An exploration of the interdependencies betweeen the real exchange rate and the size of the tradable sector in a small open economy

Fernando Zarzosa Valdivia[*]
National University of Cordoba
zarzosa.fernando@gmail.com
Eric J. Pentecost
Loughborough University
E.J.Pentecost@lboro.ac.uk

Revista Cultura Económica
Año XL • N°103
Junio 2022: 77-116
https://doi.org/10.46553/cecon.40.103.2022.p77-116

Abstract: The complex interdependences between the real exchange rates and the size of the tradable goods sector have not been fully explored in the existing literature. This article aims to full this gap by developing a neo-classical Australian general equilibrium model to further explore these linkages and to explain the impact of total factor productivity, factor endowments, terms of trade and debt services (net of transfers and/or aid flows) on the equilibrium real exchange rate and the size of the tradable sector. Measuring changes in the allocation of resources by changes in the share of tradable goods in GDP, we show that in addition to the well-known spending and resource movement effects, that there are four further separately identifiable effects, which we refer to as the extraordinary profit effect, the traded price effect, the expenditure movement effect and the debt substitution effect. The relative strengths of these additional effects help to determine the size of the tradable goods sector and hence the economic structure of a small open economy.

Keywords: Structural real exchange rates; tradable goods share in GDP; productivity; terms of trade; resource movement effect; spending effect; extraordinary profits effect; traded price effect; debt substitution effect and expenditure movement effect

Una exploración de las interdependencias entre el tipo de cambio real y el tamaño del sector transable en una pequeña economía abierta

Resumen: *A pesar de su importancia y complejidad, la interdependencia entre el tipo de cambio real y el tamaño del sector transable no ha sido estudiada en detalle por la literatura existente. Este artículo busca cubrir dichas deficiencias elaborando un modelo*

[*] Recibido: 08/06/2022 – Aprobado: 25/06/2022

neoclásico de equilibrio general para una economía pequeña que explica como las variaciones en la productividad total de los factores, en la dotación de factores, en los términos de intercambio y en los servicios de la deuda impactan en el tipo de cambio real de equilibrio y en el tamaño del sector transable. Midiendo las variaciones en la asignación de recursos por los cambios en la participación del sector transable en el producto, mostramos efectos adicionales a los ya conocidos efecto del gasto y de los movimientos de recursos; a decir, el efecto de las ganancias extraordinarias, el efecto precio transable, y los efectos gasto y sustitución generados relacionados a los servicios de la deuda.

Palabras clave: *Tipo de cambio real estructural; participación del sector transable en el producto; productividad; términos de intercambio; efecto movimiento de los recursos; efecto gasto; efecto de las ganancias extraordinarias; efecto de los precios transables; efecto sustitución y gasto de los servicios de la deuda*

I. Introduction

The structural real exchange rate, the relative tradable to non-tradable price, is a key determinant of international competitiveness and domestic resource and expenditure allocation. Thus, an exogenous rise on it indicates that the production (consumption) of tradables becomes more profitable (expensive) relative to the production (consumption) of non-tradables, and thus provide an incentive for reallocating resources (expenditures) by shifting them from the latter (former) to the former (latter) sector.

Because real exchange rates are a critical element of successful development, Williamson (2008), Rodrik (2008), Guzman et al. (2018) among other postulate economic policies that foster a high and stable real exchange rate. Following Rodrik (2008) and Razmi et al. (2009) an undervaluation impacts positively on the size (and share) of output of the tradable sector and the investment growth, respectively. Rajan and Subramanian (2011: 115) adds that countries should avoid creating the conditions that generate uncompetitive exchange rates, while Williamson (2008) states that a seriously undervalued rate impedes growth. Demir and Razmi (2021) point out that there is little discussion in existing literature of the level of the real exchange rate that is consistent with an equilibrium level of output growth or share of tradable goods sector. The ongoing debate has, however, stimulated interest in the theoretical linkages between the real exchange rate, growth and the economic structure of a country.

This article, based on an Australian model, links two strands of the literature, the real exchange rate and the Dutch Disease models. Australian or dependent economy models are based on economies with tradable and non-tradable goods and a pivotal role played by the structural real exchange rate in facilitating the adjustment in aggregate demand and its composition when the economy is buffeted by exogenous aggregate disturbances. The Dutch disease refers, following Brahmbhatt et al. (2010: 1), to a phenomenon reflecting changes in the structure of production in the wake of a favorable shock (such as a large natural resource discovery, a rise in the international price of an exportable commodity, or the presence of sustained aid or capital inflows).

Theoretical real exchange rate models for developing economies consider it as an endogenous variable determined in a complete macroeconomic system where macroeconomic fundamentals are key driving variables underlying its movements. Rather than focusing on real exchange rates, Dutch disease models analyse the role of the fundamentals on the size of the tradable and non-tradable sectors and emphasize that appreciated real exchange rates induce resource allocation favorable to sectors other than the industrial sectors; they consider thus real exchange rate as a determinant of de-industrialization in developing economies; see Araujo et al. (2021), Swan (1955), Salter (1959), Neary and Purvis (1982, 1983), Corden (1984), Sachs and Warner (1995), Fardmanesh (1990), Rodrik (2008), Rajan and Subramanian (2011), García-Cicco and Kawamura (2015), Mejalenko (2015) and Chang et al. (2021) and Nülle and Davis (2018).

When distinction between exportable and importable goods is made they are not always assumed to be domestically consumed or produced, respectively. For instance, Dornbusch (1989), Devarajan et al. (1991), De Gregorio and Wolf (1994), Devarajan (1999), Cerda (2001), Ismail (2010), García-Cicco and Kawamura (2015) and Schmitt-Grohé and Uribe (2021) consider exportable goods as domestically produced (consumed) but not consumed (produced), Soto and Elbadawi (2008) and Mejalenko (2015) allow exportable goods to be domestically consumed; Fardmanesh (1990) allows both domestically produced and imported manufactured goods.

Making a distinction between produced and consumed importable (manufacturing), exportable (primary) and non-tradable goods in a small open economy, the model developed in this paper analyses the two-way linkages between the structural real exchange rate and the relative size of the tradable sector in order to investigate how macroeconomic fundamentals, such as sector productivities, terms of trade, factor endowments, aid flows, external debt service and transfer payments, impact on the equilibrium structural real exchange rate and the size of the tradable goods sector.

On the one hand, the budget share in tradable goods depends negatively on the structural real exchange rate, but it increases when the tradable goods share in GDP increases and the debt service (net of transfers or aid flows) to GDP ratio diminishes in order to keep the equilibrium of the non-tradable and current account. These conditions combined give us a negative structural real exchange rate-tradable goods share in GDP relationship. Thus, a larger tradable goods share in GDP creates an excess supply of tradables and excess demand for non-tradables, so the structural real exchange rate must appreciate in order to switch expenditure from non-tradables to tradables and restore equilibrium in the non-tradable market and current account. On the other hand, the tradable goods share in GDP depends positively on the structural real exchange rate when producers reach their optimum production positions and the economy works efficiently along the production possibility frontier (full employment). The equilibrium is reached when both consumers and producers decisions coincide, there is full employment and the current account and the non-tradable market are in equilibrium.

In line with Swan (1955) and Salter (1959), Neary and Purvis (1982, 1983) and Corden (1984) demonstrated that a rise in the productivity in the booming (energy) sector could give rise to de-industrialisation through resource movement and the income (or spending) effects. The mechanism postulated for the resource movement effect was that following a rise in productivity in the booming sector, resources would be drawn away from the other sectors of the economy, leading to adjustments in the rest of the economy, including the real exchange rate. In addition, with higher real incomes resulting from the boom, extra spending on non-traded goods raises their price and leads to real appreciation and further adjustments in the economy according to the income effect.

Up to now, the sequence of the mechanisms through which changes in the macroeconomic fundamentals affect the tradable sector has not been studied yet, exceptions are Fardmanesh (1990) who measures the spending effect and the world price effect which, in his model, includes the resource movement effect, Bjørnland et al. (2019) who incorporates the productivity dynamics from the spending as well as the resource movement effect, and Chang et al. (2021) who provide seven Dutch disease indicators, two indicators measuring the resource movement effects and five the spending effects for a 14 countries sample.

This research postulates that macroeconomic fundamentals, not only resource or international prices booms, generate resource and spending effects. Measuring changes in the allocation of resources by changes in the size of the tradable goods sector, we are able to identify four distinct effects: specifically, the i) *extraordinary profit effect*, which is generally considered part of the resource movement effect, but which reflects the incremental income of the sector favoured by any exogenous shock; ii) *traded price effect*, which is the reallocation of resources due to the increment in the price of traded goods; iii) *expenditure movement effect*, which is defined as the reallocation of resources compatible with current account equilibrium when net external debt diminishes, the international transfer increases or exogenous revenues are injected in the economy; and finally iv) *the debt substitution effect*, which reflects the reallocation of resources originating from the excess of demand of tradable goods when net external debt service diminishes, the international transfer increases or exogenous revenues are injected in the economy. The general model developed here suggests that the terms of trade, external transfer improvements and the reduction of net external debt service (or the increase of transfers or aid flows) may give rise to Dutch Disease effects – whereby a real exchange rate appreciation leads to a contraction in the size of the manufacturing goods sector.

Although Rodrik (2008), van der Ploeg (2011a, 2011b), Bjørnland et al. (2019) and Schmitt-Grohé and Uribe (2021) analyse the two-way relationship between the real exchange rates and the economic structure, they are incomplete in that do not distinguish between exportable and importable goods and they do not provide tractable mechanisms to understand the subsequent effects, the resource movement and spending effects among others, originated by changes altogether in total factor productivities, factor endowments, terms of trade and debt services (net of transfers and/or aid flows).

The rest of this paper is set out as follows. Section II reviews the literature. Section III develops a micro-founded theoretical Salter-Swan dependent economy model. Section IV shows how this more general model can be used to identify the various effects of changes to the economic fundamentals on the size of the traded goods sector and the structural real exchange rate. Section V measures the gross domestic product of the previous model and extends it by adding imperfections in the non-tradable market, home-biased preferences, specific resources addressed to each tradable sector or "apropiability" problems arising from institutional weakness and/or market failures. Finally, Section VI concludes with a brief discussion of the potential policy implications.

II. Literature review

The behaviour of the structural real exchange rate is best interpreted in terms of micro-founded macro models. Models that might differ in their assumptions, but despite its reach a reduced form with a single equation in which the equilibrium structural real exchange rate is an endogenous variable determined in a complete macroeconomic system where macroeconomic fundamentals are key driving variables underlying its movements. Table 1 describes the relevant macroeconomic fundamentals of different theoretical models; they differ depending on the corresponding assumptions.

The main assumptions of these models could refer among others to an economy: i) that is small, ii) in which the law of one price holds, iii) with one (labour), two (labour and capital) or many production factors (including intermediate goods), iv) with only one or all production factors perfectly mobile, v) with two, three or n-goods, *e.g.* a tradable (or a exportable and importable) and non-tradable goods vi) with a representative consumer or with various consumers, *e.g.* skilled or unskilled as in García (1999), vii) with intertemporal decision making economic agents, and viii) different structures of preferences and production.

