently in each currency. This in itself has policy relevance, keeping in mind Hirschman's observation that policymakers who seek to improve the trade balance might be driven in certain situations by a need to boost foreign reserves and in others to stimulate aggregate demand. In either case, researchers have to be careful basing their *ML* estimates on only one arbitrarily chosen unit of account.

We now consider circumstances under which the modified *ML* estimates might yield contradictory predictions regarding the sign of the effect of currency depreciation. Given values of ϕ and θ^X, equations (5) and (6) imply

$$\frac{\partial B}{\partial e}\begin{Bmatrix}\geq\\<\end{Bmatrix}0 \quad \text{as} \quad \theta^M\begin{Bmatrix}\geq\\<\end{Bmatrix}1-\frac{\theta^X}{\phi}$$

$$\frac{\partial \tilde{B}}{\partial e}\begin{Bmatrix}\geq\\<\end{Bmatrix}0 \quad \text{as} \quad \theta^M\begin{Bmatrix}\geq\\<\end{Bmatrix}\frac{1-\theta^X}{\phi}$$

Defining three thresholds $\bar{\theta}^M \equiv 1-(\theta^X/\phi)$, $\tilde{\theta}^M \equiv (1-\theta^X)/\phi$ and $\hat{\theta}^M \equiv 1-\theta^X$, the following

[5] These price effects have been shown to be an important ingredient in contemporary New Keynesian models. See, *e.g*, Gali and Monacelli (2005) for a theoretical treatment; Bussière, Gaulier and Steingress (2017) and Leigh et al. (2015) present empirical relevance for these effects using a large set of countries.

possibilities arise.

For a trade deficit country $\phi > 1$ and $\bar{\theta}^M > \hat{\theta}^M > \tilde{\theta}^M$. If $\theta^M > \bar{\theta}^M$, then it is also greater than $\hat{\theta}^M$ and $\tilde{\theta}^M$. In words, if a trade deficit country satisfies the Robinson-modified *ML* condition, it then satisfies the Hirschman-modified *ML* as well as the standard *ML* condition. Conversely, a country with $\phi > 1$ and $\theta^M < \tilde{\theta}^M$ will be predicted to face a deterioration in its trade balance by all three versions of *ML*. For a trade surplus country, $\phi < 1$ and the three threshold values reverse in magnitude as do the predictions but what remains the case is that so long as θ^M lies outside a band bounded by $\bar{\theta}^M$ and $\theta^{\tilde{M}}$ each of the *ML* estimates will yield a consistent sign prediction.[6]

Sign reversals will arise if, given ϕ and θ^X, the value of θ^M lies within the above band. The width of this band is given by

$$\left|\bar{\theta}^M - \tilde{\theta}^M\right| = \left|\frac{\phi - 1}{\phi}\right|,$$

which for $\phi \geq 1$ is increasing in ϕ. While this means that countries with large trade deficits are more likely to face contradictory sign predictions between its domestic and foreign currency trade balance, in practical terms, a country with an import to export ratio of 1.5 (which is on the high side by empirical standards) will face a sign reversal if θ^M falls in an interval that is only 0.333 wide. If $\phi = 1.2$ (a more frequent value in the data), the interval would shrink to a width of only 0.17. Thus, sign reversals are likely to be an exception rather than a rule.[7]

Even so, policymakers will normally be interested in precise quantitative estimates and not just in qualitative sign effects. Indeed with quantitative prediction as a goal, it becomes clear very quickly that equations (2) or (4) are not appropriate as they only predict qualitative effects. A condition such as equation (1) or (3) or some equivalent thereof has to be applied, in which estimated elasticities are appropriately weighted by current values of exports and imports.[8] Independently of equations (1) and (3) it can be shown that the predicted change

[6] These predictions are based on the assumption that the underlying price and demand elasticities of imports and exports are such that θ^X and θ^M are both positive, as predicted by economic theory. In empirical estimation, it is not a rare occurrence to find an elasticity of demand that is negative for either exports or imports. In this case anomalous combinations can arise with respect to the three versions of *ML* discussed here: the unadjusted sum of elasticities can be negative while the weighted sums are positive in both currencies, or the other way around. In each case, the size of the initial trade imbalance can be a contributing factor to such a counter-intuitive outcome. This too is an important reason why neglecting the initial trade balance can lead to misleading predictions.

