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On the Distributive Effects of Terms of Trade Shocks: The Role of Non-tradable Goods

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On the Distributive Effects of Terms of Trade Shocks: The Role of Non-tradable Goods

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Abstract

We introduce non-tradable goods to the Heckscher-Ohlin-Samuelson (HOS) model to study the distributive effects of terms of trade shocks. We show that the employment of resources in activities producing exclusively for the local market induces a crucial association between domestic spending and factor demand and prices, which is absent in the usual HOS framework. Specifically, in a two-sector economy (producing only exportable and non-tradable goods) there are no redistributive effects of external terms of trade shifts–i.e. no Stolper-Samuelson-type of effect. By extending the model to the domestic production of a third, importable good, we show that distributional tensions arise. Distributional conflicts occur within urban labor groups (skilled vs. unskilled) and not only between the "traditional" rural vs. urban factors. Finally, export taxes are imposed to re-distribute the effects of external shocks. We show that the ability of the government to cushion the impact of the terms of trade shift on the economy's income distribution depends crucially on the use of the tax revenues.

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Contents | Page

I. INTRODUCTION

The potential for distributive impacts of changes in international prices has been traditionally recognized in the literature, at least as far back as the famous theorem of Stolper and Samuelson (1941). In turn, those distributive impacts may trigger social conflict, which could be deleterious for economic growth; see, among others, Rodrik (1999). A recent instance of the tensions that can be generated by large shifts in world prices occurred in early 2008, following a sharp rise in the prices of commodities–and food in particular. This lead 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 fixing, and export restrictions. Such reactions were observed both in food importers and in economies that export commodity foodstuffs; see Economist (2008).

In order to explore the distributive effects of terms of trade shocks for a wide arrange of configurations we introduce non-tradable goods to an otherwise standard neoclassical trade model, in the Heckscher–Ohlin–Samuelson (hereafter HOS) tradition. Specifically, we consider economies that could potentially produce three goods: a primary, exportable good, that uses land and unskilled labor as inputs of production; a manufacturing, importable, good that uses both unskilled labor and skilled workers; and the non-tradable sector that also uses unskilled and skilled labor.[1] Although our analysis can be re-interpreted to apply to economies with other configurations, for the sake of expositional clarity, we carry on the discussion referring mainly to the case of natural-resource-abundant countries. Thus, we will refer to the exportable sector as "agriculture," while imports consist of "manufactures."

The economies that we study differ regarding the presence of a significant import-competing sector. In the simplest case, the economy is specialized and produces only the exportable and non-traded goods. This setting would correspond to that of countries well endowed with natural resources, very open to international trade, and where 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; see Galiani and others (2008).[2] In this simple case, if the economy receives a positive terms of trade shock the effects are seen to be *neutral* in terms of income distribution. There is no distributive Stolper–Samuelson-type of

[1]Introducing a specific factor in manufacturing ("industrial capital") would not alter the analysis substantially.

[2]Alternatively, one could think of the case of economies also well endowed in natural resources, but where industrial sectors operate under such high levels of protection that they behave effectively as non-tradables, with manufacturing imports consisting only of goods that are not produced locally

shift. Every factor of production benefits since there are no changes in relative factor earnings and in the relative prices between locally produced goods. Thus, in this type of economy, once the demand responses to international prices have run their course, a terms of trade shock would not trigger distributive conflicts among the different socioeconomic groups (although those may arise in the transition if the effects on the spending on non-traded goods do not happen instantaneously). This result is robust to changes in the hypothesis of a representative consumer and if it is assumed that manufactured goods are used as inputs, and not only for consumption. However, the result of equal proportional changes in factor earnings would not hold if consumption demands were not characterized by unitary elasticities. If, for instance, the demand for the non-traded good were highly income elastic, the spending share in 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 that, after a positive shock on the price of the agricultural good an "urban" factor could receive the larger benefits in terms of income.

