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ABSTRACT

We revisit the theme of the distributive implications of international prices and trade policies, focusing on economies relatively abundant in natural resources. The existence of non-traded goods adds a domestic demand channel that operates on factor prices, in addition to the usual Stolper-Samuelson effects. Depending on the configuration of the economy, we find diverse patterns in the response of factor earnings to international and policy shifts. The analysis relates to a number of long-standing concerns in developing economies, especially those of Latin America, and to the recent literature that has brought the role of international trade in shaping domestic social cleavages and policy tradeoffs back to the fore.

RESUMEN

Este trabajo vuelve sobre el tema de las implicancias distributivas de los movimientos de precios internacionales y de las políticas comerciales, con foco en economías abundantes en recursos naturales. La existencia de bienes no transables introduce un canal de demanda agregada que opera sobre los precios de los factores, además del clásico efecto Stolper-Samuelson. Dependiendo de la configuración de la economía, se encuentran diferentes patrones en la respuesta de los ingresos factoriales a cambios internacionales y de política. El análisis se vincula con tradicionales preocupaciones en países en desarrollo, América Latina en particular y con literatura reciente que ha traído nuevamente a la discusión. El rol de las formas de inserción internacional en la conformación de clivajes sociales y escenarios de política económica.

Keywords: income distribution, factor endowments, international trade, non-tradable goods
Distribución del ingreso, factores productivos, comercio internacional, bienes no comerciables

JEL Codes: F16, E25

Income distribution, factor endowments and trade revisited: The role of non-tradable goods

Sebastian ***Galiani,*** *Daniel* ***Heymann*** *and Nicolás* ***Magud***

1. Introduction

The proposition that the distributive implications of international trade are shaped by external conditions, the policy setup and the economy´s configuration in terms of production and consumption has been a matter of analytical concern for a long time and particularly so since the introduction of the celebrated theorem of Stolper and Samuelson (1941). Much has happened since then in terms of both foreign trade patterns and theory. Instead of considering economies composed of large sectors operating in competitive markets and characterized by the intensity of their use of a possibly small set of factors of production, the recent literature stresses the heterogeneity of goods and factors and the behavior of firms that market differentiated goods subject to a less than fully elastic demand. While this approach accounts for the enormous diversity of goods and services involved in cross-border exchanges and the growing importance of innovative rents as sources of income, the simple Heckscher–Ohlin–Samuelson (HOS) framework retains its usefulness for a significant array of interesting distributional problems. The argument that foreign trade tends to focus on an economy´s abundant factors (whether raw materials, at one extreme, or, at the other, sophisticated skills that can be used to push back the production frontier in terms of design and technologies) seems to be a robust proposition even today. Some of the salient changes seen in the international economy in recent decades, which has been marked by a steep increase in the labor supply in activities that are integrated into world trade, along with a sizable upswing in commodity prices, seem to correspond to that simple logic. In many developing countries, the tensions between the owners of natural resources, industrial capital and different types of labor continue to be a conspicuous feature of the economic and political landscape and help to shape attitudes towards strategic policy choices, especially regarding the role of these economies in international markets. These kinds of social conflicts have been recognized as potentially being deleterious for economic growth (see, among others, Rodrik (1999)). The analysis presented in this paper refers mainly to the effects of world prices and trade policies on factor incomes and distributive tradeoffs in economies of this type.

In the simple Stolper-Samuelson setup, production sectors are assumed to interact only through factor markets: in a small economy with only tradable goods, demand conditions are completely specified by world prices. Factor incomes vary with international prices according to the factor intensities of the respective sectors, independently of whether they produce exportable or importable goods. However, because of the existence of non-tradable goods in the economy, aggregate income effects have an impact as well. Factor prices will be influenced by the level of domestic spending. This induces an asymmetry between the effects on real factor incomes of changes in the international terms of trade since, for given factor intensities in traded-goods industries, there would tend to be a complementarity between revenues in non-tradable activities and the relative prices of exportable vis-à-vis importable goods. Countries with high degrees of specialization in the production of traded goods, where import-competing sectors are relatively small and where there is a sizable non-traded goods sector in which demand is determined by the level of expenditure of producers of exportable goods, will tend to receive "good news" in the form of improvements in their terms of trade concurrently with widespread increases in real factor incomes. In the case of economies with a different type of structure, however, this kind of international "good news" may not necessarily be favorable for all social groups, as the Stolper-Samuelson effect between importable and exportable sectors may interact with the aggregate demand consequences of shifts in the terms of trade.

Thus, both complementarities and tradeoffs can influence the economic determination of factor incomes and interest groups, and there is hard evidence of the operation of those effects in different economies and time periods. In a discussion of the dynamics of land-rich economies before the import-substitution stage, Galiani et al. (2008) note the spillover of higher exports on the domestic demand for non-tradables and analyze how a rise in the value of land-intensive production activities may provide incentives for elite-controlled governments to favor public education as a means of expanding the supply of skilled labor in service sectors. By contrast, a recent example of the strength of the social stresses that may result from large shifts in international markets, even in economies with rising export prices, is provided by the commodity boom of 2008, which led to social and political unrest in a large number of developing countries (with riots in some 30 cases) and to policy responses in the form of subsidies, price setting and export restrictions (*The Economist* (2008)).

Although our analysis can be adapted to apply to economies with other configurations, for the sake of concreteness and expositional clarity, we focus on the type of case which seems most relevant for natural-resource-abundant developing countries which can potentially produce three types of goods: a primary, exportable commodity, using as inputs land and unskilled labor; the goods produced by an urban non-tradable activity; and the goods produced by an import-competitive manufacturing industry. Both of these two urban activities employ (albeit with different intensities) unskilled and skilled labor. Introducing a specific factor in the manufacturing industry ("industrial capital") would not alter the analysis substantially.

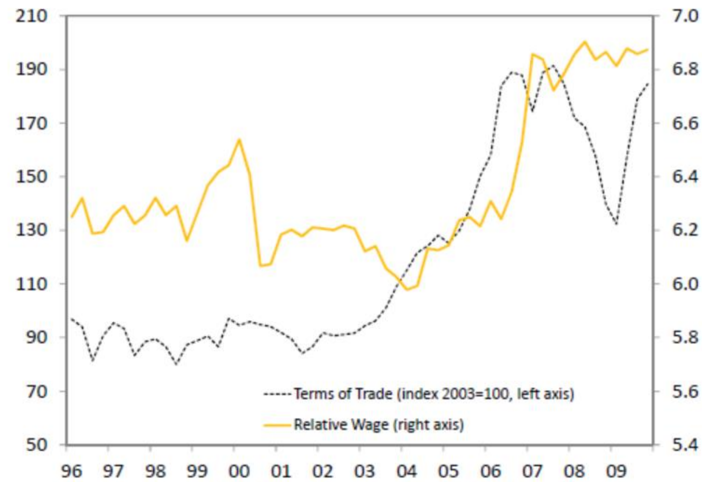
In the simplest case, the economy is specialized and produces only the exportable and non-traded goods. This setting would correspond to the production structure of countries that are well-endowed with natural resources, very open to international trade and in which urban activities related to the production of non-traded goods are supported by the demand derived from agricultural incomes, while import-competing activities are not profitable; alternatively, one could think of the case of economies that are also well-endowed in natural resources, but in which industrial sectors operate under such high levels of protection that they behave effectively as non-tradable sectors, with manufacturing imports consisting only of goods that are not produced locally. In this simple case of two relevant production sectors, and assuming that the demand for goods is determined by homothetic preferences, when the economy receives a terms-of-trade shock, the effects are seen to be *neutral* in terms of income distribution (see Subsection II.A). There is no distributive Stolper-Samuelson-type shift in relative factor prices, and the relative prices between locally produced goods remain unchanged. Thus, in this type of economy, once the demand responses to international prices have taken place, a terms-of-trade shock would not trigger distributive conflicts among the different socioeconomic groups (although such conflicts may arise during the transition if the effects on spending on non-traded goods do not emerge instantaneously). This result is robust to changes in the hypothesis of a representative consumer if it is assumed that manufactured goods are used as inputs rather than only for consumption. However, the result of equal proportional changes in factor earnings would not hold if consumption demands were not characterized by unitary income elasticities. If, for instance, the demand for the non-traded good were highly income elastic, then the share of spending on that good would rise with higher export prices, which would tend to increase the earnings of skilled labor. In such an economy, it would then be possible, following a positive shock on the price of the agricultural good, an "urban" factor could receive the larger benefits in terms of income.