[7] Suppose $\theta^X = 0.7$: then given $\phi = 1.5$ a sign reversal will occur if and only if $\theta^M \in [0.2, 0.533]$, while with $\phi = 1.2$, this interval shrinks to $[0.25, 0.42]$.

[8] Thus, while reporting their own modification to the *ML* condition, Bussière, Gaulier and Steingress (2017) impose trade balance, but in predicting the quantitative effect of depreciation on the trade balance, they use a version of equation (1) which does not.

in the trade balance in one currency is not the same as the predicted change in its counterpart in the other currency after appropriate conversion into comparable currency units.

To see this, noting that $B = e\tilde{B}$, differentiating each side of this relationship with respect to a 1% change in the exchange rate and subtracting:

$$\frac{\partial B}{(\partial e/e)} - \frac{\partial \tilde{B}}{(\partial e/e)} e = B \tag{7}$$

The first term on the LHS of equation (7) expresses the change in the trade balance measured in domestic currency, following a one percent depreciation of the exchange rate. The second term expresses the equivalent relationship for the trade balance in foreign currency, converted into domestic currency. It follows from equation (7) that the predictions based on the former would differ from those based on the latter by the magnitude of the initial trade balance. We note that an analogous expression would be obtained if each term on the LHS of equation (7) were expressed in units of foreign currency.

Bussière, Gaulier and Steingress (2017) use their elasticity estimates to predict the ratio of the change in trade balance, expressed in domestic currency, to GDP (Y) for a number of countries. As equation (7) suggests, the corresponding expression for the change in the trade balance expressed in foreign currency will differ by an amount that equals the initial trade imbalance to GDP ratio.

3. Empirical Application

To illustrate the theoretical possibilities, we utilise elasticity estimates from Leigh et al. (2015) and Bussière, Gaulier and Steingress (2017).[9] The elasticities estimated by Leigh et al. (2015) capture the response of aggregate exports and imports to changes in the real effective exchange rate for a large group of emerging markets and developing economies. On the other hand, Bussière, Gaulier and Steingress (2017) exploit the bilateral variation of prices and quantities to exchange rates by using highly disaggregated trade flows, covering 5,000 products and approximately 160 trading partners. They show that the elasticities obtained in this manner, once appropriately compiled using trade weights, are directly comparable to the macro elasticities obtained by Leigh et al. (2015).

Table 1 looks at sign predictions based on the estimates of import and export elasticities by Leigh et al. (2015) for the year 2014. Table 2 repeats this exercise using the elasticity

[9] In their paper, Leigh et al. (2015) report elasticities at the aggregate level - 'All countries', 'Asia', 'Europe' etc. (See their Annex Table 3.5.1). Country specific elasticities are not reported in their paper but were graciously shared by the authors on request.

estimates reported in Bussière, Gaulier and Steingress (2017) and data from 2012.

In Table 1, based on estimates of 39 countries,[10] the sign predictions, whether or not a devaluation will improve the trade balance based on all three versions of the *ML* condition - standard *ML*, the Robinson-modified *ML* and the Hirschman-modified *ML* - are the same for all countries except three: India, Sri Lanka and Philippines. All three countries had negative trade balance in 2014. For India and Philippines the standard *ML* and Robinson-modified *ML* make the same predictions. i.e., exchange rate devaluation will worsen trade balance, but the Hirschman-modified *ML* predicts otherwise. For Sri Lanka, the standard *ML* and Hirschman-modified *ML* predict that devaluation will improve trade balance but the Robinson-modified *ML* makes a contrary prediction.