In the case where the economy is diversified and produces the three goods, with a manufacturing sector which operates as a price taker in international markets, non-neutralities emerge. The effects on incomes depend on factor intensities. 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 sort of Stolper–Samuelson tradeoff associated with the (*endogenous*) change in the relative price 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 intensive in the non-tradable sector), this group would lose from higher export prices, while skilled labor would be comparatively favored. From this standpoint, the interests of skilled workers could be more aligned with those of farmers than with those of unskilled workers.

The effect of international prices on real incomes can take place through several channels and at 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 thus, the analysis of accumulation and growth, as well as that of international capital movements. We carry out the discussion within a static framework, which focuses on what may be considered "medium term" effects; that is, those effects 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 reserve reference to such effects as departures to our benchmark case.

We study the impact of an export tax that for re-distributional purposes lowers the domestic price of the agricultural good (at constant international prices). Revenues are used "neutrally," by "saving" a certain proportion of the revenues (or, alternatively, spending on traded goods, which are treated by individuals as separable from private consumption). The government spends the rest as lump-sum transfers to agents in proportion to their original income levels (or, similarly, from the standpoint of determining factor prices, demanding goods in the same expenditure proportions as private consumption). The results show that, in the two-sector economy, skilled workers (employed intensively in the production of non-tradables) might be interested in the application of taxes on foreign trade, but only to the extent that, in one way or another, the use of tax revenues raise the demand for the non-traded good. Such incentives would tend to fade away, however, if the main source of demand for the services that employ skilled labor is the spending of the landlord group. This holds for the case in which tax revenues are fully returned to the private sector in proportion to their income shares. If the government saves the full amount of the revenues, a neutrality effect applies: all factors reduce their real market earnings in 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 were used intensively in the non-tradable sector.

Our analysis is related to the literature in the fields of development and international trade which develops and qualifies the traditional Stolper–Samuelson results. Much of the literature that built on the HOS model, see Johnson (1957), was devoted to the question of extending the theorems to the general case of many factors and tradable goods; see Ethier (1984) for an excellent survey of this literature). Less has been done to investigate the distributional effects of world prices when non-tradable goods are also incorporated into the model. A very important exception is Komiya (1967). The latter considers the case of a small open economy that produces two tradable goods and one non-tradable good using two factors of production (capital and labor), both of which are mobile across sectors. It finds conditions under which the factor price equalization theorem, the Rybczynski's theorem, and the Metzler's theorem hold.[3] However, given the specification adopted (three goods and two factors of production),

[3]In a related contribution, Deardorff and Courant (1990) analyze conditions for the likelihood of factor price equalization with non-traded goods.

it does not have much to add to the question the income distribution effects of terms of trade shocks, which is the topic of our paper.

The paper is organized as follows. Section II analyzes the distributive effects caused by exogenous terms of trade shocks: Subsection II.A studies a two-sector economy while Subsection II.B extends the analysis to a three-sector economy, highlighting the emergence of "distributive tensions." Section III delves into the distributional consequences of incorporating export taxes to (try to) "smooth" the effects of terms of trade shocks. Section IV concludes and elaborates on the implications of the paper. Auxilliary derivations and results are provided in a series of appendices.

II. Effects of Terms-of-Trade Shifts[4]

A. Specialized Economy: 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 HOS model is diluted since factors employed in the sector that produces for the domestic market faces a demand that depends on the revenues generated in the export sector.

Production

We consider a small open economy that produces two goods: agricultural (A) and non-traded (N) goods. The quantities produced 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. Given the previous notation, technology is represented by constant to scale Cobb–Douglas production functions:

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

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

[4]Through the paper, we present all discussions in terms of positive terms of trade shocks. However, all the results hold *mutatis mutandis* for negative terms of trade shocks as well.

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:

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

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

where a "hat" 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 is the rate of return to factor H, and θ_{ij} stands for the share of factor i in the unit cost of producing 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:

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

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

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

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 in 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 income distribution on the composition of demand. All individuals have identical Cobb–Douglas preferences over the consumption of the agricultural good, c_A, non-traded good, c_N, and 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 γ 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 vary 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 exogenous price of the manufacturing good has been assumed to remain unchanged, i.e., $\hat{p}_M = 0$.