Regarding the structure of preferences CES preferences are postulated by Devarajan et al. (1991), De Gregorio and Wolf (1994), Asea and Mendoza (1994), Zarzosa Valdivia (2008), Cerda (2001), Calderon (2002), Gubler and Sax (2012), García-Cicco and Kawamura (2015), Mejalenko (2015), Pentecost and Zarzosa Valdivia (2016) and Schmitt-Grohé and Uribe (2021), quasi-convex preferences by Krugman (1988), non-homothetic preferences by García (1999) and Cobb-Douglas preferences by Galindo et al. (2001), Lartey (2008) and Soto and Elbadawi (2008).

Different authors have assumed different technologies; for instance, Krugman (1988) postulates linear technologies in both sectors, Dornbusch (1989) assumes linear (or Leontief) technology in the production of non-tradable goods, De Gregorio and Wolf (1994), García (1999) and Lartey (2008) propose linear technology in the non-tradable sector, but Cobb-Douglas in the tradable sector, Asea and Corden (1994), Asea and Mendoza

(1994), Alberola (2003), Rodrik (2006), Galstyan and Lane (2009), Soto and Elbadawi (2008), Ismail (2010), García-Cicco and Kawamura (2015) and Mejalenko (2015) are based on Cobb-Douglas technologies in both sectors, Calderon (2002) and Aguirre and Calderon (2005) assume linear technologies in the non-tradable sector, but endowed tradable goods and Razmi et al. (2009) postulate Leontief technologies in the tradable sector, but Cobb-Douglas in the non-tradable sector. Devarajan et al. (1991) go further assuming a transformation curve between tradable and non-tradable goods with CES structure. Pentecost and Zarzosa Valdivia (2016) consider CES technology in the non-tradable sector, while Cobb-Douglas in the primary and manufacturing sectors.

Following Chang et al. (2021), the Dutch disease literature commonly uses output growth or the share of output in *GDP* across sectors to detect symptoms of it, *e.g*. an appreciated real exchange rates. For instance, a) Sachs and Warner (1995) and (2001) show, in a cross-section of countries during 1970–90, that a 10% increase in the ratio of natural resource exports to *GDP* was associated with reduced manufactured export growth, b) Rodrik (2008) finds positive effects of a devaluation on the relative size of the tradable goods sector, especially those related to industrial activities, c) Rajan and Subramanian (2011) add that the excess appreciation, the appreciation that is over and above that suggested by the Balassa–Samuelson effect, may represent the Dutch disease channel through which aid influences the manufacturing sector, d) Araujo et al. (2021) note that in the least developed countries, a depreciation has a positive relationship with the value added of the manufacturing sector and that the effects of real exchange rates on growth operate, at least in part, through changes associated with the relative size of the tradable goods sector, and

Table 1. Fundamentals

Fundamentals		Authors	Fundamentals		Authors
1	**BS1**	Balassa (1964), Samuelson (1964), Asea and Corden (1994), De Gregorio and Wolf (1994), Connolly and Deveraux (1995), García (1999), Montiel (1999) and (2011), Cerda (2001), Alberola (2003), Mahbub Morshed and Turnovsky (2004), Galstyan and Lane (2009), Rodrik (2008), Soto and Elbadawi (2008), van der Ploeg (2011a) and (2011b), Pentecost and Zarzosa Valdivia (2016), Guzman et al. (2018) and Bjørnland et al. (2019)	4	**FE1**	Dornbusch (1989)
	BS2	Calderon (2002), Obstfeld and Rogoff (2004) and Aguirre and Calderon (2005)		**FE2**	Connolly and Deveraux (1995)
	BS3	Calderon (2002) and Alberola (2003)		**FE3**	Pentecost and Zarzosa Valdivia (2016)
	BS4	Dornbusch (1989) and Balvers and Bergstrand (2002)	5	**TP1**	Edwards (1989), Devarajan et al. (1991), Soto and Elbadawi (2008) and Devarajan (1999)
	BS5	Edwards (1989)		**TP2**	Salter (1959)
2	***P****	Salter (1959), Edwards (1989), De Gregorio and Wolf (1994), Calderon (2002), Mahbub Morshed and Turnovsky (2004), Aguirre and Calderon (2005) and Bjørnland et al. (2019)	6	**G1**	Dornbusch (1989), De Gregorio and Wolf (1994), Connolly and Deveraux (1995), García (1999), Montiel (1999) and (2011), Cerda (2001),

					Mahbub Morshed and Turnovsky (2004), Soto and Elbadawi (2008) and Schmitt-Grohé and Uribe (2021)
	TT	Salter (1959), Edwards (1986), Fardmanesh (1990), Devarajan et al. (1991), Devarajan (1999), Connolly and Deveraux (1995), García (1999), Montiel (1999) and (2011), Cerda (2001), Soto and Elbadawi (2008), Pentecost and Zarzosa Valdivia (2016) and Schmitt-Grohé and Uribe (2021)´		**G2**	Cerda (2001) and Galstyan and Lane (2009)
3	**ES1**	Salter (1959), Krugman (1988), Edwards (1989), Devarajan et al. (1991), Devarajan (1999), Montiel (1999), Montiel (2011), Cerda (2001) and Galstyan and Lane (2009)		**G3**	Balvers and Bergstrand (2002)
	ES2	Edwards (1989)			
	ES3	Montiel (1999) and (2011), Rodrik (2008) and Soto and Elbadawi (2008)	**7**	**Ov1**	Edwards (1986)
	ES4	Fardmanesh (1990), van der Ploeg (2011a) and (2011b) and Bjørnland et al. (2019)		**Ov2**	García (1999)
	ES5	Calderon (2002), Alberola (2003) and Aguirre and Calderon (2005)		**Ov3**	Connolly and Deveraux (1995)
	ES6	Obstfeld and Rogoff (2004)		**Ov4**	Balvers and Bergstrand (2002)
	ES7	Soto and Elbadawi (2008)		**Ov5**	Rodrik (2008)
	E8	Pentecost and Zarzosa Valdivia (2016)		**Ov6**	Schmitt-Grohé and Uribe (2021)

Note: The i) Balassa-Samuelson variables are the relative tradable to non-tradable productivity (BS1), tradable goods endowments (as indicator of total factor productivity in the tradable sector, BS2), total factor productivity in the non-tradable sector (BS3), relative productivity between countries (BS4) and technology (BS5), ii) factor endowments variables are FE1 (labour endowments or relative labour endowment), FE2 (capital stock, land and minerals) and FE3 (capital stock and labour endowment), iii) foreign prices variables are international prices (*P**) and the terms of trade (TT), iv) external sector variables are capital inflows (ES1), aid flows (ES2), international transfers (ES3), exogenous revenues injected in the economy by a boom sector (ES4), net foreign asset position-GDP-ratio (ES6), stock of foreign debt (ES7) and the debt services (net of transfers) to GDP ratio (ES8), v) fiscal policy variables are taxes (TP1) or import restrictions (TP2), vi) fiscal policy variables are government spending (G1), government investing (G2) and relative government spending (G3), and vii) other variables are exchange rate disturbances (Ov1), the openness index and inequality (Ov2), initial wealth (Ov3), institutional and market failures (Ov4), the capital-to-labour ratio and policy variables that affect the incentives to invest (Ov5) and the wages-to-exchange ratio (Ov6).

e) Chang et al. (2021) find, in a sample of 14 mineral-dependent countries for the period 1995-2011, that Brazil, Australia, Canada, and South Africa are countries with the highest likelihood of Dutch Disease, while Chile, Vietnam, Russia, and Saudi Arabia are countries with the lowest likelihood of it.

Although, real exchange rate models mention there would be a reallocation of resources when a shock hits an economy. In contrast to Dutch disease models, few consider the tradable share in GDP as an endogenous variable determined by macroeconomic fundamentals. The sources of it might lie in "apropiability" problems arising from either institutional weakness of market failures (learning by doing, for example) or both. Despite their focus on the change on the economic structure and their remarks on importance of the different effects of macroeconomic fundamentals, Dutch disease models do not measure them, exception are Fardmanesh (1990) who measures, in terms of changes in the levels of production of the manufacturing sector, the spending effects and world-price effects, that in his model includes the resource movement, of booms and international price changes, and Bjørnland et al. (2019) who incorporates the productivity dynamics from the spending as well as the resource movement effect. There are, however, several sources of deindustrialization, and there are probably different combinations of these sources (the fundamentals) that explain this process.

Regarding models that emphasize a two-way relationship between the structural real exchange rate and the economic structure, i) Rodrik (2008) proposes a positive (negative) relationship between the structural real exchange rate and the share of capital allocated to tradable goods production in which the share of capital that is allocated to tradables increases with the relative profitability of the traded-goods sector (an increase in the structural real exchange rate makes traded goods more expensive and reduces the demand for capital), ii) van der Ploeg (2011a) and (2011b), postulates a positive (negative) relationship between the structural real exchange rate and the labour share in the non-tradable sector that ensure clearing of the market for non-traded goods and the equilibrium of the current account (equilibrium of the labour markets), iii) Bjørnland et al. (2019) determines a negative (positive) relationship between the structural real exchange rate and the share of labour share in the non-tradable sector that arises from the non-tradable market equilibrium (the producers maximisation problem), and iv) Schmitt-Grohé and Uribe (2021) define a positive (negative) relationship between the structural real exchange rate and the demand for labor derived from the demand (supply) of non-tradable goods.

III. The Model

This section extends the theoretical framework of the Australian models by allowing the size of the tradable sector to become endogenous, along the structural real exchange rate, and hence the structure of the economy to change as part of the longer run adjustment process. We also include in the general model the resources devoted to debt service repayments, a change in which can give rise to a new channel through which de-industrialisation can take place.

1. The Equilibrium model

We assume a world with three goods: two of these goods are assumed to be tradable goods and the other is assumed to be a non-tradable good. Tradable goods are those with prices determined on world markets and consist of *primary* goods, of which the surplus over home consumption is exported and *manufactured* goods[1], of which the deficiency between consumption and home production is imported (Salter, 1959). The price of the non-tradable good, on the other hand, is determined by the local supply and demand conditions.

2. Optimal microeconomic relationships and macroeconomic conditions

Total consumption is assumed to be divided into consumption of primary (C_X), manufacturing (C_M) and non-traded goods (C_N) and that the representative consumer ranks tradable and non-tradable goods by constant elasticity of substitution (CES) preferences while primary and manufactured goods are subject to Cobb-Douglas preferences. The representative consumer's utility function is therefore formally defined as follows:

$$C = \left\{\gamma_p^{1-\beta}\left(C_X^{\delta} C_M^{1-\delta}\right)^{\beta} + \left(1-\gamma_p\right)^{1-\beta} C_N^{\beta}\right\}^{\frac{1}{\beta}} \qquad (1)$$

where C refers to the representative consumer's utility level, γ_p and δ are preference weight parameters that reflect the tradable goods bias and primary goods bias, respectively, and β is an elasticity parameter; $\beta < 1$[2].

The standard procedure for finding the constrained maximum of a CES utility function gives a linear Engel expenditure curve and therefore a budget share of tradable goods independent of the total expenditure, but dependent on relative prices. The optimal budget share of primary and manufacturing goods in the tradable expenditure are constant and equal to δ and $(1 - \delta)$, respectively. Following Dixit and Stiglitz (1977), the optimal tradable expenditure share of the representative consumer is defined as follows:

$$\frac{E_T}{E} = \gamma_p \left(\frac{P_T}{P}\right)^{\frac{\beta}{\beta-1}} = \gamma_p \left(\gamma_p + (1-\gamma_p) q^{\frac{\beta}{1-\beta}}\right)^{-1} \tag{2}$$

where

$$P_T = \delta^{-\delta}(1-\delta)^{-(1-\delta)} P_X^{\delta} P_M^{1-\delta} \tag{3}$$

and

$$P = \left(\gamma_P P_T^{\frac{\beta}{\beta-1}} + (1-\gamma_P) P_N^{\frac{\beta}{\beta-1}}\right)^{\frac{\beta-1}{\beta}} \tag{4}$$

and where E is the representative consumer's total expenditure, E_T is the expenditure on tradable goods, P_X, P_M and P_N are the prices of primary, manufactured and non-tradable goods, respectively and q (= P_T/P_N) refers to the structural real exchange rate. Equation (2) suggests that the budget or expenditure share in tradable goods depends negatively on the structural real exchange rate.