[10]These are the 39 countries for which all four elasticities (namely the elasticities of import and export prices with respect to exchange rate and elasticities of export and import volumes with respect to exchange rate) were available from the data shared on request by the authors of Leigh et al. (2015).

Table 1: Possible combinations of *ML* estimates

Country	(1) δ^X	(2) $\tilde{\delta}^M$	(3) η^X	(4) η^M	(5) Exports	(6) Imports	(7) Standard *ML* ($B=0$)	(8) Robinson-*ML* ($B \neq 0$)	(9) Hirschman-*ML* ($\tilde{B} \neq 0$)
ARG	0.5577	0.4751	-0.0972	1.0590	81.8368	80.9366	1.5457	1.5514	1.5343
AUS	0.4800	0.3238	0.4725	0.8477	294.7253	302.6965	1.6228	1.6037	1.6470
AUT	-0.0923	0.3799	0.8748	-0.1283	236.0253	221.5763	1.1635	1.2198	1.1452
BEL	0.5128	0.6839	0.5639	-0.2871	435.7868	435.6319	1.3807	1.3810	1.3805
CAN	0.3161	0.4842	1.1274	0.3608	567.6204	585.2995	1.7575	1.7246	1.7783
CHE	0.1235	0.7788	0.6693	0.0893	450.3423	373.6456	1.5087	1.6545	1.3727
CHL	0.9576	0.0673	0.6250	0.4890	85.7457	83.0102	1.5075	1.5399	1.4908
COL	0.4689	0.2981	-0.0328	0.5771	64.0547	75.9169	1.1546	1.0841	1.2848
CRI	1.2884	0.0202	-0.3859	0.2579	16.5617	17.3511	1.6725	1.6088	1.6855
DEU	0.3421	0.4672	0.8589	0.0156	1780.3634	1510.3597	1.3827	1.5449	1.3106
DNK	0.3517	0.4582	0.5536	0.8793	192.8959	168.3725	1.6452	1.7488	1.5264
EGY	0.6096	0.7127	0.2489	0.0953	47.1663	73.9960	1.4468	1.1906	1.8678
ESP	0.2322	0.3226	1.3134	1.0436	451.0303	416.9427	2.2702	2.3716	2.1924
FIN	0.2898	0.6530	0.9297	0.9259	101.5397	104.1064	1.9244	1.9010	1.9490
FRA	0.5627	0.3994	1.2225	-0.4490	853.2540	889.4761	1.2271	1.1824	1.2326
GBR	0.3722	0.5226	-0.2830	0.4255	854.1357	914.7019	0.9202	0.9074	0.9717
GRC	-0.2172	0.8311	0.3131	0.5895	76.8263	82.0741	1.0945	1.0840	1.1581
HUN	0.1071	0.7866	-1.6969	-0.9404	122.9144	113.9502	-0.8221	-0.9328	-0.8648
IND	0.4190	0.5051	-0.8066	0.9213	485.5830	553.5529	0.9115	0.9176	1.0460
ISR	0.5503	0.3295	-0.3025	-0.3674	99.2770	94.9922	0.4973	0.5160	0.4937
ITA	0.4666	0.1047	0.8759	-0.2121	631.1126	569.9390	0.8486	0.9488	0.8569
JPN	0.4370	0.4188	0.6349	0.2649	862.9736	991.5786	1.3672	1.2642	1.4526
KOR	0.5377	0.2537	1.0084	1.0163	725.1265	639.9196	2.0160	2.1497	1.8971
KWT	0.0941	0.8190	-0.1159	0.4651	111.0596	51.1715	0.8923	0.8796	0.4053
LKA	0.7069	-0.1039	-0.0337	0.4770	16.7350	23.1416	1.1196	0.9267	1.2814
NLD	0.4068	0.7491	0.2501	-0.1455	727.0207	631.6364	1.2678	1.3516	1.1743
NOR	0.7905	0.0056	0.3293	0.5070	193.2054	148.7708	1.3692	1.6259	1.2520
NZL	0.5801	0.1995	0.4778	0.2453	56.3802	54.1927	1.1767	1.2082	1.1613
PAK	0.2244	0.8127	0.8189	0.6528	30.6000	51.1410	1.7945	1.4493	2.4222
PHL	0.6949	0.4981	-0.2364	-0.2873	75.3218	88.0757	0.9767	0.8865	1.0366
PRT	0.8335	-0.0898	1.7299	0.0549	93.8856	91.3509	1.0915	1.1226	1.0923
SAU	0.0886	-0.3804	-0.0415	0.2436	354.9732	259.0069	0.0065	0.0253	0.0185
SWE	0.0969	0.7425	1.4733	0.8882	256.5447	231.2358	2.3986	2.5549	2.3028
THA	0.6119	0.1333	2.4113	0.7364	282.1593	254.6695	2.3192	2.4863	2.2441
TTO	0.9415	0.4716	-0.3797	0.2659	16.4238	10.6782	1.5314	2.0261	1.3173
TUN	0.1679	0.4613	0.2223	-1.0210	21.5750	26.8031	0.2642	0.1953	0.2427
TWN	-0.0056	0.3791	0.3215	0.7828	320.0900	282.0000	1.1829	1.2258	1.0799
USA	0.0718	0.6204	0.4234	0.6459	2375.9040	2866.2380	1.3304	1.2509	1.5090
ZAF	0.7698	0.3767	0.0201	0.6773	110.3207	115.6327	1.5733	1.5377	1.6118