In cases where the economy is diversified and produces all three goods, with a manufacturing sector that operates as a price taker in international markets, non-neutralities emerge, depending on factor intensities (see Subsection II.B). Not surprisingly, an increase in the term of trade benefits the factor used specifically in the production of the exportable good. The incomes of the "urban" factors are subject to a Stolper-Samuelson tradeoff associated with the (endogenous) change in the relative prices of non-tradables and manufactures. There is an urban factor whose income declines unambiguously (in terms of the three goods). If, for example, unskilled labor is used with relative intensity in the production of manufactures (as opposed to skilled labor being used intensively in the non-tradable sector), then this group would stand to lose from higher export prices, while skilled labor would be comparatively better off. Viewed from this standpoint, the interests of skilled workers could appear to be more closely aligned with those of farmers than with those of unskilled workers.

The analysis that we present below confirms the intuition that the incomes of factors used intensively in the production of non-tradables tend to move in step with the performance of the export sector (Galiani, Heymann and Magud (2009)). The study conducted by Coble and

Magud (2010) that focused on the case of Chile, a quite open resource-abundant economy, provides support for this hypothesis. Specifically, they find that higher international terms of trade are associated with wider wage gaps between unskilled and skilled workers, given that non-tradable sectors are relatively skilled-labor-intensive (see Figure 1 and Figure 2).

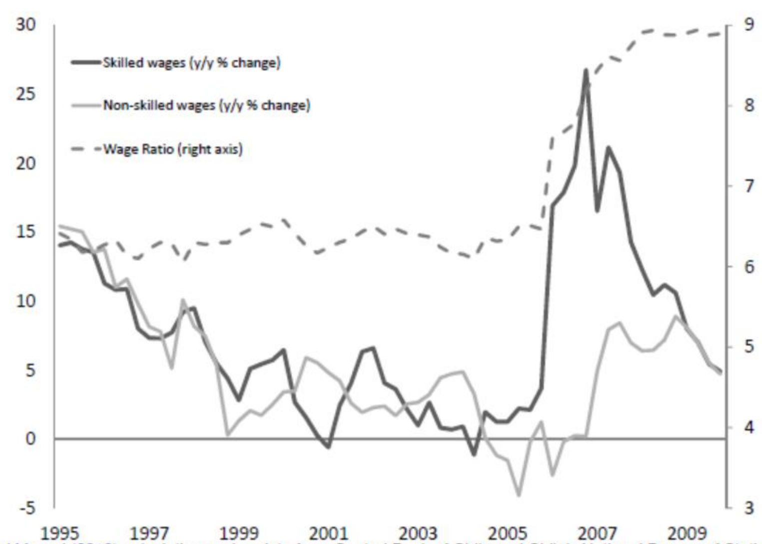
Figure 1. Terms of Trade vs. Relative Wages



Source: Coble and Magud (2010) calculations using data from Central Bank of Chile and Chile's National Bureau of Statistics

Source: Coble and Magud (2010), calculations based on data from the Central Bank of Chile and the National Bureau of Statistics of Chile.

Figure 2. Relative Wages



Source: Coble and Magud (2010) calculations using data from Central Bank of Chile and Chile's National Bureau of Statistics.

Source: Coble and Magud (2010), calculations based on data from the Central Bank of Chile and the National Bureau of Statistics of Chile.

Our study also draws on the historical evidence documented and analyzed by Williamson (2013), who states: “The simple Heckscher-Ohlin-Samuelson (HOS) model just exploited limited the story to land and labor, and to manufacturing imports and primary product exports. What about skills, and what about non-tradables? Here we are on shakier empirical grounds, but once again, theory helps. Sebastian Galiani, Daniel Heymann and Nicolas Magud (2009) have recently shown that when the HOS model is expanded to include skill-intensive urban activities (e.g., non-tradables), the rise in inequality generated by the rent-wage ratio boom is reinforced by the rise in the wage gap between skilled and unskilled labor. As it turns out, there is some evidence that the Latin America ´belle époque' supports this prediction.”

Our paper is related to the literature in the fields of development and international trade which explores and qualifies the traditional Stolper–Samuelson results and to the "dependent economy" macroeconomic models (Salter (1959), Swan (1960), Diaz Alejandro (1965)) which focuses on the effects of relative price shifts between traded and non-traded goods on real activity and distribution in economies that export land-intensive primary goods. Much of the early work built on the HOS model (see Johnson (1957)) and was devoted to extending the theorems to the general case of many factors and tradable goods; Ethier (1984) presents an excellent survey that is relevant for this area of inquiry. Regarding the incorporation of non-tradable goods, interesting early contributions have been made by McDougall (1970) and Komiya (1967), whose results were extended by Ethier (1972). Komiya´s model considers the case of a small open economy producing two tradable goods and one non-tradable good using two factors of production (capital and labor), both of which are mobile across sectors, and finds conditions under which the factor price equalization theorem, Rybczynski’s theorem and Metzler’s theorem all hold; in connected work, Deardorff and Courant (1990) analyze conditions for factor price equalization in the presence of a non-traded good. Another relevant antecedent is Jones (1974), who studies the case of an economy with two factors of production and a single traded-good sector. Cassing (1977) extends the 3-goods/2-factors model to the case of monopolistic non-tradable goods; Cassing (1978) extends the model by taking into account transport costs. More recently, Thierfelder and Robinson (2002) consider a model with two production activities, two inputs and three commodities (exportable, importable and non-tradable), while Beladi and Batra (2004) study the effects of traded goods prices on income distribution in a model where the exportable and the importable sectors share the same factors of production (see also Beladi and Batra (2008)).

The effect of international prices on real incomes can be routed through several different channels and on different temporal scales. Price shifts modify consumption and production opportunities, induce spending responses, motivate the reallocation of existing resources and change incentives for factor accumulation. We disregard intertemporal considerations and, hence, the analysis of accumulation and growth, as well as that of international capital movements. We pursue the discussion within a static framework which focuses on what may be considered "medium-term" effects; that is, those that would be induced after reallocations in demand and production have taken place. In our benchmark case, we also simplify the analysis by considering the standard case of unitary price elasticities of substitution, both in production and consumption. While differences in consumption patterns certainly play an important role in the distributive implications of price changes, we disregard these effects to focus on those deriving from production channels á la Stolper-Samuelson.

Income distribution can be modified by international trade policies. Import substitution policies in natural-resource-intensive economies have typically succeeded in creating a significant motivation for raising the incomes of urban factors of production. In Section III, we study the impact of an export tax (or, by the Lerner equivalence, an import tariff) that lowers the domestic price of the agricultural good, at constant international prices. In the presence of non-traded goods, the effects depend on the use of tax revenues. The analysis suggests that, in a two-sector economy (an exportable and a non-traded good), skilled workers (employed intensively in the production of non-tradables) might be in favor of the application of taxes to foreign trade, but only to the extent that tax revenues are spent in a way that raises the demand for the urban good. Such incentives would tend to fade away, however, if the main source of demand for the services that employ skilled labor is spending by the landlord group. This holds for the case in which tax revenues are fully returned to the private sector in proportion to income shares. If the government saves the full amount of the revenues, a neutrality effect applies: all factors reduce their real market earnings by the same proportion. In the three-sector economy, an export tax naturally reduces the return to land (the factor specific to the production of the primary good); unskilled workers gain if their labor is used intensively in the import-competing manufacturing sector and lose if their labor is used intensively in the non-tradable sector. These results can be useful inputs for a discussion on the political economy of trade taxes in economies with different resource endowments and production structures.

2. Distributive Effects of Terms-of-Trade Shifts

2.1 Specialized Economies: A Simple Two-Sector Economy

We first analyze the case of economies that specialize in the production of primary goods that are intensive in the use of natural resources and that do not have a significant import-competing sector. In these economies, the absence of a sector that produces the importable good eliminates the familiar Stolper–Samuelson effect. Consequently, the standard distributional effects that arise from changes in the international terms of trade in the traditional model are diluted, since the demand for the factors employed in the sector that produces for the domestic market depends on the revenues generated in the export sector.

Production

We consider a small, open economy that produces two goods: an agricultural good (A) and a non-traded (N) good. The quantities of output are labeled y_A and y_N, respectively. The world price of the agricultural good, p_A, is exogenously given, as is the price of the non-produced imported good M, p_M, which serves as the numeraire. Technology is represented by Cobb–Douglas production functions:

$$y_A = f(T, L) \text{ and} \tag{1}$$

$$y_N = g(H, L), \tag{2}$$

where T denotes agricultural land, L stands for raw labor, and H denotes skilled labor. The price–cost equality derived from the assumption of perfect competition in all markets can be expressed in terms of proportional changes as:

$$\hat{p}_A = \theta_{TA}\hat{t} + \theta_{LA}\widehat{w} \tag{3}$$

$$\hat{p}_N = \theta_{HN}\hat{h} + \theta_{LN}\widehat{w}, \tag{4}$$

where a circumflex above a variable denotes a proportional change, p_N is the price of the non-traded good, t is the return to factor T, w is the wage rate, h denotes the unit earnings of factor H, and θ_{ij} stands for the share of factor i in the unit cost of the production of good j.