The economy is divided into three internally homogeneous and perfectly competitive sectors: primary (X), manufacturing (M) and non-tradables (N) goods sectors. It is also assumed that there are two production factors, labour and capital (although they could equally be unskilled and skilled labour), which are perfect substitutes in the non-tradable sector, but imperfect substitutes in the tradable sectors. We assume a linear technology for the non-tradable sector, but a Cobb Douglas technology for the tradable sectors following the precedent of De Gregorio and Wolf (1994), García (1999) and Lartey (2008). Formally:

$$X = A_X L_x^{\phi_x} K_X^{\psi_X} \quad (5)$$

$$M = A_M L_M^{\phi_M} K_M^{\psi_M} \quad (6)$$

$$N = A_N\left(Z_{N_L} L_N + Z_{N_K} K_N\right) \quad (7)$$

where X, M and N are the outputs of primary, manufacturing and non-tradable goods, respectively, A_X, A_M and A_N are the total factor productivities of the production factors employed in the primary, manufacturing and non-tradable sectors, respectively. Z_{N_L} and Z_{N_K} are the constant specific productivities of labour and capital employed in the non-tradable sector. L_i and K_i are the labour and capital employments for sector i, respectively; ϕ_X and ϕ_M are the primary and manufacturing output elasticities with respect to labour; and ψ_X and ψ_M are the identical primary and manufacturing output elasticities with respect to capital, where $0 < \phi_X , \phi_M , \psi_X$ and $\psi_M < 1$. In this case, however, we also assume that the aggregate tradable output elasticities are less than one ($\phi_X + \psi_X < 1$ and $\phi_M + \psi_M < 1$) and therefore suppose that diminishing returns to scale prevail in both tradable sectors or that there are other sector-specific factors of production employed in each sector that are fixed in supply (subsection V.3 extends the model by assuming sector-specific factors and constant returns to scale).

Throughout the analysis, there is full employment of a constant supply of labour (L) and capital (K) as well as perfect mobility of both factors between all sectors. The technology of the non-tradable sector thus shapes the evolution of the factor prices, the domestic wage rate (w) and the interest rate (r), as demonstrated by the first-order conditions of the non-tradable producer's maximization problem where the marginal products of labour and capital are set equal to the factor prices, that is: $w = P_N A_N Z_{N_L}$ and $r = P_N A_N Z_{N_K}$. When these conditions are included in the supply functions of both tradable goods, the resource allocation between tradable and non-tradable goods depends on the structural real exchange rate, while resource allocation within the tradable sector depends on the terms of trade. Formally:

$$X = \left[A_X \left(\frac{q}{A_N}\frac{P_X}{P_T}\right)^{(\phi_X + \psi_X)} \left(\frac{\phi_X}{Z_{N_L}}\right)^{\phi_X} \left(\frac{\psi_X}{Z_{N_K}}\right)^{\psi_X}\right]^{\frac{1}{1-\phi_X-\psi_X}} \quad (8)$$

$$M = \left[A_M \left(\frac{q}{A_N}\frac{P_M}{P_T}\right)^{(\phi_M + \psi_M)} \left(\frac{\phi_M}{z_{N_L}}\right)^{\phi_M} \left(\frac{\psi_M}{z_{N_K}}\right)^{\psi_M} \right]^{\frac{1}{1-\phi_M-\psi_M}} \quad (9)$$

The macroeconomic link between consumers and producers is determined by the current account surplus (*CA*), which is given by the difference between the gross domestic product (*GDP*) and total expenditure plus the external debt service, the international interest rate (r^*) times the net foreign asset position (*F*), and the external transfers or aid flows. As there is no money in this model this net external debt position must be regarded as a transfer of real resources. Consumers in open economies can consume more tradable goods than their economy produces, but the consumption of non-tradable goods is always equal to their domestic production ($N = C_N$). The current account surplus when the non-tradable market clearing condition is imposed is defined as:

$$CA = GDP - E + r^*F + Tr = (P_X X + P_M M) - E_T + r^*F + Tr \quad (10)$$

Defining the tradable goods share in the gross domestic product, $\theta_T (= (P_X X + P_M M)/GDP)$, and rearranging equation (10), equation (11) displays the condition for the budget share in tradable goods when the non-tradable market and the current account ($CA = 0$) are in equilibrium: the share of the consumer's expenditure on tradable goods increases when the tradable goods share in *GDP* increases and the debt service minus transfers-to-*GDP* ratio diminishes. That is

$$\frac{E_T}{E} = \frac{\theta_T - DS}{1 + DS} \quad (11)$$

where $DS = (-(r^*F + T_r)/GDP)$ refers to the debt service minus transfers-to-*GDP* ratio. The variable *DS* is positively related to the net foreign asset position, but negatively to the international interest rate and external grants and transfers. The non-tradable market clearing condition implies that the value of the tradable production plus the transfers can be used to pay external debt services or to satisfy the demand for tradable good. Thus, if there are no corner solutions, the budget share in tradable goods is always positive.

When the consumer decision process fulfils the restrictions imposed by the equilibrium of the current account and the non-tradable market, equations (2) and (11) are equivalent and the structural real exchange rate changes due to changes in tradable goods share in GDP and net debt service movements. Formally:

$$\hat{q} = \left(\frac{(1-\beta)}{(1-\gamma)\beta}\right)\left(\frac{1}{\theta_T - DS}\right)\left(-d(\theta_T) + \frac{1-\theta_T}{1-DS} d(DS)\right) \tag{12}$$

where γ is the initial tradable expenditure share, d () and (ˆ) refer to the first differential and percentage variation operators, respectively. The equilibrium of an economy with perfectly competitive markets and full employment of its resources implies no profits, which means that the income generated by all sectors (*GDP*) and the factor rewards ($wL + rK$) are equal. As a result, the tradable goods share in *GDP* is re-expressed as follows:

$$\theta_T = \frac{P_X X + P_M M}{wL + rK} \tag{13}$$

where L and K are the labour and capital endowments, respectively. Taking into account that $\hat{P} = \gamma \hat{P}_T + (1-\gamma)\hat{P}_N$, $\hat{P}_T = \delta \hat{P}_X + (1-\delta)\hat{P}_M$ and applying the total differential of equation (13), it can be shown that the evolution of the tradable sector depends on the sector total factor productivity (*TFP*), factor endowments, the structural real exchange rate, and the terms of trade. Formally:

$$d(\theta_T) = \left(\frac{\theta_X}{1-\phi_X-\psi_X} + \frac{\theta_M}{1-\phi_M-\psi_M}\right)\left(\hat{q} - \hat{A}_N\right) - \theta_T\theta_L\hat{L} - \theta_T\theta_K\hat{K} +$$

$$\frac{\theta_X}{1-\phi_X-\psi_X}\hat{A}_X + \frac{\theta_M}{1-\phi_M-\psi_M}\hat{A}_M + \left(\frac{\delta\theta_X}{1-\phi_X-\psi_X} - \frac{(1-\delta)\theta_M}{1-\phi_M-\psi_M}\right)\widehat{TT} \tag{14}$$

where TT (= P_X/P_M) are the terms of trade, θ_X and θ_M are the primary and manufacturing shares in *GDP*, respectively, and θ_L and θ_K are the labour and capital shares in *GDP*, respectively.

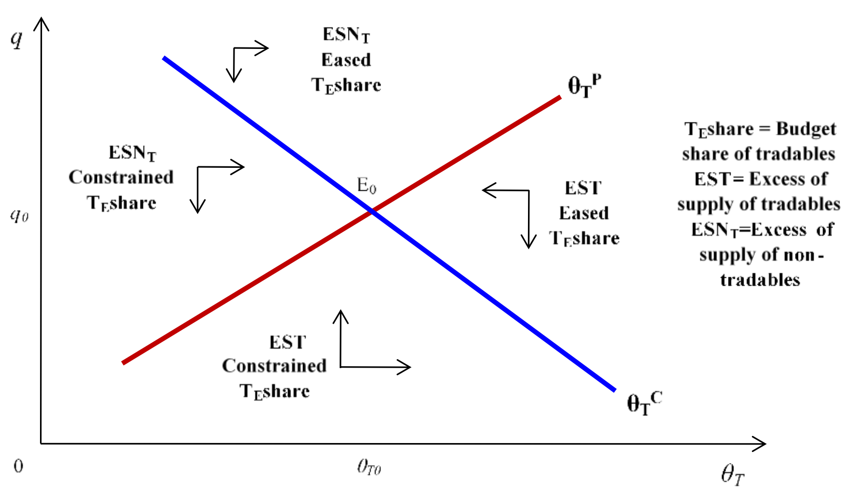
The procedure of reflecting the behaviour of the primary and manufacturing sectors as a single sector (tradable sector) is legitimate so long as the terms of trade are unaffected by events inside the small economy. The reason is that any quantity of primary goods may be exchanged for manufacturing at the relative price determined by the given terms of trade. Therefore, since trade allows primary goods to be transformed into manufactured goods and vice versa, it is a matter of indifference whether an increased tradable production is achieved by means of greater production of primary or manufacturing goods.

3. The Equilibrium

The determination of the equilibrium relationships is graphically analysed in Figure 1. The θ_T^C line shows the negative relationship between the structural real exchange rate and the tradable goods share in GDP postulated by equation (12): a larger tradable goods share in GDP creates an excess supply of tradables and excess demand for non-tradables, so the structural real exchange rate must appreciate in order to switch expenditure from non-tradables to tradables and restore equilibrium in the non-tradable market and current account. The θ_T^P line illustrates the relationship underlying equation (14) and its slope is positive since, ceteris paribus, resources would be re-allocated to the tradable sectors as the structural real exchange rate increases. Along the θ_T^P line, producers reach their optimum production positions and the economy works efficiently along the production possibility frontier. Points above such a line reflect an excess supply of non-tradable goods, while there is an excess of supply of tradable goods below it.

The intersection of the θ_T^C and θ_T^P lines in Figure 1 determines, at point E_0, the equilibrium

Figure 1. Equilibrium structural real exchange rate and tradable goods share in *GDP*



structural real exchange rate and the tradable goods share in GDP; q_0 and θ_0, respectively. The regions around E_0 represent four types of disequilibrium. Points in the right quadrant correspond to a position where the tradable production exceeds the optimal production level and the conditioned tradable expenditure share exceeds the consumers' optimal budget share in tradable goods. Producers' interaction pushes the tradable shares downwards via higher factor prices, while the consumers' optimal decision pushes the structural real exchange rate downwards until the equilibrium is reached at point E_0. The left quadrant shows the opposite combination: excess of supply of non-tradable goods and constrained tradable expenditure share, points at which the non-tradable prices are above their equilibrium level and the tradable expenditure share constrained.