Aggregate Constraints and Equilibrium

The resource constraint for the non-traded good implies the obvious condition, that hold both in levels and in proportional changes:

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

This is a static model which disregards intertemporal effects on spending. We therefore impose the condition of maintained trade balance equilibrium, which implies the equality between the proportional change in the value of production of traded goods, here composed solely of good A, and the value of 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 where the aggregate constraints on goods' production and consumption are satisfied, factor markets cleared, and consumers and firms act optimally as previously stated.

Results

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

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

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

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

which can be summarized in the following proposition.

Proposition 1 In the benchmark model, the response of the system to 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 and goods prices (produced locally).[5] The increase in the price of good A, $\hat{p}_A > 0$, causes an equivalent increase in the demand for non-traded goods. Thus, there are no changes in resource allocation (quantities produced do not vary). The only effect is a neutral increase in the purchasing power of all factors of production with respect to imports, M, since $\hat{p}_M = 0$. The volume of consumption of imported manufactures rises in the exact amount of the additional purchasing power which results from the terms-of-trade improvement.

The proof of this proposition follows immediately from equations (13) to (15).

Remark 1 (Effects of heterogeneous consumption baskets with homothetic preferences) Proposition 1 assumed the existence of a representative agent with preferences over goods that can be characterized using a homothetic utility function. Heterogeneity in the consumption baskets among individuals, maintaining the assumption of homotheticity, does not affect the important result of neutrality of factor prices changes, i.e., factor prices still would change in proportion to the positive terms of trade shock. However, it does affect the welfare implications of the shift in international prices. For example, assuming that individual agents own a single factor of production, and that they have Cobb–Douglas preferences which are identical within groups but differ across them (so that utility parameters and spending shares are γ_j^i, $j = A$, N, M, and $i = t$, w, and h), the change in the value of consumption of the various goods will be determined by the aggregate expenditure functions:

$$\hat{p}_j + \hat{c}_j = \gamma_j^t \hat{t} + \gamma_j^w \hat{w} + \gamma_j^h \hat{h}, \quad j = A, N, \text{and } M \tag{16}$$

[5] These results carry through if we add another mobile factor, such as physical capital, K.

It can readily be seen that the equal proportional changes in all factor earnings also applies in this instance: $\hat{t} = \hat{w} = \hat{h} = \hat{p}_A = \hat{p}_N$. Consequently, the welfare of all agents would still increase with an improvement of the international terms of trade. Nevertheless, the existence of differentiated consumption baskets means that agents with consumption preferences biased towards good M, i.e., higher γ_M^I for $I = w$, h, and t, would benefit relatively more.

Remark 2 (Imports as production inputs)
The use of good M as a production input, and not only as a consumption good, does not alter the income-distribution neutrality of the terms-of-trade shift obtained in Proposition 1. This result is shown in the Appendix.

Remark 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. If, for instance, the demand for the non-traded good were highly income elastic, the spending share in 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.

Remark 4 (Transitory non-neutralities)
In a multi-period setup, the dynamics of spending may cause differences between the "short" and "medium-run" impacts of a positive terms of trade shock on the economy. 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 of agricultural producers, resulting in a trade surplus, until eventually the additional income gets reflected in domestic spending), the first effect on "urban" groups would take the form of a loss of purchasing power, as the agricultural consumption good becomes more expensive while incomes would not react. Thus, the result of neutrality of factor prices changes would not hold in this case and, hence, it is more realistic to think about it as the equilibrium response to permanent than transitory changes in the terms of trade.

Remark 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:

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

Thus, the improvement of 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 may be affected by "Dutch disease;" see Gylfason (2008). Given the structure of economy, all groups benefit or loose together according to the evolution of international relative prices.

B. Diversified Economy: A Three-Sector Economy

The existence of a sector producing the imported good, M, changes significantly the distributive effects of changes in international prices discussed in the previous section and, in particular, generates tensions between the revenues of the factors used intensely in one of the two traded sector. In this section we discuss this issue in detail by extending the analysis to the case where the economy produces and consumes the three goods A, N, and M. There is now an import-competing sector which, for simplicity, is assumed to face a price (relative to that of the exported good) given exclusively by international conditions (and, possibly, taxes on international trade), irrespective of the state of domestic demand. This opens the possibility for Stolper–Samuelson-type of effects on factor earnings, which interact with those resulting from the adjustment of the non-traded sector to the shifts in spending.