Factor Markets

The economy is endowed with a fixed amount of factors of production. Given competitive factor markets and the assumption of homogenous of degree one Cobb–Douglas production functions, the equilibrium conditions can be characterized as:

$$\hat{\hat{T}} = 0 = \hat{p}_A + \hat{y}_A - \hat{t} \tag{5}$$

$$\hat{\hat{L}} = 0 = \lambda_{LA}(\hat{p}_A + \hat{y}_A) + \lambda_{LN}(\hat{p}_N + \hat{y}_N) - \widehat{w} \tag{6}$$

$$\widehat{H} = 0 = (\hat{p}_N + \hat{y}_N) - \hat{h} \tag{7}$$

where λ_{ij} stands for the participation of sector j in the employment of factor i, i.e., $\lambda_{Li} = L_i/L$. Since the incomes of the specific factors T and H are determined by constant shares of the values of production of the goods A and N, respectively, their unit earnings vary in proportion to those values. In the case of the mobile factor, L, wages change according to a weighted average of the values of production in relation to the importance of the sector in total employment.

Preferences and Consumption

For analytical tractability, we assume homothetic preferences, thus ignoring the effects of incomes on the composition of demand. All individuals have identical Cobb–Douglas preferences over the consumption of the agricultural good c_A, the non-traded good c_N, and the manufactured good c_M:

$$u(c_A, c_M, c_N) = c_A^{\gamma_A} c_M^{\gamma_M} c_N^{\gamma_N} \tag{8}$$

The parameters represent the constant proportions of spending allocated to the different goods. Without loss of generality, we assume that $\gamma_A + \gamma_M = 1$, so that these two coefficients measure the shares of the value of each tradable good in the total value of expenditures on traded goods. The individual's budget constraint is given by:

$$I = p_A c_A + p_N c_N + p_M c_M \tag{9}$$

where I is the income earned by the individual, which depends on the factor prices w, t and h, as well as the factor endowments of the agents. Optimal consumption is such that the value of spending on each of the three goods varies proportionally. Hence, in equilibrium:

$$\hat{p}_A + \hat{c}_A = \hat{c}_M = \hat{p}_N + \hat{c}_N = \hat{p}_N + \hat{y}_N \tag{10}$$

where the price of the manufactured good is fixed by the choice of numeraire, $\hat{p}_M = 0$.

Aggregate Constraints and Equilibrium

The resource constraint for the non-traded good implies the equality of output and consumption, which is valid in levels and in terms of proportional changes:

$$\hat{y}_N = \hat{c}_N \tag{11}$$

This is a static model that disregards intertemporal effects on spending. We therefore impose the condition of a zero trade balance, which implies the equality of the proportional change in the value of the production of traded goods (here composed solely of good A) with the value of the consumption of tradables:

$$\hat{p}_A + \hat{y}_A = \gamma_A(\hat{p}_A + \hat{c}_A) + \gamma_M \hat{c}_M \tag{12}$$

The equilibrium of the economy is defined as the state in which the aggregate constraints on production and consumption are satisfied, factor markets clear, and consumers and firms act optimally, as previously stated.

Results

It is straightforward to verify that, in equilibrium, the following results hold:

$$\hat{p}_A = \hat{p}_N = \hat{t} = \hat{h} = \hat{w} \tag{13}$$

$$\hat{c}_A = \hat{y}_A = \hat{y}_N = \hat{c}_N = 0 \tag{14}$$

$$\hat{c}_M = \hat{p}_A \tag{15}$$

This can be summarized in the following proposition.

Proposition 1. In the two-sector case, a positive terms-of-trade shock ($\hat{p}_A > 0$; $\hat{p}_M = 0$) is neutral in the sense that there are no changes in relative factor earnings or in the relative prices of locally produced goods. The increase in the price of good A, $\hat{p}_A > 0$, triggers an equivalent increase in the demand for non-traded goods. Thus, there are no changes in resource allocation: the quantities that are produced do not vary. The only effect is a proportional increase in the purchasing power of all factors of production with respect to imports (M); the increase in the volume of consumption of imported manufactures exactly matches the increase in purchasing power.

These results carry over when we add in another mobile factor, such as physical capital, K.

Point 1 (Effects of heterogeneous consumption baskets with homothetic preferences)

Proposition 1 assumes the existence of a representative agent with preferences for goods that can be characterized using a homothetic utility function. Heterogeneity in individuals' consumption baskets, maintaining the assumption of homotheticity, does not alter the neutrality of factor price changes. However, different preferences do affect the welfare implications of the shift in international prices.

For example, assume that individual agents own a single factor of production and that they have Cobb-Douglas preferences which are identical within groups but differ depending on the factor that generates earnings (so that utility parameters and spending shares are $\gamma_j^i, j = A, N, M$, and $i = t$, w, and h). The change in the value of consumption of the various goods will then be determined by the aggregate expenditure functions:

$$\hat{p}_j + \hat{c}_j = \gamma_j^w \hat{t} + \gamma_j^w \hat{w} + \gamma_j^h \hat{h} \tag{16}$$

Where $j = A, N, M$

It can readily be seen that here, too, factor returns change proportionally: $\hat{t} = \hat{w} = \hat{h} = \hat{p}_A = \hat{p}_N$. Consequently, the welfare of all agents will still increase with an improvement in the international terms of trade. Nevertheless, the existence of differentiated consumption baskets means that agents with consumption preferences biased toward good M, i.e., higher γ_M^I for I = w, h, and t, will benefit relatively more.

Point 2 (Imports as production inputs)

The use of good M as a production input, rather than only as a consumption good, does not alter the income-distribution neutrality of the terms-of-trade shift obtained in proposition 1. However, the presence of importable inputs implies that the physical production of goods changes following movements in international prices. This result is detailed in the Appendix.

Point 3 (Non-unitary demand elasticities)

The result of equal proportional changes in factor earnings would not hold if consumption demands were not characterized by unitary elasticities. For example, with a highly income-elastic demand for the non-traded good, the spending share of that good would rise with higher export prices, which would tend to increase the earnings of the specific factor H. In such an economy, it would then be possible that, after a positive shock on the price of the agricultural good A, an "urban" factor could receive larger benefits in terms of income.

Point 4 (Non-neutralities with transitional effects on demand)

In a multi-period setup, the dynamics of spending may give rise to differences between the "short-run" and "medium-run" impacts of a permanent shift in the terms of trade. If, for instance, after an increase in the international price of good A there is a delay in the rise of domestic expenditures (in this context, if the higher export prices initially induce larger savings on the part of agricultural producers, resulting in a trade surplus, until eventually the additional income gets reflected in spending), the first effect on "urban" groups will take the form of a loss of purchasing power, as the agricultural consumption good becomes more expensive while incomes do not react. Thus, the result of neutrality of changes in factor prices would not hold during the transition.

Point 5 (Terms-of-trade improvement: real appreciation, but no "Dutch disease")

An increase in the international price of good A implies an unambiguous rise in the price of the non-traded good relative to an index of the consumer prices of traded goods:

$$\hat{e} = \gamma_A \hat{p}_A + \gamma_M \hat{p}_M - \hat{p}_N = -(1-\gamma_A)\hat{p}_A < 0 \quad (17)$$

Thus, the improvement in the terms of trade brings about an appreciation of the real exchange rate (e). However, in this economy, there is no import-competing sector that could be affected by Dutch disease (see Gylfason (2008)). The real appreciation reflects higher incomes across sectors and factors.

2.2 Diversified Production: A Three-Sector Economy

The existence of a sector that is producing the imported good, M, substantially modifies the distributional effects of changes in international prices and generates tensions between the incomes of the factors used in the traded-goods sectors.

Production

The three goods are now produced domestically. The (Cobb – Douglas) production functions are given by (1) and (2) for the agricultural (exportable) good and the non-traded good, respectively. The third sector competes with foreign products in the domestic market for M . The M industry (manufacturing) is assumed to use labor and an "urban" factor (interpreted, as before, as skilled labor). Factor L is assumed to be mobile between the three sectors, while H can shift between manufactures and the non-traded sector. The production function of M is given by:

$$y_M = s(H, L) = A_M H_M^{\theta_{HM}} L_M^{\theta_{LM}} \tag{18}$$

where H_M and L_M are the inputs of each factor in the production of good M, and the parameters θ_{iM} are the corresponding output elasticities or factor shares ($\theta_{HM} + \theta_{LM} = 1$). Under perfect competition, the price-cost equality implies, using good M as the numéraire (with equations analogous to (3) and (4) holding for the other two goods):

$$\hat{p}_M = 0 = \theta_{HM}\hat{h} + \theta_{LM}\hat{w} \tag{19}$$

As before, an exogenous terms-of-trade shock is represented by a change in world prices of agricultural goods relative to those of manufactures ($\hat{p}_A > 0, \hat{p}_M = 0$).