Points in the upper quadrant also reflect excess of supply of non-tradable goods, but in this case, it is combined with an eased tradable expenditure share. The equilibrium is reached via lower factor prices. The adjustment towards the equilibrium occurs through a real depreciation and higher factor prices when the economy is in the lower quadrant.

The substitution of equation (14) into equation (12) determines the structural real exchange rate movement equation and the substitution of such an equilibrium relation into equation (10) determines the tradable goods share in GDP movement equation. Formally:

$$\hat{q} = -\Phi_1 \hat{A}_X - \Phi_2 \hat{A}_M + \Phi_3 \hat{A}_N + \Phi_4 \hat{L} + \Phi_5 \hat{K} - \Phi_6 \widehat{TT} + \Phi_7 d(DS) \quad (15)$$

$$d(\theta_T) = \Gamma_1 \hat{A}_X + \Gamma_2 \hat{A}_M - \Gamma_3 \hat{A}_N - \Gamma_4 \hat{L} - \Gamma_5 \hat{K} + \Gamma_6 \widehat{TT} + \Gamma_7 d(DS) \quad (16)$$

where

$$\Phi_0 = \frac{\left(\frac{1-\beta}{\beta}\right)\left(\frac{1}{\theta_T - DS}\right)}{(1-\gamma) + \left(\left(\frac{1-\beta}{\beta}\right)\left(\frac{1}{\theta_T - DS}\right)\left(\frac{\theta_X}{1-\phi_X-\psi_X} + \frac{\theta_M}{1-\phi_M-\psi_M}\right)\right)}$$

$$\Phi_1 = \Phi_0 \frac{\theta_X}{1-\phi_X-\psi_X} \qquad 0 \leq \Phi_1 \leq 1 \qquad \Gamma_1 = \frac{\Phi_1}{\Phi_0}(1-\Phi_3)$$

$$\Phi_2 = \Phi_0 \frac{\theta_M}{1-\phi_M-\psi_M} \qquad 0 \leq \Phi_2 \leq 1 \qquad \Gamma_2 = \frac{\Phi_2}{\Phi_0}(1-\Phi_3)$$

$$\Phi_3 = \Phi_1 + \Phi_2 \qquad 0 \leq \Phi_3 \leq 1 \qquad \Gamma_3 = \Gamma_1 + \Gamma_2$$

$$\Phi_4 = \Phi_0 \theta_T \theta_L \qquad 0 \leq \Phi_4 \leq 1 \qquad \Gamma_4 = \frac{\Phi_4}{\Phi_0}(1-\Phi_3)$$

$$\Phi_5 = \Phi_0 \theta_T \theta_K \qquad 0 \leq \Phi_5 \leq 1 \qquad \Gamma_5 = \frac{\Phi_5}{\Phi_0}(1-\Phi_3)$$

$$\Phi_6 = (1-\delta)\Phi_1 - \delta\Phi_2 \qquad \Phi_6 \lesseqgtr 0 \qquad \Gamma_6 = \frac{\Phi_6}{\Phi_0}(1-\Phi_3)$$

$$\Phi_7 = \Phi_0 \left(\frac{1-\theta_T}{1-DS}\right) \qquad \Phi_7 \geq 0 \qquad \Gamma_7 = \frac{\Phi_7}{\Phi_0}\Phi_3$$

Although existing models of real exchange rate determination imply a role for tastes and technology, as well as the conditions under which one might be more relevant than the other (García, 1999) in contrast to the model developed here, these models do not take account of the fact that different economies may respond asymmetrically to similar exogenous shocks as a result of their heterogeneous economic structure; exceptions are Cerda (2001) that notices that the effect of larger capital flows affects negatively the real exchange rate, but the effect depends on the size of the exportable sector, and Asea and Mendoza (1994) who express the equilibrium structural real exchange rate as a function of sectoral labour shares and the capital-output ratio in the tradable sectors. Additional indicators of the structure of the economy involved in the model are the income distribution ratios (θ_X, θ_M, θ_T, θ_L and θ_K) and the *DS* ratio.

Table 2 summarizes the comparative static results derived so far: that is, the signs in the first column indicate that TFP improvements in the primary sector: a) have initially a positive impact on the tradable goods share in *GDP*, b) appreciate the equilibrium structural real exchange rate and c) increase the equilibrium tradable goods share in *GDP*. Table 2 also displays how exogenous shocks, via their impact on the structural real exchange rate, affect the allocation of resources within the tradable sector; *e.g.* the last two rows of the first column suggest that TFP improvements in the primary sector increase the size of the primary sector, but reduce the size of the manufacturing sector.

Before undertaking experiments with the model, assuming that initial changes in the sector outputs reflect their TFP variation, equation (17) defines the initial impact of TFPs, the structural real exchange rate, and the terms of trade on the size of the tradable goods sector; note that the impact of sector TFPs, structural real exchange rate, and terms of trade on the tradable goods share in GDP are larger (in absolute value) than their initial impact.

$$d\left(\theta_T^d\right) = (1-\theta_T)\left(\left(\theta_X \hat{A}_X + \theta_M \hat{A}_M - \theta_T \hat{A}_N\right) + \left((1-\delta)\theta_X - \delta\theta_M\right)\widehat{TT} + \hat{q}\theta_T\right) \quad (17)$$

where θ_T^d is defined as $\left(\frac{P_X X + P_M M}{P_X X + P_M M + P_N N}\right)$

Table 2. Real exchange rates and shares in GDP responses to shocks

	Exogenous shocks								*Linkages*	
Impact	**Variables**	A_X	A_M	A_N	L	K	T	DS	q	θ_T
First	q							+		-
	θ_T	+	+	+	-	-	?+		+	
Equilibrium	q	-	-	+	+	+	?-	+		
	θ_T	+	+	-	-	-	?+	+		
	θ_X	+	-	-	?	?	+	+		
	θ_M	-	+	-	?	?	-	+		

Note: The first two rows correspond to the relationships of equations (12) and (14), respectively. The third and fourth row correspond to equations (15) and (16), respectively. The last two rows shows the response of the equilibrium share in *GDP* of the primary and manufacturing sectors to exogenous shocks. A + indicates a positive effect, a - a negative effect and a ? an ambiguous effect; the signs in subscripts are valid relationships when terms of trade improvements appreciate q.

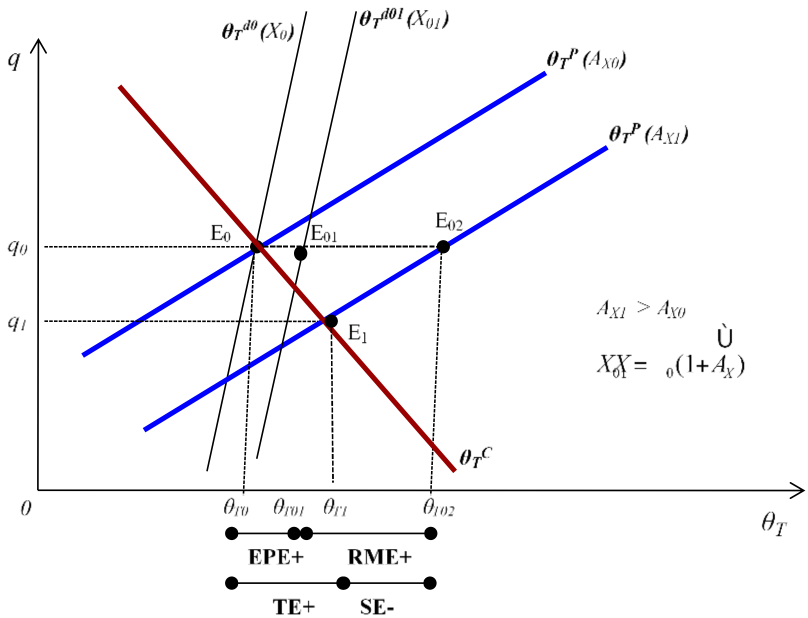
IV. Experiments with the model

The model can now be used to examine the impact of various shocks and in particular to identify the new channels of interaction between the structural real exchange rate and the size of the traded goods sector, θ_T. These shocks are: improvements in total factor productivities, factor endowments, terms of trade and debt service (or transfers or aid flows), respectively.

1. Improvements in A_X

Figure 2 displays the effects of A_X improvements in the structural real exchange rate and tradable goods share in *GDP*; the θ_T^d line depicts the relationship between the last two variables according to equation (17). TFP improvements in the primary sector diminish the relative cost of producing primary goods and shift the θ_T^P and θ_T^d lines downwards. The additional income of the primary producers increases their profits and generates *Extraordinary Profit Effects* (EPE), which are reflected by an increment of the tradable sector size equal to E_0E_{01} or $\theta_{T0}\theta_{T01}$.

Figure 2. The role of A_X improvements



The increased productivity drives up the value of the marginal product of both factors employed in the primary sector and increases their demand. It pushes factor prices up, pushing labour and capital out of the manufacturing and the non-tradable sectors. At the initial structural real exchange rate, producers thus reach their optimum at point E_{02} and A_X improvements re-allocate resources to the primary sector and thus cause direct de-industrialisation of the manufacturing sector; the consequent *Resource Movement Effects* (RMEs) are measured by the distance $\theta_{T01}\theta_{T02}$.

Due to the full employment conditions, factor price increments increase *GDP* and the demand for all goods. A higher non-tradable demand pushes non-tradable prices and the factor prices upwards. This has the effect of drawing production factors out of both tradable sectors, which is the so-called *indirect* de-industrialisation of the manufacturing sector. The equilibrium point is reached at point E_1, where a real appreciation has occurred and the tradable goods share in *GDP* has increased. *Spending Effects* (SEs), and *Total Effects* (TEs) are equal to the distances $\theta_{T1}\theta_{T02}$ and $\theta_{T0}\theta_{T1}$, respectively.

Increases in TFP in the manufacturing sector have similar effects to the ones explained above, but in this case, the de-industrialization effect occurs in the primary sector. The impact of TFP improvements in the non-tradable sector operates in the opposite way to TFP improvements in the tradable sectors, but in this case, a de-industrialization of both tradable sectors occurs.

Following Baumol and Bowen (1966: 171), the faster the general pace of technological advance, the higher will be the wage level, and the greater will be the upward pressure on costs in other industries which do not benefit from rising productivity. Consequently, if productivity in the tradable goods sector grows faster than in the non-tradable sector the relative price of non-tradable goods would rise; the subsequent real appreciation is known as the *Baumol-Bowen effect*. In our model, larger TFP improvements in the tradable sector give the Baumol-Bouwen effects, but symmetric TFP changes across sectors do not affect the structural real exchange rate and tradable goods share in *GDP*, since $\Phi_1 + \Phi_2 = \Phi_3$ and $\Gamma_1 + \Gamma_2 = \Gamma_3$.