Production

The three goods are now produced domestically. The (Cobb–Douglas) production functions are given by equations (1) and (2) for the agricultural (exportable) good and the non-traded good, respectively. The third sector competes with foreign products in the market for the imported good (interpreted as a composite of manufactured goods). This industry 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 numeraire (with equations analogous to equations (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 would be 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 completely allocated among the sectors that use them. Given the production functions in equations (1), (2), and (18) above, the market clearing condition for land is given by equation (5), while those for L and H are now given by:

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

and

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

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 two-sector economy. Given preferences in equation (8) and the flow budget constraint in equation (9), we obtain the same condition on the allocation of spending as in equation (10).

Aggregate Constraints and Equilibrium

Clearly, the equilibrium condition (11), which equates production and consumption of good N, holds also 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 in 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 in production is larger than its share in consumption.

We define an equilibrium as a set of proportional changes in the 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 $\left\{\hat{t}, \hat{w}, \hat{h}\right\}$, and the price of the non-traded good $\hat{p}_N$, which satisfies equations (3) to (5), (10), (11), and (19) to (22) for given values of the changes in international prices $\{\hat{p}_A, \hat{p}_M = 0\}$.

Results

Equations (23) and (24) clearly show that a Stolper–Samuelson type of distributive tension arises in this economy between factors H and L (with the important proviso that here the change in the relative price of both goods, $\hat{p}_N$, is determined endogenously):

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

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

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

Proposition 2 If the production of the non-traded good, N, is relatively intensive in human capital (factor H) in comparison with the manufactured good, M (or equivalently, if sector M is relatively labor intensive), then $\Delta > 0$. This implies that if an exogenous change (for instance, in international prices, as analyzed here) results in an increase in the price of good N relative to the imported good M, then 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 equations (23) and (24).

In order to find a closed form solution, the system can be reduced to two equations in the variables $\hat{t}$ (the proportional change of the rent on agricultural land) and $\hat{y}_M$ (the proportional change of the output in the import-competing sector):[6]

$$\left[(\lambda_{LA}+\lambda_{LN}\chi_A)\theta_{LA}+\theta_{TA}\right]\hat{t}+(\lambda_{LM}+\lambda_{LN}\chi_M)\theta_{LA}\hat{y}_M=\hat{p}_A \tag{25}$$

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

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

Proposition 3 In the three-good three-factor economy described above, an increase in the international relative price of the agricultural good A implies:

- The return to factor T, specific to the production of good A, increases unambiguously, and that the proportional change of the return to factor T is greater than the proportional change in the price of the exported good: $\hat{t} > \hat{p}_A > 0$. Besides, the proportional change of the return to factor T is also greater than the proportional change of the non-traded good: $\hat{t} > \hat{p}_N$.
- Production factors are reallocated in such a way that agricultural output increases ($\hat{y}_A > 0$) and the output of the import-competing sector decreases, ($\hat{y}_M < 0$).
- The consumption of traded goods switches towards good M, $\hat{c}_M > 0$. The economy increases its volume (and value) of imports since c_M increases, while y_M falls.
- If, as assumed, factor H is used more intensively in sector N than in sector M, and conditional on the share of labor used in the production of the agricultural good being "small" (see the Appendix for the precise bound):
  1. The price of the non-traded good increases in terms of the manufactured good M.
  2. The price of the factor used intensively in the production of the non-traded good, skilled labor, increases relative to the prices of goods M and N.
  3. The return to the unskilled labor L, used intensively in the production of import-competing goods, M, decreases in terms of the three goods.
- Compared to an "aggregate" consumption price index ($\hat{p} = {\gamma_A}'\hat{p}_A + {\gamma_M}'\hat{p}_M + {\gamma_N}'\hat{p}_N$):

[6] See Appendix B.