Factor Markets

The supply of all the factors of production is fixed, and allocated among the sectors that use them. Given the production functions in (1), (2), and (18) above, the market clearing condition for land is given by (5), while those for L and H are now:

$$\hat{L} = 0 = \lambda_{LA}(\hat{p}_A + \hat{y}_A) + \lambda_{LN}(\hat{p}_N + \hat{y}_N) + \lambda_{LM}\hat{y}_M - \hat{w} \tag{20}$$

$$\hat{H} = 0 = \lambda_{HN}(\hat{p}_N + \hat{y}_N) + \lambda_{HM}\hat{y}_M - \hat{h} \tag{21}$$

The parameters λ_{ij} represent, as before, the share of sector j in the total employment of factor i.

Preferences and Consumption

The demand side of the economy is the same as the one described in the discussion of the two-sector economy. Given preferences in (8) and the flow budget constraint in (9), we obtain the same condition for the allocation of spending as in (10).

Aggregate Constraints and Equilibrium

Condition (11), which equates production and consumption of good N, also holds in this case. The trade balance constraint or, equivalently, the equality between the value of production of traded goods and the value of consumption of those goods (in an economy without capital flows), is now given by the expression:

$$\chi_A(\hat{p}_A + \hat{y}_A) + \chi_M \hat{y}_M = \gamma_A(\hat{p}_A + \hat{c}_A) + \gamma_M \hat{c}_M \tag{22}$$

where χ_i denotes the share of traded good i of the total value of tradable production, i.e., $\chi_i = p_i y_i/(p_A y_A + p_M y_M)$. Since A is the exported good, it must be the case that $\chi_A > \gamma_A$: its share of production is larger than its share of consumption.

We define an equilibrium as a set of proportional changes in produced quantities $\{\hat{y}_A, \hat{y}_N, \hat{y}_M\}$, volumes of consumption $\{\hat{c}_A, \hat{c}_N, \hat{c}_M\}$, factor earnings $\{\hat{t}, \widehat{w}, \hat{h}\}$ and the price of the non-traded good $\hat{p}_N$ that satisfy (3), (4), (5), (10), (11), (19), (20), (21) and (22) for given changes in international prices $\{\hat{p}_A, with\, \hat{p}_M = 0\}$.

Results

Proposition 2. A Stolper-Samuelson distributive tradeoff arises in this economy between factors H and L (with the important proviso that, here, the change in the relative prices of both goods, $\hat{p}_N$, is determined endogenously):

$$\hat{h} = \frac{\theta_{LM}}{\Delta}\hat{p}_N \tag{23}$$

$$\widehat{w} = -\frac{\theta_{LM}}{\Delta}\hat{p}_N \tag{24}$$

where $\Delta = \theta_{HN} - \theta_{HM} = \theta_{LM} - \theta_{LN}$.

Proposition 3. If the production of the non-traded good, N, is more intensive in skilled labor (factor H) than the manufactured good, M (or equivalently, if sector M is relatively unskilled-labor-intensive), then $\Delta > 0$. Then: an exogenous increase in the price of agricultural goods relative to manufactures results in an increase in the price of good N relative to the imported good M. In that case, the earnings of skilled workers H increase unambiguously in terms of both goods, N and M, while the wage of factor L falls, also in terms of both goods.

The proof follows directly from (23) and (24).

In order to find a closed form solution, the system can be reduced to two equations with variables $\hat{t}$ (the proportional change in the unit rent on agricultural land) and $\hat{y}_M$ (the proportional change in output in the import-competing sector):[1]

$$[(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA}]\hat{t} + (\lambda_{LM} + \lambda_{LN}\chi_M)\theta_{LA}\hat{y}_M = \hat{p}_A \quad (25)$$
$$[\lambda_{HN}\chi_A\theta_{HM}\theta_{LA} - \theta_{LM}\theta_{TA}]\hat{t} + (\lambda_{HM} + \lambda_{HN}\chi_M)\theta_{HM}\theta_{LA}\hat{y}_M = -\theta_{LM}\hat{p}_A \quad (26)$$

It can further be shown (see Appendix B) that the determinant of this system, Ω, is unambiguously positive. Hence, we can set out the following proposition:

Proposition 4. In the three-good, three-factor economy described above, an increase in the international relative price of the agricultural good A implies:

- An unambiguous (in terms of all three goods in the economy) increase in the return to factor T, specific to the production of good A. Thus, $\hat{t} > \hat{p}_A > 0$ and $\hat{t} > \hat{p}_N$.
- Production factors are reallocated in such a way that agricultural output increases ($\hat{y}_A > 0$) while the output of the import-competing sector decreases ($\hat{y}_M < 0$) .

The response of the other endogenous variables depends on the structure of the economy, which can be described by the parameters of factor shares of production and the distribution of factors and output across the various activities. It is useful to map some limit cases in order to provide some economic intuition of the results. One especially salient distinction is between economies with very high and very low labor intensities in the A sector ("agriculture"), which correspond, respectively, to values of θ_{LA} that are close to one or to zero.

- Sector A labor intensive: $\theta_{LA} \approx 1$. The cases to be considered are those where both "urban" factors are used in producing good M ($\theta_{LM} > 0, \theta_{HM} > 0$) while the non-traded good is produced exclusively with one factor, L or H.
    a. $\theta_{LN} \approx 0, \theta_{HN} \approx 1$ Non- traded good produced with factor H

[1] See Appendix B.

Labor benefits from the higher price of good A, implying $\widehat{w} \approx \hat{p}_A$. Factor H is hurt by the migration of labor out of sector M into A, so its market returns fall for both traded goods. This means that the price of the non-traded good declines (in terms of A and M) as its production costs fall. This supply effect implies that, in such an economy, an improvement in the terms of trade may trigger a depreciation of the real exchange rate (in a process which, admittedly, would have to entail urban-rural migration and a substantial de-industrialization process that would lower the production costs of the non- traded goods). The consumption of non-tradables increases in volume, but not necessarily in value (in terms of good M); that value may decline if sector M is intensive in L, which implies a sharp decrease in the unit earnings of factor H and, consequently, a substantial drop in the price of good N. In that case, a higher price for A would be associated with a lower level of consumption of both traded goods.

b. $\theta_{LN} \approx 1, \theta_{HN} \approx 0$ Non-traded good produced with factor L

With this configuration, non-tradables are produced exclusively by factor L, which is also intensively employed in the product of A. The “urban” factor H is hurt by the fact that a smaller quantity of L is utilized in sector M. As a result, its earnings fall relative to all goods. Since both goods A and N are produced by the same single factor, their prices move in parallel. Consumption shifts towards good M.

- Sector A with very low labor intensity: $\theta_{LA} \approx 0$,

Here, the supply of good A is fixed, and the earnings of the specific factor vary in proportion to the price of the good: $\hat{t} = \hat{p}_A$. Labor is now a purely “urban factor”. The value (in terms of M) of the demand for non-tradables rises; this leads to a reallocation of resources from M to N, which induces a redistribution of earnings between the factors used in these industries toward the one with a larger share in the non-traded sector (say, H); however, this does not prevent its purchasing power from falling in terms of A . The returns to the other factor (here, L) are lowered unambiguously in terms of the three goods. The shifts in factor prices imply an increase in p_N relative to good M. Consumption shifts toward good M, while output falls.

Concretely, the returns to factors L and H are defined here by the simple system:

$$\lambda_{LM}\hat{y}_M + \lambda_{LN}\hat{c}_M = \widehat{w}$$
$$\lambda_{HM}\hat{y}_M + \lambda_{HN}\hat{c}_M = \hat{h} = -\frac{\theta_{LM}}{\theta_{HM}}\widehat{w}$$
$$\chi_A\hat{p}_A + \chi_M\hat{y}_M = \hat{c}_M$$

It can be seen that the signs of the proportional changes $\widehat{w}$ and $\widehat{h}$ depend on the sign of the expression: $\lambda_{LM}\lambda_{HN} - \lambda_{LN}\lambda_{HM}$, an indicator of the relative factor intensities in sectors M and N.

The results presented above indicate that an increase in the world price of the traded good A raises the volume and the value of the output of that good and the income of the factor specific to that sector, while the output of the other traded good contracts as its relative price declines in international markets. The price of factor T varies (à la Stolper-Samuelson) disproportionately relative to the price of A, and it also increases in terms of the non-traded good N. The contraction of the import-competing sector reduces the income of the factor used intensively in this activity (L in this case), provided that the demand for it in sector A is not too strong. If agriculture is very labor-intensive, however, wages will rise alongside the price of A, which will hurt the urban factor H, since it has to absorb the decrease in the relative price of the importable good. In the opposite case, if sector A is not labor-intensive, then the factor used more intensively in the production of non-tradables benefits from the higher demand for those goods, while the M-intensive factor will register a loss in earnings relative to the three goods.