Notes: The table reports price and quantity elasticities (columns 1 - 4) based on estimates by Leigh et al. (2015) - shared by the authors on request; imports and exports (in billions of USD) for the year 2014 (columns 5 & 6) and GDP (in billions of USD) in column (7) - obtained from the International Financial Statistics (IFS) database; estimates of standard *ML* (column 8) and modified *ML* conditions (columns 9 and 10).

In Table 2, based on estimates of 51 countries, there are two cases of sign reversal, Great Britain and Norway. In the case of Great Britain (with negative trade balance) and Norway (positive trade balance), the modified ML suggests different predictions depending on how trade balance is measured. In both cases the Hirschman-modified ML makes the same prediction as the standard ML, which is different from the prediction made by the Robinson-modified ML.

Table 2: Possible combinations of *ML* estimates

Country	(1) δ^X	(2) $\tilde{\delta}^M$	(3) η^X	(4) η^M	(5) Exports	(6) Imports	(7) Standard *ML*	(8) Robinson-*ML*	(9) Hirschman-*ML*
ARG	1.013	0.376	12.4615	0.742	36.2875	30.8393	1.69	1.8403	1.564
AUS	0.551	0.341	1.6236	0.4674	24.748	24.1899	1.929	1.9585	1.9144
AUT	0.089	0.59	0.5357	0.2122	12.3609	13.2048	1.254	1.2171	1.3002
BEL	0.2	0.717	0.7075	-0.2544	34.7784	34.0801	1.411	1.4267	1.398
BRA	0.439	0.447	0.5027	0.4141	47.3772	43.5893	1.397	1.4597	1.343
CAN	0.404	0.539	0.1779	0.6247	45.373	46.1991	1.337	1.3279	1.3521
CHE	-0.147	0.702	0.5432	1.2148	29.2823	27.6684	1.54	1.5678	1.4814
CHL	-0.005	0.641	0.4229	0.9331	3797.5407	3895.9423	1.396	1.3854	1.4213
CHN	0.172	0.571	0.744	-0.0956	1293.2595	1147.7079	1.318	1.4179	1.2584
COL	0.313	0.388	0.3886	0.9755	10830.5418	10437.7828	1.565	1.5868	1.5293
CRI	0.852	0.27	4.2635	1.0781	565.8046	923.1256	2.54	1.966	3.2075
CZE	0.332	0.545	0.4416	0.6088	306.2366	273.5502	1.449	1.5239	1.3613
DEU	0.151	0.621	0.4229	0.2269	109.7495	90.3765	1.217	1.3263	1.0922
DNK	0.307	0.63	0.5512	0.2432	61.4605	52.9001	1.409	1.5205	1.3087
EGY	0.627	0.509	0.6702	0.7699	17.8151	42.311	1.764	1.2563	2.9836
ESP	0.203	0.651	0.5395	0.533	22.2543	25.3595	1.47	1.3925	1.5868
FIN	0.201	0.516	0.5569	0.2252	5.6796	5.922	1.271	1.2446	1.2977