1. The purchasing power of the return to unskilled labor decreases (increases), $\hat{w} - \hat{p} < 0$ ($\hat{w} - \hat{p} > 0$), if non-traded goods are sufficiently skilled-labor intensive (not sufficiently skilled-labor intensive). The threshold is shown in the Appendix. The "wedge" in factor intensity increases, among other things in the share of exportable goods consumed and decreases in the share of exportable tradable goods production and the share of land used in the production of exportable goods.
2. The purchasing power of the return to skilled-labor increases (decreases), $\hat{h} - \hat{p} > 0$ ($\hat{h} - \hat{p} < 0$), if non-tradable goods are sufficiently skilled-labor intensive (not sufficiently skilled-labor intensive). The threshold is shown in the Appendix. The "wedge" in factor intensity increases, among other things in the share of exportable goods consumed and decreases in the share of exportable tradable goods production and the share of land used in the production of exportable goods.

The proof of this proposition is provided in Appendix C.

The results presented above state that an increase in the world price of the traded good A raises the volume and the value of output of that good and the income of the factor specific to that sector, while the output of the other traded good contracts, following the decline of its relative price in the international markets. The price of factor T varies (à la Stolper–Samuelson) more than proportionally with the price of A, and it also increases in terms of the non-traded good N. Moreover, as $\hat{c}_M / \hat{p}_A > 0$, a higher price of good A results in a larger volume of consumption of the other traded good. The contraction of the import-competing sector reduces the income of the factor used intensively in this activity (L in this case), provided its demand in sector A is not too strong. Spending in the non-traded good increases (in terms of M), which tends to raise its price and the earnings of factor H if it is demanded with relative intensity in that sector.

Hence, in this particular case, the shift in international prices would cause, à la Stolper and Samuelson, quite distinct distributive impacts, which favor the factor specific to sector A and hurt the factor highly demanded in the import-competing sector M. The effects shown above derive exclusively from features of the productive structure of the economy and from the Cobb–Douglas preferences. Thus, those results do not vary with the weights of the goods in the spending basket and, in particular, they do not depend on whether good A is the exported or the imported one. However, the sign and strength of the terms-of-trade effect would have a definite impact on the the value of the CPI-deflated changes in real incomes, output reallocations, and welfare implications due to the change in international prices.

Remark 6 (Distributive effects with different factor intensities in the urban sectors.)
It is conceivable that in some primary-goods exporting economies, relative factor intensities in the "urban activities" are different from the configuration that we have considered before, and that services are more unskilled-labor intensive than manufacturing. In this case, it is factor H which faces a decline in its earnings in terms of the three goods, while the wage of L rise relative to the urban goods; those shifts in factor prices are associated with an increase in the relative price of N relative to M (see Appendix).

Remark 7 (Effects of terms of trade in an economy with manufacturing exports)
Consider the case of an economy with different factor endowments (for example, with lower land-labor ratio) which, given factor intensities as before, exports good M and imports A. It is straightforward to show[7] that if the economy experiences a positive terms of trade shock (in this case $\hat{p}_M > 0$, $\hat{p}_A = 0$), then skilled-labor (or physical capital) increases its income unambiguously, land decreases its income unambiguously, and unskilled-labor increases its relative income provided that agricultural goods represent a sufficiently high share in its consumption basket relative to manufactures; decreases otherwise.[8] Clearly, the results are reversed if the terms of trade shock is negative, i.e., $\hat{p}_M = 0$ and $\hat{p}_A > 0$ as in the previous cases.

Remark 8 (Transitory non-neutralities)
As in the two-sector model, here too the dynamics of spending might cause differentiated effects in the short run versus the medium term.

III. Effects of Export Taxes

In this section, we analyze the case where the change in the domestic relative price between the traded goods derives from a policy intervention (at constant international prices) consisting in the implementation of an export tax, which lowers the domestic price of good A. The reason for using this specification, instead of an export subsidy that would increase p_A, is simply to focus on a case often observed in countries specialized in agricultural exports.