Hence, the distributive impact of the shift in international prices would favor the factor specific to sector A and hurt the factor intensively used in the import-competing sector M. The effects shown above are derived exclusively from features of the economy's production structure and from the Cobb-Douglas preferences. Thus, those results do not vary with the weights of the goods in the shopping basket and, in particular, do not depend on whether good A is exportable or importable. However, the sign and strength of the terms-of-trade income effect would have a definite impact on the value of the CPI-deflated changes in real incomes, output reallocations and welfare implications owing to the change in international prices.

3. Effects of Export Taxes

We now turn to the case where the change in the relative domestic prices of the traded goods derives from a policy intervention (at constant international prices) in the form of the introduction of an export tax, which lowers the local price of good A. This intervention has two aspects: a change in the relative prices of traded goods (which, from the point of view of economic agents, is analogous to an exogenous price shift originating in the international economy) and an appropriation of resources by the government, which can use them in different ways. The effects on production, consumption and income distribution will depend on how the revenues generated by the tax are used. Given the purpose of this analysis, we will concentrate on the case where tax proceeds are used "neutrally" because the government utilizes the revenues to distribute lump-sum transfers to agents in proportion to their original income levels. However, we allow for some part of those revenues to be kept as government savings (foreign asset accumulation) or to be spent directly on traded goods, which would reduce the demand for non-tradables relative to what the situation would be if all the tax revenues were transferred back to the private sector in the manner described earlier.

3.1 Export Taxes in a Specialized Two-Sector Economy

The setup of the model is similar to the one described earlier in section 2.1, where the economy produces only goods A and N. Starting from a situation with no taxes, the government applies a proportional duty α on exports of good A, which implies $\hat{p}_A = -\alpha$. If the resulting tax revenues, τ , are expressed as a proportion of the value of output (or consumption) of traded goods, then:

$$\tau = \gamma_M \alpha \tag{27}$$

since, due to the assumption of trade balance equilibrium in the original state, the value of exports of A is equal to the value of imports of M, which is equivalent, in this case, given no local production, to the domestic consumption of this good. The system is characterized by eqs. (3) to (10), where $\hat{p}_A$ is replaced by $-\alpha$. The economy must also satisfy a trade balance condition at international prices. A fraction $1-\delta$ of tax revenues is "kept" by the government and is neither made available to economic agents for use in financing consumption nor spent on non-traded goods. Therefore, the budget constraint on the private sector can be written as an equality between the value of the consumption of traded goods and the value of the output of the traded good A, net of the resources appropriated by the government:

$$\hat{y}_A - (1-\delta)\alpha\gamma_M = \gamma_A \hat{c}_A + \gamma_M \hat{c}_M \tag{28}$$

The fraction δ of tax revenues is given back to private agents in proportion to their original incomes. This implies that the change in the after-transfer income of individual j is given by:

$$\hat{I}' = \hat{I}_j + \alpha\delta\gamma_M{}' \tag{29}$$

where $\hat{I}_j$ denotes the proportional change in the price of the factor owned by the agent ($\hat{w}$ or $\hat{t}$ according to the case) and $\gamma_M{}'$ is the share of good M in total expenditures, including expenditures on non-traded goods.[2] Combining eqs. (5), (10) and (28), it can be seen that changes in pre-transfer factor earnings satisfy:

$$\hat{h} - \lambda_{LA}\alpha\delta\gamma_M = \hat{w} = \hat{t} + \lambda_{LN}\alpha\delta\gamma_M \tag{30}$$

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[2] This can be derived as follows. Let ΔI_J and $\Delta I_j{}'$ be the absolute change in the pre-transfer and post-transfer incomes of agent j, which were originally at the level I_j , Y the total value of incomes at the initial state, and Y_A the value of production of the traded good. Then, the assumption of a proportional distribution of tax revenues implies $\Delta I_j' = \Delta I_j + \alpha\gamma_M Y_A (I_j/Y)$. Now, $Y_A/Y = C_T/C = (1-\gamma_N)$, is the share of traded goods in total consumption. The expression in the text results using that $\gamma_M^{'} = \gamma_M(1-\gamma_N)$ and that $\hat{I}_j^{'} = \Delta I_j^{'}/I_j$.

Proposition 5. Changes in factor prices satisfy: $\hat{h} \geq \hat{w} \geq \hat{t}$. This implies that export taxes redistribute income in favor of the factor used intensively in the production of the non-traded good relative to labor and, especially, relative to land. However, the distributive effect depends on the spending effects of the tax revenues, and it disappears if the parameter $\delta = 0$, that is, if the use of those revenues does not bring about an increase in expenditure on the non-traded good. The redistribution would be associated with a reallocation of resources away from sector A and toward sector N.

The use of the revenues from the tax on international trade in the form of transfers has two implications: an effect on market outcomes -- and particularly on factor prices, via its implications for domestic demand -- and a direct impact on the budget constraint of consumers. Combining those responses, changes in after-transfer earnings are given by:

$$\frac{\hat{t}'}{\alpha} = -(1 + \lambda_{LN}\theta_{LA}\delta\gamma_M) + \gamma_M{}'\delta \tag{31}$$

$$\frac{\hat{h}'}{\alpha} = (-1 + (1 - \lambda_{LN}\theta_{LA})\delta\gamma_M) + \gamma_M{}'\delta \tag{32}$$

$$\frac{\hat{w}'}{\alpha} = -(1 - \lambda_{LN}\theta_{TA}\delta\gamma_M) + \gamma_M{}'\delta \tag{33}$$

Proposition 6 A. If the total revenues from the export tax are saved by the government (or spent on buying traded goods), i.e., if $\delta = 0$, all factor prices vary by the same proportion, which is equal to the change in the price of the exported good; that is, the incomes of all factors vary proportionally. Earnings are reduced in terms of imports, M, and remain constant relative to goods A and N. Also, the price of the non-traded good falls, together with that of the exportable good. In this case, the export tax would be associated with a “real depreciation” due to the higher relative price of the importable good. These effects are like those that applied in the case of a change in international prices. The tax directly reduces incomes in sector A, which translates into a proportionally lower demand for non-traded goods, so the impact is spread out homogeneously. There is no reallocation of production, and the consumption effect is concentrated on the importable good. When a portion of the funds generated by the tax is transferred back to the private sector and is incorporated into the disposable income of consumers, the repercussion on demand would tend to raise the production level and price of the non-traded good and to favor the factors used intensively in that sector.

Proposition 6 B. If all the revenues from the export tax are returned to the private sector in proportion to private agents’ income shares (or spent by the government on the basis of the same distribution of expenditures on goods as the distribution of private consumption), so that $\delta = 1$, the effects on disposable incomes would be as follows:

1. For the factor specific of sector A (T): The transfer of funds to consumers raises the demand for non-tradables and tends to increase wages, which exacerbates the decline in the market earnings of factor T. The direct effect of the "tax refund" works in the opposite direction on disposable incomes. In some cases (in the presence of a large non-tradable sector and when the agricultural sector accounts for a substantial share of the workforce), owners of factor T may prefer for there to be little or no refund of the tax revenues (due to their effect on factor prices) even if that means sacrificing the receipt of a direct transfer of resources.
2. For the factor specific of sector N (H): The market remuneration and (*a fortiori*) the post-transfer income increase in terms of good A. If production in the agricultural sector is sufficiently land-intensive (large θ_{TA}) and γ_M is relatively large, then, eq. (32) $\hat{h}' > 0$, implying that the return to this factor increases its purchasing power in terms of manufactures and, consequently, rises relative to all goods prices.
3. Market wages of the mobile factor (L) rise in terms of the exportable good. If labor is mainly an urban factor (with a small share in the A sector and a high proportion of employment going to the production of N), then this factor could increase its earnings in terms of M.

Proof A. Directly from equations (31) to (33).
Proof B. See the Appendix.

Thus, in such an economy, factor H may be in favor of the levying of taxes on foreign trade, but only to the extent that, in one way or another, the use of the tax revenues boosts demand for the non-traded good. Such incentives would tend to fade away if, as is the case in the land-rich economies studied by Galiani and others (2008), the main source of demand for the services that employ skilled labor is the expenditure of the landlord group T.

3.2 Trade Taxes in a Three-Sector Economy

After some transformations, equations (25) and (26) can be modified as follows:

$$[(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA}]\hat{t} + (\lambda_{LM} + \lambda_{LN}\chi_M)\theta_{LA}\hat{y}_M = -\alpha - \lambda_{LN}\delta\alpha(\chi_A - \gamma_A)$$

$$[\lambda_{HN}\chi_A\theta_{HM}\theta_{LA} - \theta_{LM}\theta_{TA}]\hat{t} + (\lambda_{HM} + \lambda_{HN}\chi_M)\theta_{HM}\theta_{LA}\hat{y}_M = \theta_{LM}\alpha - \lambda_{HN}\theta_{HM}\theta_{LA}\,\delta\alpha(\chi_A - \gamma_A)$$

It can be seen that the only difference between the case of the international price shift and that of the trade tax is the addition in the RHS of the equations of the terms in $\delta\alpha(\chi_A - \gamma_A)$, reflecting the effect of the tax refund as channeled through the demand for goods and the economy´s external budget constraint. Thus, as before, when there is no transfer and $\delta=0$, the implications for factor prices, production and private consumption are the same regardless of whether the change in the relative domestic prices of traded goods is brought about by policies or by external conditions.