FRA	0.156	0.561	0.4893	0.4647	43.4646	51.8869	1.334	1.2416	1.4822
GBR	0.326	0.518	0.2211	0.2884	30.4639	43.6256	1.132	0.9887	1.4159
GRC	0.137	0.381	0.4438	0.7221	2.7358	4.8647	1.348	1.1204	1.9923
GTM	-0.027	0.831	0.2921	1.071	7.8529	13.1694	1.285	1.1748	1.9701
HKG	0.186	0.486	0.3735	0.7471	386.1243	433.5795	1.36	1.3064	1.4669
HUN	0.168	0.295	1.2272	-0.0355	2314.7417	2122.7473	1.459	1.5665	1.4366
IDN	0.93	0.422	5.2	-0.0035	178375.8405	179933.1469	1.714	1.7028	1.7177
IND	0.072	0.592	0.3664	1.2647	1547.354	2612.9545	1.52	1.352	2.283
IRL	0.831	0.527	1.0888	0.2093	9.3558	4.8853	1.641	2.5698	1.3419
ISR	0.272	0.203	0.1071	0.67	24.3465	28.1914	1.087	1.0393	1.2034
ITA	0.156	0.592	0.2607	0.7353	39.0337	38.0667	1.268	1.2776	1.2459
JPN	0.571	0.135	0.6597	0.1457	6372.2255	7069.6825	1.115	1.0307	1.1436
KOR	0.497	0.342	0.7316	0.1018	61714.2053	58528.6752	1.274	1.3211	1.2529
LKA	0.325	0.803	0.3215	-0.0254	119.5616	228.2176	1.34	1.0819	2.0652
MAR	0.358	0.439	0.2539	1.0339	18.4797	38.6466	1.54	1.2681	2.652
MEX	0.555	0.605	0.0337	0.4127	488.2006	488.2595	1.338	1.3379	1.3381
NLD	0.195	0.519	0.6981	0.6008	51.0073	45.6801	1.565	1.6533	1.4806
NOR	-0.11	0.668	0.3577	0.0994	93.6339	50.7913	0.988	1.2301	0.6673
NZL	0.414	0.457	0.3805	0.7882	4.6045	4.7202	1.522	1.5064	1.5443
PAK	0.305	0.654	0.8691	1.3642	229.8799	409.1948	2.035	1.6367	2.9133
PER	0.138	0.557	0.4002	1.4289	12.2296	11.1208	1.673	1.7212	1.5651
PHL	-0.012	0.491	0.8686	0.2417	219.5696	275.9642	1.481	1.3038	1.6387
POL	0.461	0.565	0.5807	0.5862	58.4887	62.34	1.594	1.5462	1.648
PRT	0.363	0.506	0.2779	0.7105	4.525	5.6431	1.397	1.29	1.6088
RUS	0.508	0.202	0.2175	0.5664	1618.3708	975.1336	1.269	1.6747	1.0091
SAU	0.444	0.744	1.518	0.168	145.2652	56.7225	2.075	4.0855	1.5953
SGP	0.076	0.808	0.3939	0	51.0359	47.4531	1.248	1.2812	1.1913
SWE	0.296	0.481	-0.0128	0.9383	116.8278	111.4777	1.255	1.2688	1.2107
THA	0.48	0.694	0.6077	0.5588	713.4953	769.5423	1.661	1.603	1.7289
TUN	0.366	0.558	0.1877	0.4932	2.6564	3.822	1.261	1.1131	1.6015
TUR	0.831	0.199	2.7278	-0.0062	27.3821	42.4835	1.486	1.0267	1.593
URY	0.515	0.532	1.4454	0.2073	17.6889	23.6661	1.845	1.5379	2.0575
USA	0.289	0.707	0.27	0.3208	154.4932	233.4678	1.282	1.1193	1.6915
ZAF	0.639	0.415	0.7922	0.2701	81.1738	85.5022	1.498	1.4512	1.5286