The distributive effects of this policy clearly depend on how the government spends the revenues generated by the tax. Given that the purpose of the analysis is to highlight the effects of relative price shifts, we assume that tax proceeds are used "neutrally." Clearly, one obvious possibility is that the government applies the tax revenues to disburse lump-sum transfers

[7]The proofs are available from the authors upon request.

[8]The formal proof finds a threshold that makes $\hat{w} - \hat{p} > 0$ conditional on $\gamma_A{}'/\gamma_M{}'$ greater than a threshold, based on parameters. $\hat{p}$ stands for an aggregate consumption index, defined as $\hat{p} = \gamma_A{}'\hat{p}_A + \gamma_M{}'\hat{p}_M + \gamma_N{}'\hat{p}_N$.

to agents in proportion to their original income levels. However, in order to explore also the effect of saving the tax revenues, we allow the government to "save" a proportion of the revenues by changing its net position of foreign reserves.

A. Export Taxes in the Specialized Two-Sector Economy

The setup of the model is similar to the one described earlier, in Subsection II.A, where the economy produces only goods A and N. Starting from a situation with no taxes, the government raises a proportional tax 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:

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

since due to the assumption of trade balance equilibrium in the original state, exports of A equal imports of M, which are equal to the consumption of this good, which in turn is assumed not to be produced domestically.

The system is characterized by equations (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 neither made available to agents in order to finance consumption nor spent in non-traded goods. Therefore, the budget constraint of the private sector can be written as an equality between the value of consumption of traded goods and the value of the output of the traded good A, net of the resources appropriated by the government:[9]

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

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

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

[9]Thus, the trade balance is such that the value of exports equals the value of imports plus the "savings" of the government that are equal to $(1-\delta)\alpha\gamma_M$. In each of the exercises in this section the latter term is constant and therefore does not affect the results.

where $\widehat{I_j} = \hat{w}$, $\hat{h}$, and $\hat{t}$ denotes the proportional change in factor prices and $\gamma_M{}'$ is the share of good M in total expenditures, including those non-traded goods.[10] Combining equations (5), (10), and (28), it can seen that changes in pre-transfer factor earnings satisfy:

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

Proposition 4 Factor prices vary according to: $\hat{h} \geq \hat{w} \geq \hat{t}$. 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 an increase in the expenditures in the non-traded good. The redistribution would be associated with a reallocation of resources away from sector A into sector N.

See equation (30) and its derivation for a proof of this proposition.

Solving the system we find that 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 5 **A:** If revenues from the export tax are fully saved by the government, i.e., if $\delta = 0$, the purchasing power of all factors varies in the same proportion, equal to the change in the price of the exported good; that is, all incomes 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 exported one. In this regard, the export tax would be associated with a "real depreciation" (as we use M as the numeraire) due to the higher relative price of the exported good.

B: If revenues from the export tax are fully returned to the private sector in proportion to their income shares (or spent by the government with the same composition of expenditures

[10] This expression can be derived as follows. Let ΔI_J and $\Delta I_j{}'$ be the absolute changes of the income 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, $Y_A/Y = C_T/C = 1/(1+\gamma_N)$, the share of traded goods in total consumption. Recalling that $\gamma_M{}' = \gamma_M/(1+\gamma_N)$ and that $\widehat{I}_j' = \Delta I_j{}'/I_j$, the expression in the text follows immediately.

between goods as that of private consumption), so that $\delta = 1$, the effects on disposable incomes would be as follows:

- For the specific factor of sector A (T):

  1. The purchasing power of earnings in terms of manufactures unambiguously falls; see equation (31).
  2. Incomes relative to the exported good may increase or decrease. If the economy has a relatively important service sector (N), it could happen that the purchasing power of T in terms of A decreases: by equation (31), for λ_{LN} sufficiently low and for $\gamma_M{}'$ sufficiently lower than γ_M, we observe that $\gamma_M{}' - \lambda_{LN}\theta_{LA}\gamma_M < 0$. Otherwise, factor T increases its purchasing power in terms of the agricultural good.

- For the specific factor of sector N (H), if the production of agricultural goods is sufficiently land-intensive (large θ_{TA}) and γ_M is relatively large, then by equation (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 good prices.