It can be seen that, when δ>0, the effect of the tax refund on the markets earnings of factor T is determined by:

$$\Omega\hat{t}_{tax} = \Omega\hat{t}_{int} + \theta_{HM}\theta_{LA}(\lambda_{LM}\lambda_{HN} - \lambda_{LN}\lambda_{HM})\ \delta\alpha(\chi_A - \gamma_A)$$

In that expression, $\hat{t}_{tax}$ indicates that the proportional change in the return to factor T after the application of a tax on foreign trade, $\hat{t}_{int}$ is equivalent to the change in that factor price that would occur if the international price of A had fallen at the rate α of the tax ($\hat{t}_{int} \leq 0$, as seen in the previous section) and, as before, Ω is the determinant (shown to be positive) of the system formed by equations (25) and (26). Thus, the effect of the tax refund on the market income received by owners of factor T depends on the previously mentioned relative factor intensities in "urban" activities.

The intuition of this effect is reasonably simple. For a given price of A, the return to T varies negatively relative to the level of wages, w. The transfers made using these tax revenues tend to boost the demand for non-tradables. If labor is used with more intensity in the production of the importable good than in sector N, the reallocation of urban production changes factor prices in favor of H and against labor. Thus, larger transfers would benefit T (and certainly factor H, which is oriented toward the production of non-tradables), while pushing down wages.

However, the effect of the transfer cannot offset the loss that factor T sustains as a result of the fall in the relative price of good *A.*

Proposition 7. In a three-good, three-factor economy, a tax on foreign trade that lowers the price of A relative to M will result in an increase in t:

- An unambiguous (in terms of all three goods in the economy) decrease in the market return to factor T, specific to the production of good A. Thus, $\hat{t} < -\alpha$ and $\hat{t} < \hat{p}_N$.
- Production factors are reallocated in such a way that agricultural output decreases ($\hat{y}_A < 0$) while the output of the import-competing sector increases ($\hat{y}_M > 0$).

Regarding the other effects, it is useful to consider the extreme cases analyzed earlier.

- Sector A is labor-intensive. $\theta_{LA} \approx 1$.

a. $\theta_{LN} \approx 0, \theta_{HN} \approx 1$. The non-traded good is produced using factor H.

The change in the relative prices of traded goods favors factor H and hurts L: in this extreme case, market wages vary almost proportionally to the price of good A ($\hat{w} \approx -\alpha$). The tax refund tends to raise the demand and the output of good N and to drive factor H away from the import-competing sector, which provides "urban employment" to labor. The larger the refund, the smaller the drop in the output of that good (which, if the share of factor L is not strictly 1, would be associated with a less steep fall in the earnings of factor T) and the smaller the increase in the production of M.

b. $\theta_{LN} \approx 1, \theta_{HN} \approx 0$. The non-traded good is produced using factor L

The effects on factor prices are the same as in the previous case, since they are determined by the exogenous policy-driven changes in the prices of traded goods. Now, the tax refund motivates labor to move out of sector A in response to the higher demand for N.

- Sector A, with a very low level of labor intensity: $\theta_{LA} \approx 0$,

When the proceeds of the trade tax are "kept" by the government in the form of traded goods, the distributive effects of the rise in the price of good M relative to A, which unambiguously hurts the specific factor T, operate in favor of the urban factor used intensively in sector M (L , say), whose market earnings increase in terms of the three goods. The other urban factor (H) stands in an intermediate position, with earnings higher in terms of A but lower relative to the two other goods. When the tax revenue is used for transfers to consumers, the aggregate demand channel tends to equalize the returns to the two urban factors, since it strengthens the demand for the one (H) used intensively in the non-traded-goods sector. The consequent increase in the price of good N reduces the purchasing power of the owners of factor T, but this group benefits from the direct effect of the transfer.

4. Conclusions

We have studied the distributive effects of shifts in international terms of trade and of the introduction of export or import taxes on the basis of a conceptually simple HOS model with non-traded goods. Although the results can be generalized, we focus on land-abundant economies that export primary goods. The introduction of non-tradables enriches the analysis and gives it added relevance, since the employment of resources in production activities that cater exclusively to the local market induces a crucial association between domestic spending and factor demand and prices which is absent from the usual HOS framework. Specifically, we consider economies that could potentially produce three goods: a primary (exportable) good for which land and unskilled labor are the production inputs; a manufacturing good for which both unskilled and skilled labor are production inputs; and a non-tradable sector that also uses both unskilled and skilled labor.

In our simplest case, the two-sector economy, no distributive Stolper–Samuelson effect results from a terms-of-trade shock: all factors gain from an improvement in international export prices. In the three-sector economy, however, non-neutralities emerge. The effects on relative incomes depend on factor intensities. A terms-of-trade improvement benefits the factor used specifically in the production of the exportable good. However, given the endogenous change in the relative price of non-tradables and manufactures, the incomes of the urban factors are subject to a variant of the Stolper–Samuelson tradeoff. The income of one of the urban factors (which one depending on factor intensities in production) declines unambiguously in relation to all three goods,.

We have also studied the income distribution effect of an export tax. In a two-sector economy, skilled workers (employed intensively in the production of non-tradables) are in favor of the application of taxes on foreign trade. However, this holds only to the extent that the use of the tax revenues ends up increasing the demand for the non-traded good. Here, unskilled labor stands to lose from protection, since part of the demand for this type of labor originates in the agricultural sector. The opposite would be true when there is a labor-intensive import-substitution sector, especially if the tax revenues are used in a way that does not favor the non-tradable sector.

The nature and intensity of distributive tensions depend on the configuration of the economy. In the case of a country with no significant import-competing activity, those conflicts would appear to be diluted, as indicated by the neutrality results. This does not hold in a three-sector economy, however, since distributional conflicts can arise not only in the traditional "rural-urban" dimension, but also between different "urban" production factors. These effects can be the outcomes of exogenous changes in international prices or may be associated with trade policy decisions. The existence of non-traded goods implies that the redistributive consequences of those policies depend not only on the levels of taxes, but also on choices about spending that modify the relative price of the domestic good or, otherwise stated, a measure of the equilibrium exchange rate. Thus, our analysis can be used to describe the motivations and incentives of different groups in political economy games. This establishes a connection with a broader literature which emphasizes the role of international trade on domestic political cleavages and domestic policies and institutions. See, for example, Rogowski (1989) and O'Rourke and Taylor (2006); Galiani, Torrens and Schofield (2014) present a formal political economy model for this issue.

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Appendix A. Imports as Production Inputs in the Two-Sector Case

Good M is now not only a consumer product but is also used as an input in the production of goods A and N. The proportional change in intermediate imports after a change in the price of A (with $\hat{p}_M$=0):

$$\widehat{M} = \lambda_{MA}(\hat{p}_A + \hat{y}_A) + \lambda_{MN}(\hat{p}_N + \hat{y}_N) - \hat{p}_M$$

The supply-demand conditions for primary factors L, T and H are still given by:

$$\hat{L} = 0 = \lambda_{LA}(\hat{p}_A + \hat{y}_A) + \lambda_{LN}(\hat{p}_N + \hat{y}_N) - \widehat{w}$$

$$\hat{T} = 0 = \hat{p}_A + \hat{y}_A - \hat{t}$$

$$\widehat{H} = 0 = \lambda_{HN}(\hat{p}_N + \hat{y}_N) - \hat{h}$$

The trade balance condition:

$$\hat{p}_A + \hat{y}_A = (1-m)\gamma_A(\hat{p}_A + \hat{c}_A) + (1-m)\gamma_M\hat{c}_M + m\widehat{M}$$

Cost- price equations:

$$\hat{p}_A = \theta_{TA}\hat{t} + \theta_{LA}\widehat{w} + \theta_{MA}\hat{p}_M$$

$$\hat{p}_N = \theta_{LN}\widehat{w} + \theta_{HN}\hat{h} + \theta_{MN}\hat{p}_M$$

It can be seen that these equations are satisfied if:

$$\hat{t} = \widehat{w} = \hat{h} = \hat{p}_A + \hat{y}_A = \hat{p}_N + \hat{y}_N = \hat{c}_M = \hat{p}_A + \hat{c}_A = \widehat{M} = \frac{1}{1-\theta_{MA}}\hat{p}_A$$

and:

$$\hat{p}_N = \frac{1-\theta_{MH}}{1-\theta_{MA}}\hat{p}_A, \hat{y}_N = \frac{\theta_{MH}}{1-\theta_{MA}}\hat{p}_A, \hat{y}_A = \frac{\theta_{MA}}{1-\theta_{MA}}\hat{p}_A$$

The change in the price of the exportable good has, as in the case in which there are no intermediate imports, neutral effects on the returns to the domestic factors. However, now factor earnings rise more than in proportion to the price of good A because of the expanded production opportunities created by the relative reduction in the cost of international inputs.