2. Factor endowments expansions

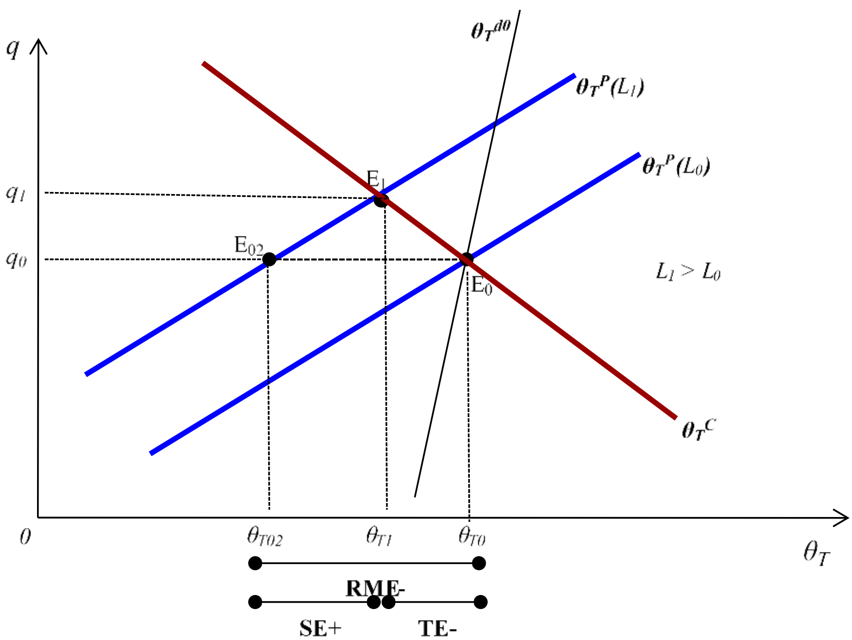
A rise in the factor endowments increases the output levels of all sectors. At the initial factor prices, it increases the income of all factors, but, at the initial structural real exchange rate, the income of the tradable sector does not change and therefore the tradable goods share in *GDP* diminishes. Consequently, the θ_T^P line of Figure 3 shifts to the left and the corresponding *resource movement effects* are measured by the distance $E_{02}E_0$ in Figure 3.

The resulting excess supply of non-tradable goods pushes non-tradable prices and consequently factor prices down. *GDP* and the demand for all goods increase; the excess supply of non-tradable goods, however, persists. The consequent spending effects are reflected by a higher structural real exchange rate $(q1 - q0)$ and tradable goods share in *GDP*, $(\theta_{T1} - \theta_{T02})$. Thus, a rise in factor endowments generates a real depreciation, but diminishes the tradable goods share in GDP from θ_{T0} to θ_{T1}.

3. Terms of trade shocks expansions

Terms of trade improvements increase the primary producers' income and profits; $\theta_{T01} - \theta_{T0}$ in Figure 4 measures the subsequent extraordinary profits effect, *EPE*. These improvements give rise also to additional traded price effects (*T_PEs*) because their direct and positive impact on the

Figure 3. Factor endowments influences

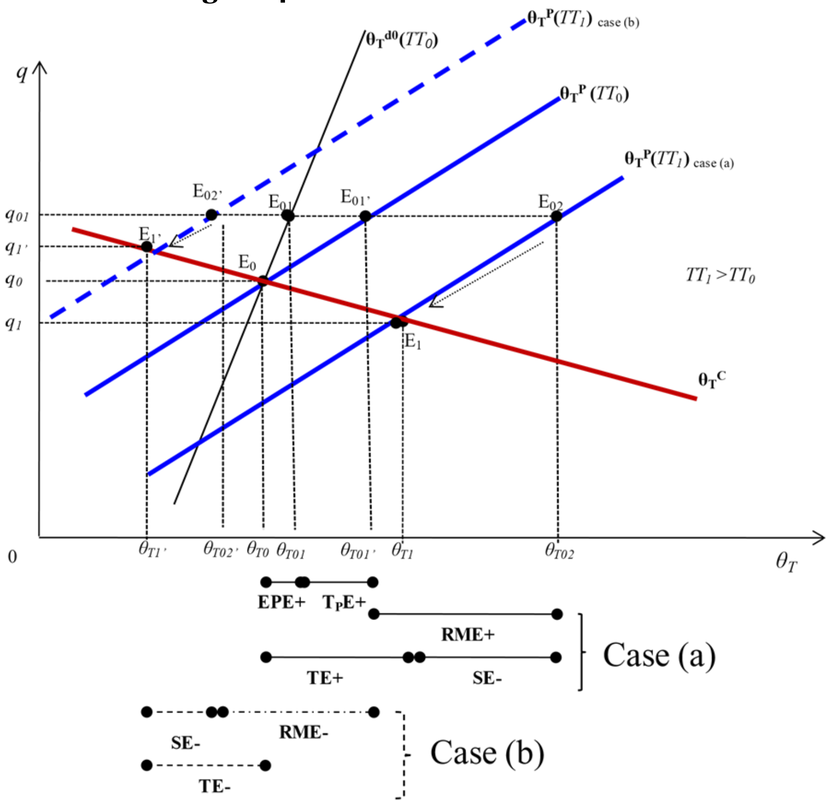


structural real exchange rate (q01-q0) reallocates resources by shifting both production factors to the primary sector and the tradable sector as a whole. Graphically, the economy moves along the initial θ_T^P line up to the point E_{01}, and the traded price effects of terms of trade are measured by the distance $\theta_{T01}\theta_{T01'}$. The reallocation of resources as a result of trade price effects occurs only via higher factor prices. Subsequently, the relevant θ_T^P line is the one corresponding to the higher terms of trade. Thus production factors would again be re-allocated via resource movement effects favorable to the primary sector only.

The overall effect on the tradable sector is however ambiguous. If a) the increase in the size of the primary sector (θ_X) outweighs the reduction of the manufacturing sector (θ_M), the θ_T^P line shifts to the right as in the $\theta_T^P(TT_1)_{case\ (a)}$ line or b) the increase in the size of the primary sector is offset by the reduction of the manufacturing sector, the θ_T^P line shifts to the left as in $\theta_T^P(TT_1)_{case\ (b)}$ line. The distances $\theta_{T02}\theta_{T01'}$ and $\theta_{T01'}\theta_{T2}$ measure the resource movement effects corresponding to case (a) and (b), respectively.

At point E_{02} (or point $E_{02'}$) the income of the economy has increased as well as the demand for all goods. There is, therefore, an excess of demand for non-tradable goods that pushes the structural real exchange rate and the tradable goods shares in *GDP* downwards; the distances

Figure 4. Terms of trade influences



q01-q1 and q01-q1' measure the real appreciation corresponding to case (a) and (b), respectively. The spending effects originated by such real appreciation are equal to $\theta_{T1} - \theta_{T02}$ and $\theta_{T1'} - \theta_{T02'}$ in case (a) and (b), respectively. Point E_1 (or $E_{1'}$) is the new equilibrium point. Note that, in any case, terms of trade improvements give rise to both *direct* and *indirect* de-industrialisation on the manufacturing sector through resource movement effects to the primary sector and spending effects to the non-tradable sector.

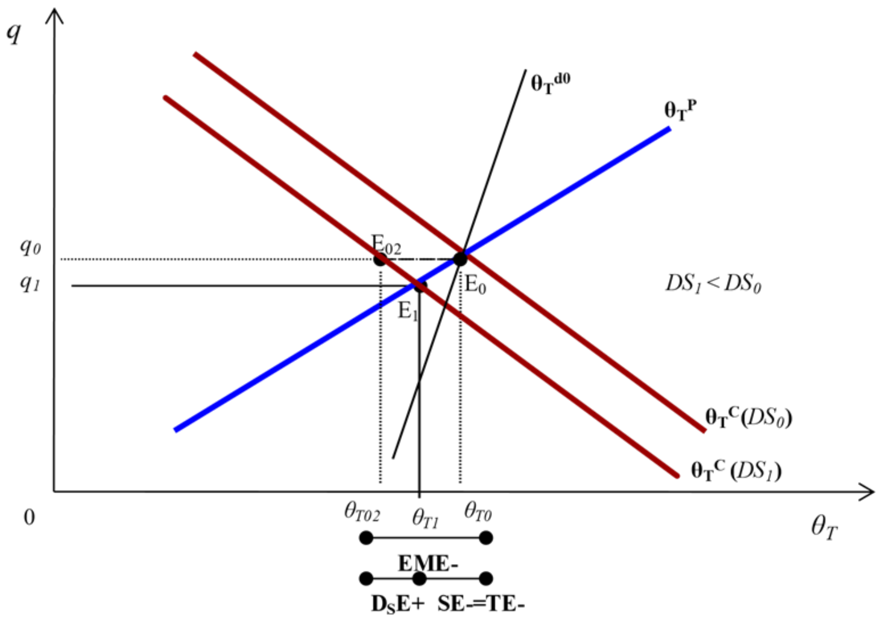
To sum up, the impact on the structural real exchange rate is ambiguous since terms of trade shocks change tradable and non-tradable prices in the same direction. It is worth nothing that larger primary goods expenditure in the total tradable expenditure ($\delta \rightarrow 1$) or larger manufacturing sector ($\theta_M \rightarrow \theta_T$) could lead to real depreciations, while the opposite effects give rise to real appreciations.

The model of Fardmanesh (1990) proposes the world price effect, which comprises among others the resource movement effect, and analyses the impact of terms of trade on the primary, manufacturing and non-tradable production levels, but not on the tradable (or manufacturing) shares in GDP as this paper does.

4. Debt service reductions, additional aid flows/transfers or exogenous revenues injected in the economy

A decline in the variable *DS* eases the tradable expenditure shares and shifts the θ_T^C line down as in Figure 5. At the initial structural real exchange rate, the tradable goods share in *GDP* that satisfy the new macroeconomic restrictions should diminish at point E_2; the consequent *expenditure movement effects* (EMEs) are equal to the distance E_0E_{02}.

Figure 5. External debt service (net of transfer) influences



Producers, however, do not adjust their production levels at the initial structural real exchange rate. As a result, the excess of demand for non-tradable goods pushes non-tradable prices up-wards. The resulting real appreciation induces substitution effects (*DsE*, the *debt substitution effects*) favourable to the tradable sector, as given by the distance $\theta_{T02}\theta_{T1}$. At the new equilibrium point (point E_1) the structural real exchange rate appreciates, spending effects, which are equal to the total effects, reduce the size of the tradable sector equal to distance $\theta_{T1}\theta_{T0}$ and both tradable goods production (consumption) levels diminish (increased). *DS* reduction has Dutch Disease effects since it reduces the share of the manufacturing sector in *GDP*.

The positive impact of external liabilities on the real exchange rates is considered by Aguirre and Calderon (2005: 6) as the "*transfer effect*" in the sense that it is expected that countries with significant external liabilities need to run trade surpluses in order to service them. In this paper, countries with high debt services need to have larger tradable sectors.

This model also allows the incorporation of aid flows: a) if they increase the transfers-to–GDP ratio, they will reduce the size of both tradable sectors in the economy and give rise to Dutch Disease effects; b) if they improve TFP in a particular sector, they would induce an allocation of resources to that sector; and c) if they increase consumption and cause TFP improvements, their effect on the structural real exchange rate and the share of the tradable sector would be ambiguous.

V. Additional considerations

1. Overvalued structural real exchange rates and economic growth

Movements of the equilibrium structural real exchange rate and the tradable share of output, due to a change in the underlying fundamentals, also modify the income of our small economy. Equation (18) formally presents the *GDP* equilibrium movement equation:

$$G\widehat{D}P = \Phi_1\hat{A}_X + \Phi_2\hat{A}_M + (1-\Phi_3)\hat{A}_N + (\theta_L-\Phi_4)\hat{L} + (\theta_K-\Phi_5)\hat{K} + \Phi_{6X}\hat{P}_X + \Phi_{6M}\hat{P}_M - \Phi_7 d(DS) \quad (18)$$

where Φ_i were defined by equation (15), and where $\Phi_{6X} = \Phi_6 + \delta$ and $\Phi_{6M} = (1-\delta) - \Phi_6$.