- For the mobile factor across sectors (L), if the economy has a relatively important service sector (N), implying a large λ_{LN} (so that a large proportion of employment goes to the non-traded sector), this factor could increase its earnings in terms of M.

Proof. **A**: Direct from equations equations (31) to (33). **B**: See Appendix. □

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

B. Export Taxes in the Diversified Three-Sector Economy

As in the previous analysis of the two-sector economy, fiscal policy in the three-sector economy is given by equation (27), and the system of equations is still characterized by equations (1) to (10), with $\hat{p}_A$ substituted for $-\alpha$. Assuming that the government returns to the private sector a fraction δ of the revenue $\alpha\gamma_M$ collected in terms of traded goods (and keeps unspent or uses directly for other purposes the remaining fraction $1-\delta$), the balance of trade constraint takes the form:

$$\begin{aligned}\chi_A \hat{y}_A + \chi_M \hat{y}_M &= \gamma_A \hat{c}_A + \gamma_M \hat{c}_M + (1-\delta)\alpha\gamma_M \\ &= \hat{c}_A - \delta\alpha\gamma_M \\ &= \hat{c}_M + \alpha(1-\delta\gamma_M) \qquad (34)\end{aligned}$$

where the latter terms result from the fact that, given fixed shares of spending in individual goods in total consumption, $\hat{c}_A - \alpha = \hat{c}_M$.

It is clearly intuitive that the imposition of an export tax will reduce the income in terms of the imported good of the factor specific to the export sector, i.e., $\hat{t} < 0$ (see Appendix). The effects on the prices of the factors used in "urban" activities depend on factor intensities and the use of the revenue derived from the tax. If the non-traded sector N is relatively intensive in skilled labor H in relation to the import-competing sector M, unskilled labor L would be favored by the export tax (in the sense that its earnings would rise unambiguously in terms of the three goods) if that factor has a much higher share in the production of good M than in the export sector A, and a small fraction of tax revenues is spent domestically (indicated here by a small value of the parameter δ). In such a case, wages increase since the lower price of the exported good does not have a strong impact on the demand for labor, and the reallocation of output towards sector M, where labor is used intensively, is not stringily restricted by the competition of the non-traded sector for the use of skilled labor. Conversely, assuming again that the non-traded sector is relatively intensive in skilled labor in relation to the import-competing activity, factor H would be interested in a use of tax revenues in a way that would raise domestic spending and, in that case, the factor could be benefitted by the export tax if, given factor mobility, the taxed export sector releases a substantial quantity of unskilled labor, thus hampering an increase in wages.

The previous effects can be seen in the expression indicating the change in wages w in terms of the import-competing good (recalling that $\theta_{HM}\hat{w} + \theta_{HN}\hat{h} = 0$):

$$\Big\{\lambda_{HM} + \chi_M\lambda_{HN} + \frac{\theta_{LM}}{\theta_{HM}}(\lambda_{LM} + \chi_M\lambda_{LN}) \\ + \frac{\theta_{LA}}{\theta_{TA}}\big[\lambda_{HM}(\lambda_{LA} + \chi_A\lambda_{LN}) + \lambda_{HN}(\chi_M\lambda_{LA} - \chi_A\lambda_{LM})\big]\Big\}\hat{w} \\ = \alpha\Big\{(\chi_M - \gamma_M\delta)[\lambda_{HN}\lambda_{LM} - \lambda_{LN}\lambda_{HM}] \\ - \frac{1}{\theta_{TA}}\big[\lambda_{HM}(\lambda_{LA} + \chi_A\lambda_{LN}) + \lambda_{HN}\frac{\lambda_{LA}\lambda_{LM}}{\theta_{LA}\lambda_{LM} + \theta_{LM}\lambda_{LA}}(\theta_{LA} - \theta_{LM})\big]\Big\}$$

It can be shown (see Appendix) that the term multiplying $\hat{w}$ is unambiguously positive. Thus, if $\lambda_{HN}\lambda_{LM} - \lambda_{LN}\lambda_{HM} > 0$, so that sector N is relatively skilled-labor intensive, an increase in w would be obtained if $\chi_M - \gamma_M\delta > 0$, that is if δ is sufficiently low (it may be recalled here that, since M is the import- competing sector, $\chi_M - \gamma_M < 0$) and $\theta_{LM} - \theta_{LA}$ sufficiently high.