Appendix B. Derivation of the Reduced System involving the Sign of the Determinant in the Three-Goods Case

The supply-demand equations for production factors can be written as follows:

$$\hat{L} = 0 = \lambda_{LA}(\hat{p}_A + \hat{y}_A) + \lambda_{LN}(\hat{p}_N + \hat{y}_N) + \lambda_{LM}\hat{y}_M - \widehat{w}$$

$$\hat{T} = 0 = \hat{p}_A + \hat{y}_A - \hat{t}$$

$$\widehat{H} = 0 = \lambda_{HN}(\hat{p}_N + \hat{y}_N) + \lambda_{HM}\hat{y}_M - \hat{h}$$

Price equations for A and M:

$$\hat{p}_A = \theta_{TA}\hat{t} + \theta_{LA}\widehat{w}$$

$$\hat{p}_M = 0 = \theta_{LM}\widehat{w} + \theta_{HM}\hat{h}$$

Trade balance:

$$\chi_A(\hat{p}_A + \hat{y}_A) + \chi_M\hat{y}_M = \gamma_A(\hat{p}_A + \hat{c}_A) + \gamma_M\hat{c}_M$$

Taking into account the form of the consumption demand functions and the supply-demand balance of non-tradable-goods:

$$\hat{p}_N + \hat{y}_N = \hat{p}_N + \hat{c}_N = \hat{p}_A + \hat{c}_A = \hat{c}_M$$

The system then reduces to:

$$\lambda_{LA}\hat{t} + \lambda_{LN}\hat{c}_M + \lambda_{LM}\hat{y}_M = \frac{\hat{p}_A - \theta_{TA}\hat{t}}{\theta_{LA}}$$

$$\lambda_{HN}\hat{c}_M + \lambda_{HM}\hat{y}_{M=} - \frac{\theta_{LM}}{\theta_{HM}}\frac{\hat{p}_A - \theta_{TA}\hat{t}}{\theta_{LA}}$$

$$\chi_A\hat{t} + \chi_M\hat{y}_M = \hat{c}_M$$

or:

$$(\lambda_{LA}\theta_{LA} + \theta_{TA})\hat{t} + \theta_{LA}\lambda_{LN}\hat{c}_M + \theta_{LA}\lambda_{LM}\hat{y}_M = \hat{p}_A$$

$$-\theta_{LM}\theta_{TA}\hat{t}+\theta_{HM}\theta_{LA}\lambda_{HN}\hat{c}_M + \theta_{HM}\theta_{LA}\ \lambda_{HM}\hat{y}_{M=} - \theta_{LM}\hat{p}_A$$

$$\chi_A\hat{t} + \chi_M\hat{y}_M = \hat{c}_M$$

leading to:

$$((\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA})\hat{t} + \theta_{LA}(\lambda_{LM} + \lambda_{LN}\chi_M\ )\hat{y}_M = \hat{p}_A$$

$$(\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A - \theta_{LM}\theta_{TA})\hat{t} + \theta_{HM}\theta_{LA}(\lambda_{HM}+\lambda_{HN}\chi_M) = -\theta_{LM}\hat{p}_A$$

The determinant of this system is:

$\Omega= ((\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA})\ (\lambda_{HM}+\lambda_{HN}\chi_M)\ \theta_{HM}\theta_{LA} - (\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A - \theta_{LM}\theta_{TA})(\lambda_{LM} + \lambda_{LN}\chi_M\ )\ \theta_{LA}$

It can be seen that the only negative term is a multiple of $\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A$. Collecting the terms in λ_{HN}:
$(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA}\lambda_{HN}\theta_{HM}\theta_{LA}\chi_M + \lambda_{HN}\theta_{HM}\theta_{LA}\theta_{TA}\chi_M - (\lambda_{LM} + \lambda_{LN}\chi_M)\theta_{HM}\theta_{LA}\lambda_{HN}\theta_{LA}\chi_A=\theta_{HM}\theta_{LA}\lambda_{HN}(\theta_{LA}((\lambda_{LA} + \lambda_{LN}\chi_A)\chi_M - (\lambda_{LM} + \lambda_{LN}\chi_M)\chi_A)+ \theta_{TA}\chi_M)$

This reduces to:

$$\theta_{HM}\theta_{LA}\lambda_{HN}((\theta_{LA}\lambda_{LA} + \theta_{TA})\chi_M - \lambda_{LM}\theta_{LA}\chi_A)$$

But:

$$\chi_M = \frac{p_M y_M}{p_M y_M + p_A y_A} = \frac{\frac{p_M y_M}{wL_M}\frac{wL_M}{wL}}{\frac{p_M y_M}{wL_M}\frac{wL_M}{wL} + \frac{p_A y_A}{wL_A}\frac{wL_A}{wL}} = \frac{\lambda_{LM}\theta_{LA}}{\lambda_{LM}\theta_{LA} + \lambda_{LA}\theta_{LM}} = \frac{\lambda_{LM}\theta_{LA}}{x}$$

And a similar expression for χ_A.

Then:
$(\theta_{LA}\lambda_{LA} + \theta_{TA})\chi_M - \lambda_{LM}\theta_{LA}\chi_A = \frac{\lambda_{LM}\theta_{LA}}{x}(\theta_{LA}\lambda_{LA} + \theta_{TA} - \lambda_{LA}\theta_{LM}) = \frac{\lambda_{LM}\theta_{LA}}{x}(\theta_{TA}(1 - \lambda_{LA})+ \lambda_{LA}\theta_{HM}) > 0$

Therefore, Ω is unambiguously positive.

Appendix C. Proof of Proposition 3 and Related Results

Proof that $\frac{\hat{t}}{\hat{p}_A} > 0$ and $\frac{\hat{y}_M}{\hat{p}_A} \leq 0$

Using the reduced system shown in Appendix B, it follows that:

$$\Omega\frac{\hat{t}}{\hat{p}_A} = \theta_{HM}\theta_{LA}(\lambda_{HM}+\lambda_{HN}\chi_M) + \theta_{LM}\theta_{LA}(\lambda_{LM} + \lambda_{LN}\chi_M) > 0$$

$$\Omega\frac{\hat{y}_M}{\hat{p}_A} = -\theta_{LM}((\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA}) - (\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A - \theta_{LM}\theta_{TA}) = -\theta_{LM}(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} - \theta_{HM}\theta_{LA}\lambda_{HN}\chi_A < 0$$

Proof that $\frac{\hat{t}}{\hat{p}_A} \geq 1$

This result is equivalent to $\hat{p}_A + \hat{y}_A \geq \hat{p}_A$ or $\hat{y}_A \geq 0$. The system can be rearranged as:

$$((\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA})\hat{y}_A + \theta_{LA}(\lambda_{LM} + \lambda_{LN}\chi_M)\hat{y}_M = \hat{p}_A(1 - (\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA})$$

$$(\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A - \theta_{LM}\theta_{TA})\hat{y}_A + \theta_{HM}\theta_{LA}(\lambda_{HM}+\lambda_{HN}\chi_M)\hat{y}_M = -\hat{p}_A(\theta_{LM} + (\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A - \theta_{LM}\theta_{TA}))$$

which implies:

$$\Omega\frac{\hat{y}_A}{\hat{p}_A} = (1 - ((\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA}))\,\theta_{HM}\theta_{LA}(\lambda_{HM}+\lambda_{HN}\chi_M) + \theta_{LA}(\lambda_{LM} + \lambda_{LN}\chi_M)(\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A + \theta_{LM}\theta_{LA}) > 0$$

because $(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA} < 1$

Expression for $\boldsymbol{\hat{w}}$

The system can be rearranged (taking into account that $\hat{t} = \frac{\hat{p}_A - \theta_{LA}\hat{w}}{\theta_{TA}}$) to give:

$$((\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA})\hat{w} - \theta_{TA}(\lambda_{LM} + \lambda_{LN}\chi_M)\hat{y}_M = \hat{p}_A(\lambda_{LA} + \lambda_{LN}\chi_A)$$

$$-(\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A - \theta_{LM}\theta_{TA})\hat{w} + \theta_{HM}\theta_{TA}(\lambda_{HM}+\lambda_{HN}\chi_M) = -\hat{p}_A\lambda_{HN}\theta_{HM}\chi_A$$