In contrast to Demir and Razmi (2021: 25), who argue that, empirically, the relationship between the real exchange rate and growth is bidirectional, in our model the equilibrium *GDP* does not depend on the structural real exchange rate. Equation (18) implies that an overvalued structural real exchange rate increases the tradable share and GDP, but it does so only temporarily. If the economy is initially in equilibrium and policy-makers choose to devalue tradable prices will increase, while factor prices will exceed the value of the marginal product of the factors employed in the tradable sector, whilst falling below those in the non-traded sector. The subsequent excess of demand for resources in the tradable sector and excess supply in the non-tradable sector increases GDP and the tradable goods share in *GDP*. The additional *GDP* will increase the demand for all goods in such a manner that the structural real exchange rate and tradable goods share in GDP will return to their equilibrium position. Note, however, that the economy reaches its new equilibrium position through inflation since the price of all goods has increased at a rate equal to the initial devaluation.

Our results suggest thus that real exchange rate misalignments, observed real exchange rate that differ from their equilibrium levels, do not influence, in the long-run, the *GDP*. The supporters of export-led growth, however, would claim that there is always a role for economic policy to keep the currency undervalued so as to spur economic growth (Magud and Sosa, 2010: 7). Williamson (2008), on the other hand, notes that a misaligned exchange rate, particularly an overvalued rate, although also a seriously undervalued rate, impedes growth, which receives empirical support in the study of Aguirre and Calderon (2005). Guzman et al. (2018) adds that a stable and competitive real exchange rate as a tool for promoting economic development. In this paper, the only stable and competitive real exchange rate is an equilibrium one.

Equation (18) also shows that if total factor productivity in the tradable sectors is lower due to market imperfections, as in Rodrik (2008), economic growth will be lower than in the perfectly competitive case. Also, if TFP grows faster in the manufacturing sector than others, as suggested by Rodrik (2006), our model will postulate that the evolution of the TFP of the manufacturing sector will be the main driver of economic growth (from equation 18). Thus, rapidly growing countries would be those with larger manufacturing sectors, note that Φ2 increases when the manufacturing share in *GDP* increases and that such a share increases when the TFP in the manufacturing sector increases.

2. The monopolistic non-tradable sector case

The baseline model is extended by relaxing the assumption of perfect competitive non-tradable market for a monopolistic non-tradable market. Under these circumstances, the first order of the non-tradable producers optimisation problem, $w = \beta P_N A_N Z_{N_L}$ and $r = \beta P_N A_N Z_{N_K}$, imply lower factor prices and, with given factor endowments, lower total factor rewards with respect to the perfectly competitive case. As a result, the gross domestic product will be larger than the total factor rewards and, therefore, the tradable goods share in $GDP (\theta_T = (P_X X + P_M M)/GDP)$ would be lower than the tradable goods share in the total factor reward $\left(\theta_{T_a} = (P_X X + P_M M)/(wL + rK)\right)$. Formally:

$$\frac{P_X X + P_M M}{wL + rK} = \frac{GDP}{wL + rK} \frac{P_X X + P_M M}{GDP} \tag{19}$$

$$\theta_T = \frac{1}{gdp_N} \theta_{T_a} \tag{20}$$

where $gdp_N \left(= GDP/(wL + rK)\right)$ is the *GDP*-to-total factor reward ratio, which is higher than one.

Assuming a constant gdp_N ratio and taking into account that the variations of θ_{T_a} are given by the right-hand side of Equation (14), variations of the tradable goods share in *GDP* are defined as follows:

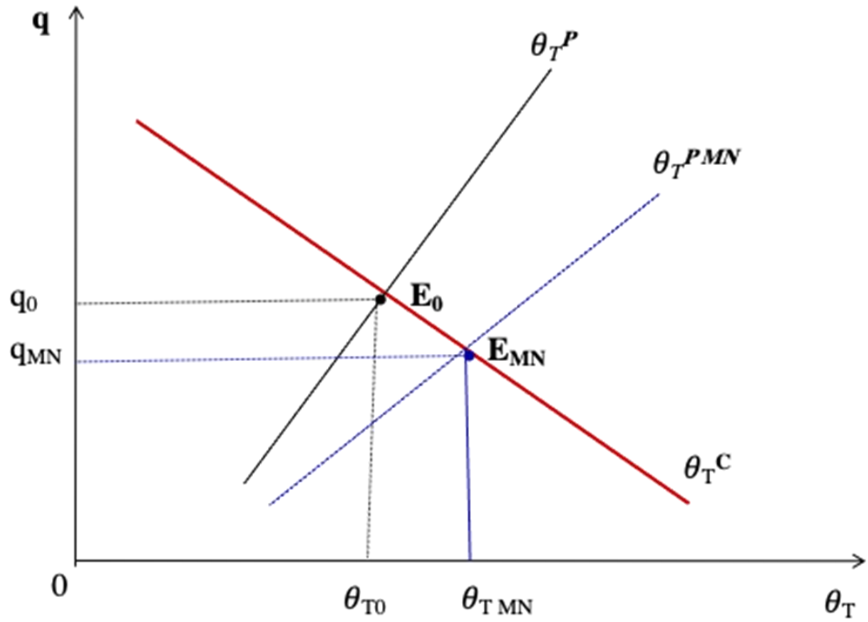
$$d(\theta_T) = \frac{1}{gdp_N}\left\{\left(\frac{\theta_X}{1-\phi_X-\psi_X} + \frac{\theta_M}{1-\phi_M-\psi_M}\right)(\hat{q}-\hat{A}_N) - \theta_T\theta_L\hat{L} - \theta_T\theta_K\hat{K}\right.$$

$$\left. + \frac{\theta_X}{1-\phi_X-\psi_X}\hat{A}_X + \frac{\theta_M}{1-\phi_M-\psi_M}\hat{A}_M + \left(\frac{\delta\theta_X}{1-\phi_X-\psi_X} - \frac{(1-\delta)\theta_M}{1-\phi_X-\psi_M}\right)\widehat{TT}\right\} \qquad (21)$$

The relationship between Equations (12) and (21) determines the movement equation of the equilibrium structural real exchange rate and tradable goods share in *GDP*. Graphically, Figure 6 benchmarks the determination of the equilibrium relationships when non-tradable markets are perfect competitive or monopolistic. The line θ_T^P represents the non-tradable sector perfectly competitive case (see Equation (15)), while the line $\theta_T^{P^{MN}}$ represents the monopolistic non-tradable case (see Equation (21)). As before, the line θ_T^C refers to the relationships defined by Equation (12). As expected, the structural real exchange rate diminishes, while the tradable goods share increases when a perfectly competitive non-tradable markets becomes a monopolistic one, see points E_0 and E_{MN} in Figure 6.

Figure 6 also tells that the impact of exogenous shocks on the structural real exchange rate and the tradable goods share in *GDP*, under perfectly competitive or monopolistic non-tradable markets are qualitatively similar, as described by Table 2. Nonetheless, the magnitude of the impact of exogenous shocks under these two market conditions differs. For instance, Figure 7 shows that, under a monopolistic non-tradable sector, the structural real exchange rate diminishes less and the tradable goods share increase less *w.r.t.* the perfect competitive case when a total factor productivity shock hit any of the tradable sectors.

Figure 6. Perfectly competitive vs monopolistic non-tradable market

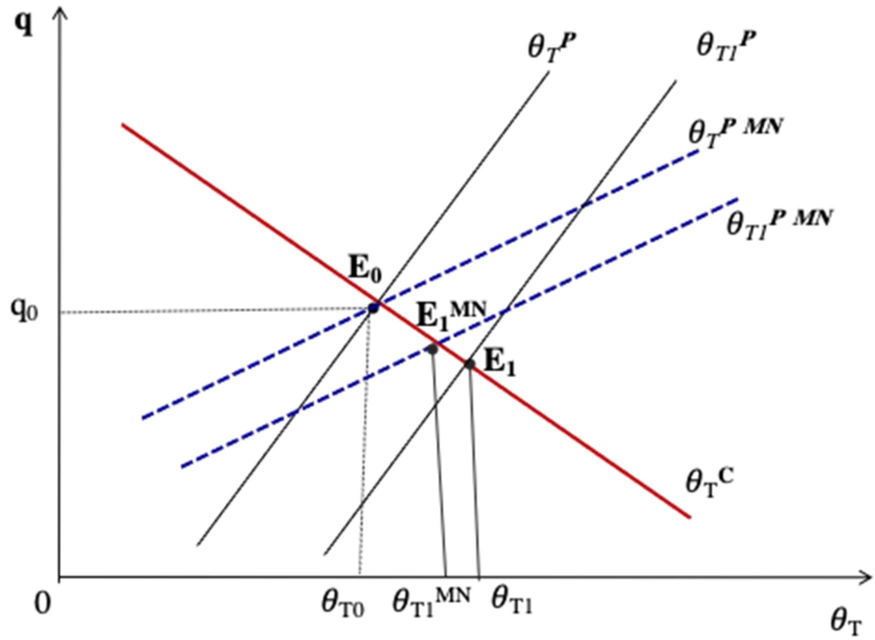


3. Benchmarking to Corden and Neary (1982) core model

Based on the seminal papers of Swan (1955) and Salter (1959), in the 1980s Neary and Purvis (1982), Neary and Purvis (1983) and Corden (1984) demonstrated that a rise in the productivity in the booming (energy) sector could give rise to de-industrialisation through resource movement and the income (or spending) effects. They assume three sectors, a booming sector (energy), a lagging sector (manufacturing) and a non-tradable sector. They also assume that each sector's output is produced by a specific factor to that sector, and by labour, which is assumed mobile between sectors and moves to equalize its wage. Their results suggest that productivity improvements, terms of trade shocks and windfall discoveries of sector specific resources might generate the Dutch disease.

In order to benchmark our baseline model to Corden and Neary (1982) model the booming sector is assumed to be the primary sector and the lagging sector the manufacturing sector. Perfectly

Figure 7. Different responses to exogenous TFP shocks in any of the tradable sectors



Note that after the tradable productivity shock, θ_{T1}^{P} line shift is larger than the $\theta_{T\,1}^{P\,MN}$ line shift since the gdp_N ratio is larger than one.

mobility of labour and capital and an exogenously given third specific factor R to each tradable sector (energy for example) are additionally assumed. Production functions of the primary and manufacturing sectors are thus re-defined as follows:

$$X = A_X R_X^{\varphi X} L_X^{\phi X} K_X^{\psi X} \tag{22}$$

$$M = A_M R_M^{\varphi M} L_M^{\phi M} K_M^{\psi M} \tag{23}$$

where:

R_X and R_M are the specific factors addressed to the primary and manufacturing sectors, respectively.

φ_X and φ_M are the primary and manufacturing output elasticities to the factors R_X and R_M, respectively. They lie between zero and one and $\phi_x + \psi_X + \varphi_X = 1$ and $\phi_M + \psi_M + \varphi_M = 1$.

Qualitative results of this extension are also similar to the baseline model results shown in Table 2. In the base line model thus changes of A_X and A_M can be seen as a consequence of total factor productivity shocks or windfall increments of R_X and R_M, respectively. Consequently, windfall discoveries of specific resources R addressed to a specific tradable sector only reallocate resources to that sector. It is so because they increase the marginal productivity of labour and capital employed in that sector only. Additionally, windfall discoveries of R_X resources reduce the competitiveness of an our economy (lower structural real exchange rate) and generate Dutch disease effects because they diminish the output and share to GDP of the manufacturing sector, although they increase the tradable sector share to GDP; graphically the θ_T^p and θ_T^d lines will shift downwards when R_X increases with extraordinary profit, resource movement and substitution effects similar to the ones described in subsection IV.1.