Notes: The table reports price and quantity elasticities (columns 1 - 4) based on estimates in Bussière, Gaulier and Steingress (2017); imports and exports (in billions of USD) for the year 2012 (columns 5 & 6) - obtained from the International Financial Statistics (IFS) database; estimates of standard ML (column 7) and modified ML conditions (columns 8 and 9).

4. Discussion

This note has examined the qualitative and quantitative implications of assuming balanced trade to predict the effect of a depreciation on the trade balance. Assuming unbalanced trade yielded tractable counterparts to unadjusted *ML* in both domestic and foreign currency. On the empirical side, we found that for a set of 39 countries for which all four elasticities (namely the pass through elasticities of import and export prices and the price elasticities of imports and exports) are estimated by Leigh et al. (2015), all three versions of *ML* condition predict the same sign as to the effects of depreciation for the year 2014 for all countries except three (India, Sri Lanka and Philippines). Similarly of 51 countries for which elasticities are reported by Bussière, Gaulier and Steingress (2017), all three versions of *ML* condition predict the same sign as to the effects of depreciation for the year 2012 for all countries except two (GBR and Norway).

At the same time, as we have argued using an analytical approach, the predicted magnitudes of change in the trade balance will differ between the two currencies by an amount that will increase in line with the size of the initial trade deficit or suprlus.

Such differences are important, especially for policymaking purposes. To quote Hirschman, "There are two tasks that devaluation might be and has been called upon to accomplish: to solve balance of payments problems and to stimulate domestic income" (Hirschman (1949), p.53). He goes on to argue that for balance of payments problems the foreign currency version of the *ML* condition would be more suitable for predicting whether an intended outcome would be achieved, while for verifying whether a particular stimulus to domestic income would arise, the domestic currency version would be better. When currency depreciation takes place in the presence of a significant trade imbalance, then arbitrarily applying the *ML* condition in only one currency could mislead policy makers as to the precise effect of the devaluation on the outcome of most interest to them.

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A. Appendix: Country codes

Table 3: Country ID & Complete Names

Country ID	Full Name	Country ID	Full Name
ARG	Argentina	ISR	Israel
AUS	Australia	ITA	Italy
AUT	Austria	JPN	Japan
BEL	Belgium	KOR	Republic of Korea
BRA	Brazil	LKA	Sri Lanka
CAN	Canada	MAR	Morocco
CHE	Switzerland	MEX	Mexico
CHL	Chile	NLD	Netherlands
CHN	China	NOR	Norway
COL	Colombia	NZL	New Zealand
CRI	Costa Rica	PAK	Pakistan
CZE	Czech Republic	PER	Peru
DEU	Germany	PHL	Philippines
DNK	Denmark	POL	Poland
EGY	Egypt	PRT	Portugal
ESP	Spain	RUS	Russia
FIN	Finland	SAU	Saudi
FRA	France	SGP	Singapore
GBR	Great Britian	SWE	Sweden
GRC	Greece	THA	Thailand
GTM	Guatemala	TTO	Trinidad and Tobago
HKG	Hong Kong	TUN	Tunisia
HUN	Hungary	TUR	Turkey
IDN	Indonesia	TWN	Taiwan
IND	India	URY	Uruguay
IRL	Ireland	USA	United States of America
		ZAF	South Africa