In a similar way to what was done before, it can be shown that the determinant of this system is positive:

$$\Omega' = ((\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA})\theta_{HM}\theta_{TA}(\lambda_{HM}+\lambda_{HN}\chi_M) - \theta_{TA}(\lambda_{LM} + \lambda_{LN}\chi_M)(\theta_{HM}\theta_{LA}\lambda_{HN}\chi_A - \theta_{LM}\theta_{TA}) > 0$$

Then:

$$\Omega' \frac{\hat{w}}{\hat{p}_A}=(\lambda_{LA} + \lambda_{LN}\chi_A)\ \theta_{HM}\theta_{TA}(\lambda_{HM}+\lambda_{HN}\chi_M) - \lambda_{HN}\theta_{HM}\chi_A\theta_{TA}(\lambda_{LM} + \lambda_{LN}\chi_M)$$

Which can be reduced to an expression with an ambiguous sign:

$$\Omega' \frac{\hat{w}}{\hat{p}_A} = \theta_{HM}\theta_{TA}(\lambda_{LA}(\lambda_{HM}+\lambda_{HN}\chi_M) - \lambda_{HN}\chi_A\lambda_{LM})$$

Limit cases

1. Sector $A = -$ labor intensive: $\theta_{LA} \approx 1$

At the limit $\theta_{LA} = 1, \hat{w} = \hat{p}_A, \hat{h} = -\frac{\theta_{LM}}{\theta_{HM}}\hat{p}_A$

a. $\theta_{LN} \approx 0, \theta_{HN} \approx 1$. Non-traded good produced using factor H

Here, clearly, $\hat{p}_N = \hat{h} < 0$ so that the prices of non-tradables decline relative to both traded goods in the event of a rise in the price of *A*. The value of spending on good *N* (in terms of *M*) and the consumption of *M* may increase or fall depending on factor intensities. To clarify this, it is useful to rewrite the system as:

$$\lambda_{LA}\hat{c}_M + (\chi_A\lambda_{LM} - \chi_M\lambda_{LA})\hat{y}_M = \chi_A\hat{p}_A$$

$$\theta_{HM}\lambda_{HN}\hat{c}_M + \theta_{HM}\lambda_{HM}\,\hat{y}_M = -\,\theta_{LM}\,\hat{p}_A$$

The determinant Ω'' can be shown to be positive. Now:

$$\Omega'' \frac{\hat{c}_M}{\hat{p}_A} = \theta_{HM}\lambda_{HM}\,\chi_A + \theta_{LM}\,(\chi_A\lambda_{LM} - \chi_M\lambda_{LA})$$

Recalling the expressions for χ_A, χ_M:

$$\Omega'' \frac{\hat{c}_M}{\hat{p}_A} = \frac{\theta_{LM}\,\lambda_{LA}}{x}(\theta_{HM}\lambda_{HM} +\lambda_{LM}(\theta_{LM} - \theta_{LA})) = \frac{\theta_{LM}\,\lambda_{LA}}{x}\theta_{HM}(\lambda_{HM} - \lambda_{LM})$$

So that the sign of $\hat{c}_M$ depends on that of the difference in factor uses in sector: $\lambda_{HM} - \lambda_{LM}$.

It can also be seen that, despite that ambiguity, the volume of production/consumption of good *N* would increase when $\hat{p}_A > 0$.

Recalling that $\hat{p}_N = \hat{h} = -\frac{\theta_{LM}}{\theta_{HM}}\hat{p}_A$, the system can be rewritten as:

$$\lambda_{LA}\hat{c}_N + (\chi_A\lambda_{LM} - \chi_M\lambda_{LA})\hat{y}_M = (\chi_A + \lambda_{LA}\frac{\theta_{LM}}{\theta_{HM}})\hat{p}_A$$

$$\theta_{HM}\lambda_{HN}\hat{c}_N + \theta_{HM}\lambda_{HM}\,\hat{y}_M = -\,\theta_{LM}\,\lambda_{HM}\hat{p}_A$$

and:

$$\Omega'' \frac{\hat{c}_N}{\hat{p}_A} == (\chi_A \theta_{HM} + \theta_{LM}\,\lambda_{LA})\lambda_{HM} \ + \theta_{LM}\lambda_{HM}(\chi_A\lambda_{LM} - \chi_M\lambda_{LA})$$

$$\Omega'' \frac{\hat{c}_N}{\hat{p}_A} = \lambda_{HM}\left(\theta_{LM}\,\lambda_{LA} + \frac{\theta_{LM}\lambda_{LA}}{x}(\theta_{HM} + \theta_{LM}\lambda_{LM} - \theta_{LA}\,\lambda_{LM})\right) =$$

$$= \lambda_{HM}\,\theta_{LM}\,\lambda_{LA}\left(1 + \frac{1}{x}\theta_{HM}(1-\lambda_{LM})\right) > 0$$

b. $\theta_{LN} \approx 1, \theta_{HN} \approx 0$ Non-traded good produced with factor L.

Now $\hat{p}_N = \hat{w} = \hat{p}_A$ and $\hat{y}_M = \hat{h} = -\frac{\theta_{LM}}{\theta_{HM}}\hat{p}_A$

The system now reduces to:

$$\theta_{HM}(\lambda_{LA} + \lambda_{LN}\chi_A)\hat{c}_M = (\chi_A\theta_{HM} + \chi_A\lambda_{LM}\theta_{LM} - \chi_M\lambda_{LA}\theta_{LM})$$

$$= \frac{\theta_{LM}\,\lambda_{LA}}{x}(\theta_{HM} + \lambda_{LM}\theta_{LM} - \lambda_{LM}\theta_{LA}) = \frac{\theta_{LM}\,\lambda_{LA}\theta_{HM}}{x}(1-\lambda_{LM}) > 0$$

2. Sector A, with very low labor intensity: $\theta_{LA} \approx 0, \lambda_{LA} \approx 0$

Now, $\frac{\hat{t}}{\hat{p}_A} = 1, \hat{y}_A = 0$

The system can be written:

$$\hat{w} - (\lambda_{LM} + \lambda_{LN}\chi_M)\,\hat{y}_M = \lambda_{LN}\chi_A\hat{p}_A$$

$$\theta_{LM}\,\hat{w} + \theta_{HM}(\lambda_{HM} + \lambda_{HN}\chi_M)\hat{y}_M = -\theta_{HM}\lambda_{HN}\chi_A\hat{p}_A$$

The determinant Ω''' is positive. Now,

$$\Omega''' \frac{\hat{w}}{\hat{p}_A} = \theta_{HM}\chi_A(\lambda_{LN}(\lambda_{HM} + \lambda_{HN}\chi_M) - \lambda_{HN}(\lambda_{LM} + \lambda_{LN}\chi_M))$$

Or:

$$\Omega''' \frac{\hat{w}}{\hat{p}_A} = \theta_{HM}\chi_A(\lambda_{LN}\lambda_{HM} - \lambda_{HN}\lambda_{LM}) = \theta_{HM}\chi_A(\lambda_{LN} - \lambda_{HN})$$

Then, $\frac{\hat{w}}{\hat{p}_A} > 0$ if sector N is comparatively L- intensive. However, $\frac{\hat{w}}{\hat{p}_A} < 1$ whatever the value of $\lambda_{LN} - \lambda_{HN}$.

It can also be shown that:

$$\Omega''' \frac{\hat{p}_N}{\hat{p}_A} = \theta_{LN}\Omega''' \frac{\hat{w}}{\hat{p}_A} + \theta_{HN}\, \Omega''' \frac{\hat{h}}{\hat{p}_A} > 0$$

That is so because:

$$\Omega''' \frac{\hat{p}_N}{\hat{p}_A} = \chi_A(\lambda_{LN} - \lambda_{HN})(\,\theta_{LN}\theta_{HM} - \theta_{HN}\theta_{LM}) = \chi_A(\lambda_{LN} - \lambda_{HN})(\theta_{LN} - \theta_{LM}) > 0$$

a

Also: $\frac{\hat{p}_N}{\hat{p}_A} < 1$ since, as indicated before, both $\frac{\hat{w}}{\hat{p}_A} < 1$ and $\frac{\hat{h}}{\hat{p}_A} < 1$.

It can also be seen that:

$$\Omega''' \frac{\hat{c}_M}{\hat{p}_A} = \chi_A(\theta_{HM}\lambda_{HM} + \theta_{LM}\lambda_{LM}) > 0$$

and:

$$\Omega''' \frac{\hat{c}_N}{\hat{p}_A} = \chi_A\big((\theta_{HM}\lambda_{HM} + \theta_{LM}\lambda_{LM}) - (\lambda_{LN} - \lambda_{HN})(\theta_{LN} - \theta_{LM})\big) = \chi_A(\lambda_{HM}\theta_{HN} + \lambda_{LM}\theta_{LN}) > 0$$