In line with Rodrik (2008), it can be assumed that private tradable goods producers can only retain $(1 - \tau_i)$ of their output $(i = X, M)$ due to "apropiability" problems arising from either institutional weakness of market failures or both. In our extended model, R_M and R_X can be interpreted as $(1 - \tau_X)$ and $(1 - \tau_M)$, respectively. The size of the exportable and importable sector in such economy will be lower with respect to the baseline economy. The structural real exchange rate will be larger, but not large enough to guarantee that the size of both tradable sectors coincide with the perfect economy model case. Rodrik (2008: 22) mentions that governments have a variety of instruments at their disposal to influence the level of the real exchange rate, and the evidence is that they use them. In this extended model, an undervalued structural real exchange rate could help, although in the short-run, to overcome the negative effects of the market imperfections on the tradable sectors, specially to the manufacturing sector.

4. Home-biased preferences

According to the Heckscher-Ohlin-Samuelson model, a country imports its non-comparative advantage goods and exports its comparative advantage goods. There is no two-way trade at the commodity level. In trade data, however, "there is evidence of cross-hauling-countries import and export of the same commodity, even for the most detailed commodity category" (Thierfelder and Robinson, 2002: 4).

The baseline model is thus extended by assuming consumers to choose between two kinds of varieties for each kind of tradable goods: a variety produced internally (C_{X^d} and C_{M^d}) and a variety produced abroad (C_{X^*} and C_{M^*}). Consumer preferences are defined as in the original model, but her preferences between varieties are linear and biased to the variety domestically produced. Consequently, C_X and C_M are redefined as follows:

$$C_X = \epsilon_X C_{X^d} + (1-\epsilon_X) C_{X^*} \tag{24}$$

$$C_M = \epsilon_M C_{M^d} + (1-\epsilon_M) C_{M^*} \tag{25}$$

where ϵ_X and ϵ_M are the home biased coefficients for primary and manufactured goods, respectively. They lie between 0.50 and 1.

Each tradable sector is divided in two sub-sectors, one which produces exclusively for the internal market (X^d and M^d) and another one which produces only to export (X^* and M^*). Each tradable sub-sector technology is assumed to be Cobb-Douglas, while the non-tradable technology is still assumed to be linear. Tradable goods supply functions are formally defined as follows:

$$X^d = A_{X^d} L_{X^d}^{\phi_{X^d}} K_{X^d}^{\psi_{X^d}} \tag{26}$$

$$X^* = A_{X^*} L_{X^*}^{\phi_{X^*}} K_{X^*}^{\psi_{X^*}} \tag{27}$$

$$M^d = A_{M^d} L_{M^d}^{\phi_{M^d}} K_{M^d}^{\psi_{M^d}} \tag{28}$$

$$M^* = A_{M^*} L_{M^*}^{\phi_{M^*}} K_{M^*}^{\psi_{M^*}} \tag{29}$$

where, for $i = X, M$ and $j = d, *$, L_i^j and K_i^j are each sector's labour and capital, while ϕ_i^j and ψ_i^j are the output elasticities of labour and capital, respectively. Again, it is assumed that $\phi_i^j + \psi_i^j$ is lower than one.

The marginal rate of substitution of a domestically produced tradable good for a foreign produced tradable good equals, in the optimal point, to the relative price between these goods. Formally:

$$\frac{P_{X^d}}{P_{X^*}} = \frac{\epsilon_X}{1-\epsilon_X} \tag{30}$$

$$\frac{P_{M^d}}{P_{M^*}} = \frac{\epsilon_M}{1-\epsilon_M} \quad (31)$$

where P_{X^*} and P_{M^*} are the domestic prices of the exportable and importable goods produced abroad, respectively; which are assumed exogenously given and equal to the domestic prices of the domestic goods sell abroad.

The price conditions set by equations (30) and (31) assures positive production and consumption levels of any primary or manufacturing good as well as the relative law of one price; the absolute law of one price, however, does not hold $\left(P_{X^d} > P_{X^*} \text{ or } P_{M^d} > P_{M^*}\right)$. The producers' optimization problem yields supply functions for each primary and manufacturing sub-sector similar to equations (8) and (9), respectively. The interaction of all producers, the full employment condition, zero profit condition and the relative law of one price implies the re-definition of equation (14). Formally:

$$d(\theta_T) = \left(\frac{\theta_{X^d}}{1-\phi_{X^d}-\psi_{X^d}} + \frac{\theta_{X^*}}{1-\phi_{X^*}-\psi_{X^*}} + \frac{\theta_{M^d}}{1-\phi_{M^d}-\psi_{M^d}} + \frac{\theta_{M^*}}{1-\phi_{M^*}-\psi_{M^*}}\right)(\hat{q} - \hat{A}_N) +$$

$$\frac{\theta_{X^d}}{1-\phi_{X^d}-\psi_{X^d}}\hat{A}_{X^d} + \frac{\theta_{X^*}}{1-\phi_{X^*}-\psi_{X^*}}\hat{A}_{X^*} + \frac{\theta_{M^d}}{1-\phi_{M^d}-\psi_{M^d}}\hat{A}_{M^d} + \frac{\theta_{M^*}}{1-\phi_{M^*}-\psi_{M^*}}\hat{A}_{M^*} - \theta_T\theta_L\hat{L}$$

$$-\theta_T\theta_K\hat{K} + \left(\frac{\delta\theta_{X^d}}{1-\phi_{X^d}-\psi_{X^d}} + \frac{\delta\theta_{X^*}}{1-\phi_{X^*}-\psi_{X^*}} - \frac{(1-\delta)\theta_{M^d}}{1-\phi_{M^d}-\psi_{M^d}} - \frac{(1-\delta)\theta_{M^*}}{1-\phi_{M^*}-\psi_{M^*}}\right)\widehat{TT} \quad (32)$$

The interaction between equations (12) and (32) determines the movement equation of the equilibrium structural real exchange rate and tradable goods share in GDP. The impact of the economic fundamentals will be similar to the results described by the baseline model, but in this case total factor productivities in the tradable sectors will have different impact depending on which tradable subsector the productivity increases, the one that produces solely for the domestic or for the foreign market.

Table 3. Equilibrium relationships in presence of Home-biased trade

Variables	Exogenous shocks								
	Sector TFP shocks					Factor Endowments		Terms of Trade	Debt services net of transfers
	Primary		Manufacturing		Non-tradable				
	Domestic	Foreign	Domestic	Foreign					
	A^d_X	A^*_X	A^d_M	A^*_X	A_N	L	K	TT	DS
q	-	-	-	-	+	+	+	?-	+
θ_T	+	+	+	+	-	-	-	?+	+
θ_X	+	+	-	-	-	?	?	+	+
θ_M	-	-	+	+	-	?	?	-	+

Key: Domestic and foreign indicate whether the output of the corresponding tradable subsector is addressed solely to the domestic or foreign market, respectively.

VI. Conclusions

This paper extends the theoretical framework of the Australian models by allowing the size of the tradable sector to become endogenous and hence the structure of the economy to change as part of the longer run adjustment process. Our model analyses thus the two-way linkages between the structural real exchange rate and the relative size of the tradable sector in order to investigate how sector productivities, terms of trade, factor endowments and debt service payments impact on the equilibrium structural real exchange rate and the size of the tradable goods sector in a small economy.

Measuring changes in the allocation of resources by changes in the size of the tradable goods sector, Table 4 summarises the impact of exogenous shocks not only on the structural real ex- change rate, but also to the tradable goods share in *GDP* via: i) the extraordinary profit effect (*EPE*), which is reflected by a rise in the income of the sector favoured by the corresponding shock; ii) the resource movement effect (*RME*), which is related to the reallocation of resources, at the initial structural real exchange rate, generated by the subsequent exogenous shocks; iii) the spending effect (*SE*), which refers to the re-allocation of resources and expenditures due to structural real exchange rate movements; iv) the traded price effect (T_PE), the re-allocation of resources corresponding to increments of the tradable goods prices, v) the expenditure movement effects (*EME*), which measure the reallocation of resources compatible with the equilibrium of the current account when the external net debt servicing changes, and vi) the debt substitution effects, (D_SE) reflect the reallocation of resources originated by excess of demand of tradable goods when the net external debt servicing changes.

Table 4. Effects of exogenous shocks in the tradable goods share in GDP

Shock	Type of effect							Trabable share	Structural Real Exchange Rate
	EPE	T_PE	RME	EME	D_SE	SE	TE		
A_X	+		+			-	+	Increases	Appreciates
A_M	+		+			-	+	Increases	Appreciates
A_N	-		-			+	-	Diminishes	Depreciates
TT	+	+	+			-	+	Increases	Appreciates
			-			-	-	Diminishes	Depreciates
DS				+	-	+	+	Increases	Depreciates

Note: A plus (minus) indicates the direction of the corresponding effect, postive (a plus) or negative (a minus). A_X, A_M and A_N are the total factor productivity of the primary, manufacturing and non-tradable sectors, respectively. L and K are the labour and capital endowments, while TT and DS are the terms of trade and the debt services (net of transfers)-to-*GDP* ratio. EPE, T_PE, RME, EME, D_SE and TE refer to the extraordinary price, the traded price, the resource movement, the expenditure movement, the debt service subsitution, and the total effects, respectively.

The model suggests that terms of trade improvements and reductions of net external debt service give rise to a "Dutch Disease" effect; which maybe a source of concern for policy-makers to the extent that a smaller tradable sector might undermine future possibilities of growth and employment creation (Lama et al., 2012). Economic policies designed either to raise sector productivity or influence the evolution of a country's external debt should be at least partly evaluated by their impact on the long-term structural development of the economy of which the relative size of the tradables sector is an important component.

Our results hold when adding imperfections to the non-tradable sector, but it suggests, as expected, that an economy with a monopolistic (perfectly competitive) non-tradable sector will have a smaller (larger) structural real exchange rate, but larger (smaller) tradable sector. Also, when a total factor productivity shock hit any of the tradable sectors, the real exchange rate appreciation and the increase of the tradable sector share in *GDP* will be lower under a monopolistic non-tradable sector than under the perfect competition case.

When adding home-biased preferences and therefore consumers that choose between two kinds of varieties (a variety produced internally and a variety produced abroad), the assumption of the absolute law of one price is relaxed, but our results are qualitatively similar to the baseline model. In this case, however, the impact of total factor productivities differ depending on whether they arise from the tradable sector that produces solely for the domestic market or the foreign one.

This research can be extended by considering intertemporal decision processes as in Asea and Mendoza (1994), Balvers and Bergstrand (2002), García-Cicco and Kawamura (2015), Mejalenko (2015) and Schmitt-Grohé and Uribe (2021), non-linear technology in the non-tradable sector as García-Cicco and Kawamura (2015), Pentecost and Zarzosa Valdivia (2016)[3] and Schmitt-Grohé and Uribe (2021) do or by adding the public sector, learning by doing spillovers and/or a boom sector that produces energy, which can be used as input for the other sectors.

Referencias Bibliográficas

Aguirre, A., & Calderon, C. (2005). "Real exchange rate misalignments and economic performance". *Documentos de Trabajo No. 315*, Banco Central de Chile, 1–49.

Akinci, O. (2011). "A note on the estimation of the atemporal elasticity of substitution between tradable and non-tradable goods". manuscript, Columbia University.

Alberola, E. (2003). "Misalignment, liabilities dollarization and exchange rate adjustment in Latin America". Banco de España *Research Paper No. WP-0309*.

Araujo, E., Araújo, E., Peres, S. C., & Punzo, L. F. (2021). "An investigation into shapes and determinants of deindustrialization processes: Theory and evidence for developed and developing countries (1970–2017)". *EconomiA*, *22*(2), 129-143.

Asea, P. K., & Corden, W. M. (1994). "The balassa-samuelson model: An overview". *Review of International Economics*, *2*(3), 191–200.

Asea, P. K., & Mendoza, E. G. (1994). "The balassa-samuelson model: A general-equilibrium appraisal". *Review of International Economics*, *2*(3), 244–267.

Balassa, B. (1964). "The purchasing-power parity doctrine: a reappraisal". *Journal of Political Economy*, *72*(6), 584–596.

Balvers, R. J., & Bergstrand, J. H. (2002). "Government expenditure and equilibrium real exchange rates". *Journal of International Money and Finance*, *21*(5), 667–692.
Baumol, W. J., & Bowen, W. G. (1966). *Performing arts: the economic dilemma*. New York: Twentieth Century Fund.
Bjørnland, H. C., Thorsrud, L. A., & Torvik, R. (2019). "Dutch disease dynamics reconsidered". *European Economic Review*, Vol. 119, 411–433.
Brahmbhatt, M., Canuto, O., & Vostroknutova, E. (2010). "Dealing with Dutch disease". *Economic Premises*, World Bank Group.
Calderon, C. (2002). "Real exchange rates in the long and the short run: A panel co-integration approach". *Working Paper 153*, Central Bank of Chile.
Cerda, R. (2001). "Capital flows, oppennes and real exchange rate variability". *Working Paper 2015*, Catholic University of Chile.
Chang, K.-F., Lin, J.-X., & Lin, S.-M. (2021). "Revisiting the Dutch disease thesis from the perspective of value-added trade". *Resources Policy*, Vol. 72, 102103.
Connolly, M., & Deveraux, J. (1995). "The equilibrium real exchange rate: Theory and evidence for Latin America". In Stein, J. L., & Reynolds Allen, P. *Fundamental determinants of exchange rates* (pp. 154-81). Oxford: Oxford University Press.
Corden, W. M. (1984). "Booming sector and Dutch disease economics: survey and consolidation". *Oxford Economic Papers*, *36*(3), 359-380. (Reprinted in 1992 by the *International Trade Theory and Policy Handbook*. Cheltenham, UK; Northampton, MA, USA: Edward Elgar Publishing).
Corden, W. M., & Neary, J. P. (1982). "Booming sector and de-industrialisation in a small open economy". *The Economic Journal*, *92*(368), 825–848.
De Gregorio, J., & Wolf, H. C. (1994). "Terms of trade, productivity, and the real exchange rate". *Working Paper 4807*, National Bureau of Economic Research.
Demir, F., & Razmi, A. (2021). "The real exchange rate and development theory, evidence, issues and challenges". *Journal of Economic Surveys*, *36*(2), 386-428.
Devarajan, S. (1999). "Estimates of real exchange rate misalignment with a simple general equilibrium model". In Hinkle, L. E., & Montiel, P. J. (eds.). *Exchange rate misalignment: concepts and measurements for developing countries* (pp. 359–80). Oxford: Oxford University Press.
Devarajan, S., Lewis, J., & Robinson, S. (1991). "External shocks, purchasing power parity, and the equilibrium real exchange rate". *Development Discussion Paper No. 385*, Harvard Institute for International Development, Harvard-University.

Dixit, A. K., & Stiglitz, J. E. (1977). “Monopolistic competition and optimum product diversity”. *The American Economic Review*, *67*(3), 297–308.

Dornbusch, R. (1989). “Real exchange rates and macroeconomics: A selective survey”. *The Scandinavian Journal of Economics*, *91*(2), 401–432.

Edwards, S. (1986). “Terms of trade, exchange rates and labor markets adjustment in developing countries”. *NBER Working Papers 2110*, National Bureau of Economic Research.

Edwards, S. (1989). Real exchange rates, devaluation, and adiustment. Exchange rate policy in developing countries. Cambridge: MIT Press.

Fardmanesh, M. (1990). “Terms of trade shocks and structural adjustment in a small open economy: Dutch disease and oil price increases”. *Journal of Development Economics*, *34*(1-2), 339–353.

Galindo, A., Izquierdo, A., & Montero, J. M. (2001). “Real exchange rates, dollarization and industrial employment in Latin America”. *Research Paper 0601*, Banco de España.

Galstyan, V., & Lane, P. R. (2009). “The composition of government spending and the real exchange rate”. *Journal of Money, Credit and Banking*, *41*(6), 1233–1249.

García, P. (1999). “Income inequality and the real exchange rate”. *Working paper 54*, Banco Central de Chile.

García-Cicco, J., & Kawamura, E. (2015). “Dealing with the Dutch disease: Fiscal rules and macro-prudential policies”. *Journal of International Money and Finance*, Vol. 55, 205–239.

Gubler, M., & Sax, C. (2012). “Skill-biased technological change and the real exchange rate”. *Working Paper 2012/08*, Faculty of Business and Economics, University of Basel.

Guzman, M., Ocampo, J. A., & Stiglitz, J. E. (2018). “Real exchange rate policies for economic development”. *World Development*, Vol. 110, 51–62.

Ismail, K. (2010). “The structural manifestation of the ‘Dutch disease’: the case of oil exporting countries”. *Working Paper WP/10/103*, International Monetary Fund.

Krugman, P. R. (1988). “Deindustrialization, reindustrialization, and the real exchange rate”. *Working Paper 2586*, National Bureau of Economic Research.

Lama, R., Medina, J. P., et al. (2012). “Is exchange rate stabilization an appropriate cure for the Dutch disease”. *International Journal of Central Banking*, *8*(1), 5–46.

Lartey, E. K. (2008). “Capital inflows, resource reallocation and the real exchange rate”. *International Finance*, *11*(2), 131–152.

Magud, N., & Sosa, S. (2010). “The missing link between Dutch disease, appreciation, and growth”. *IMF Working Paper 271*, International Monetary Fund.

Mahbub Morshed, A., & Turnovsky, S. J. (2004). "Sectoral adjustment costs and real exchange rate dynamics in a two-sector dependent economy". *Journal of International Economics*, *63*(1), 147–177.
Mejalenko, J. (2015). "Un modelo de ciclo real para una economía pequeña y abierta: Uruguay frente al aumento de precios agropecuarios". Mimeo.
Montiel, P. J. (1999). "Determinants of the long-run equilibrium real exchange rate: an analytical model". In Hinkle, L. E., & Montiel, P. J. (eds.) *Exchange rate misalignment: concepts and measurement for developing countries* (pp. 264–290). Oxford: Oxford University Press.
Montiel, P. J. (2011). *Macroeconomics in emerging markets*. Cambridge University Press.
Neary, J. P., & Purvis, D. D. (1982). "Sectoral shocks in a dependent economy: Long-run adjustments and short-run accomodation". *The Scandinavian Journal of Economics*, *84*(2), 229–253.
Neary, J. P., & Purvis, D. D. (1983). "Sectoral shocks in a dependent economy: Long-run adjustment and short-run accommodation". In Calmfors, L. (eds.). *Long-Run Effects of Short-Run Stabilization Policy* (pp. 97–121). London: Palgrave Macmillan.
Nulle, G. M., & Davis, G. A. (2018). "Neither Dutch nor disease? — natural resource booms in theory and empirics". *Mineral Economics*, *31*(1), 35–59.
Obstfeld, M. and Rogoff, K. (2004). "The unsustainable us current account position". In revised paper prepared for the NBER conference on G-7 current account imbalances: sustainability and adjustment, July.
Pentecost, E. J., & Zarzosa Valdivia, F. (2016). "Structural real exchange rate and unemployment interdependencies in Argentina". *Revista de Economía y Estadística*, *52*(1), 57–86.
Rajan, R. G., & Subramanian, A. (2011). "Aid, Dutch disease, and manufacturing growth". *Journal of Development Economics*, *94*(1), 106–118.
Razmi, A., Rapetti, M., & Skott, P. (2009). "The real exchange rate as an instrument of development policy". Economics Department Working Paper Series, University of Massachusetts Amherst.
Rodrik, D. (2006). "Industrial development: stylized facts and policies". Harvard University, Massachusetts. Mimeo (also as draft for the "Industrial Development for the 21st Century", U.N.DESA Publication).
Rodrik, D. (2008). "The real exchange rate and economic growth". Brookings Papers on Economic Activity, 2008(2), 365–412.
Sachs, J. D. & Warner, A. (1995). Natural resource abundance and economic growth. *Working Papers 5398*, National Bureau of Economic Research.
Sachs, J. D., & Warner, A. M. (2001). "The curse of natural resources". *European Economic Review*, *45*(4-6), 827–838.

Salter, W. E. (1959). “Internal and external balance: the role op price and expenditure effects”. *Economic Record*, *35*(71), 226–238 (Reprinted in: Deepak, L. (ed.). *Development economics* (Vol. IV. The International Library of Critical Writing in Economics). Cheltenham, UK; Northampton, MA, USA: Edward Elgar Publishing.
Samuelson, P. A. (1964). “Theoretical notes on trade problems”. *The Review of Economics and Statistics*, *46*(2), 145–154.
Schmitt-Grohé, S., & Uribe, M. (2021). “Reviving the salter-swan small open economy model”. *Journal of International Economics*, Vol. 130:103441.
Soto, R., & Elbadawi, I. (2008). “Theory and empirics of real exchange rates in developing countries”. *Working Paper 324*, Institute of Economy, Catholic University of Chile.
Swan, T. (1955). “Longer runs problems of balance of payments, readings in international economics”. In Caves, R. E., & Johnson, H. G. (eds.). Readings in international economics: selected by a committee of the American Economic Association. London: Allen and Unwin.
Thierfelder, K., & Robinson, S. (2002). “Trade and tradability: Exports, imports, and factor markets in the salter-swan model”. *TMD discussion paper 93*, International Food Policy, Research institute.
van der Ploeg, F. (2011a). “Fiscal policy and Dutch disease”. *International Economics and Economic Policy*, *8*(2), 121–138.
van der Ploeg, F. (2011b). “Natural resources: curse or blessing?”. *Journal of Economic Literature*, *49*(2), 366–420.
Williamson, J. (2008). “Do development considerations matter for exchange rate policy?” Series on Central Banking, Analysis, and Economic Policies, no. 12, pages 475–489.
Zarzosa Valdivia, F. (2008). “Real exchange rate movements, Dutch disease and functional and sectoral income distribution”. In Tondl, G. Trade, *Integration and Economic Development*. *The EU and Latin America* (pp. 81-109). Dordrecht: Springer.

[1] In this model “home produced manufactured goods are treated as a special class of exportables: goods which could be sold on world markets, but in fact are not, for we should only have to buy them back” (Salter, 1959: 227).
[2] Following Akinci (2011), existing econometric studies point to an elasticity of substitution between tradable and non- tradable goods, $\frac{1}{1-\beta}$ of around 0.5 for emerging countries; for instance 0.46 for Uruguay, while between the [0.403, 0.5] range for Argentina.
[3] Pentecost and Zarzosa Valdivia (2016) point that the relative labor-to-capital price will be endogenous when nonlinearities are added to the model.