The following Proposition summarizes and generalizes the results for the polar cases of $\delta = 0$ and 1.

Proposition 6 **A:** If revenues from the export tax are not spent (or spent in traded goods), so that $\delta = 0$, the after-transfer proportional changes in the earnings of the factors of production equal the pre-transfer proportional changes, i.e., $\hat{t}' = \hat{t}$, $\hat{h}' = \hat{h}$, $\hat{w}' = \hat{w}$, and

- The return to the factor specific to the production of the exported agricultural good, land, decreases unambiguously in terms of the imported good ($\hat{t} < 0$).
- If the non-traded sector is highly intensive in skilled labor (the threshold is shown in the Appendix), the return to unskilled labor increases in terms of the three goods ($\hat{w} > 0$) and decreases otherwise; on the other hand, the return to skilled labor decreases in terms of the imported and the non-traded goods ($\hat{h} < 0$) and increases otherwise.

B: If revenues from the export tax are fully returned to the private sector in proportion to their income shares (or spent by the government with the same composition of expenditures between goods as that of private consumption), so that $\delta = 1$, the effects on factor prices are as follows:

- The return to the factor specific to the production of the exported agricultural good, land, decreases in terms of the importable good.

- If the manufacture sector is highly intensive in skilled labor (the threshold is shown in the appendix), the return to skilled labor decreases in terms of the three goods ($\hat{h} < 0$) and increases otherwise; on the other hand, the return to unskilled labor increases in terms of the imported and the non-traded goods ($\hat{w} > 0$) and decreases otherwise ($\hat{w} < 0$).

The proof is provided in Appendix F.

IV. Conclusions

In this paper we introduce production of non-tradable goods to the Heckscher–Ohlin–Samuelson (HOS) model to study the distributive effects of terms of trade shocks. This is important since the employment of resources in activities producing exclusively for the local market induces a crucial association between domestic spending and factor demand and prices, which is absent in the usual HOS framework. Specifically, we consider economies that could potentially produce three goods: a primary (exportable) good, that uses land and unskilled labor as inputs of production; a manufacturing good that uses both unskilled labor and skilled workers; and the non-tradable sector that also uses unskilled and skilled labor.

In our benchmark case, the two-sector economy, no distributive Stolper–Samuelson effect results from a positive terms of trade shock: it is neutral in terms of income distribution. 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 the urban factors decline unambiguously–in terms of the three goods.

We also study the income distribution effect of an export tax–the recently observed "typical" response to external terms of trade shocks. In the two-sector economy, skilled workers (employed intensively in the production of non-tradables) favor 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. On the contrary, it does not hold when the owners of land, specific to the exportable good, tend to demand an excessive share of the good that uses skilled labor intensively. The latter is valid for the case in which tax revenues are fully returned to the private sector–proportionally to each factor's income share. If the government saves the full amount of the revenues, however, a neutrality effect applies: all factors reduce their real market earnings in the same proportion. In the three-sector economy, an export tax reduces the return to land (the factor specific to the production of the exportable good); unskilled workers gain (lose) if their labor is used intensively in the import-competing manufacturing (non-tradable) sector.

Throughout the analysis, naturally, distributive tensions potentially arise. In the two-sector economy, the neutrality result dilutes any such conflicts. In the three-sector economy, on the contrary, distributional tensions emerge. Interestingly, distributional conflicts could also occur within urban labor groups (skilled vs. unskilled) and not only between the "traditional" rural vs. urban factors. Similar type of effects are present when studying redistributive export taxes. Importantly, the spending/saving decisions of the government affect the ability (or not) of export taxes as effective external terms of trade re-distributional instruments.

The analytical framework can be used to describe the motivations and incentives of different groups in political economy games. In this connection, our arguments contribute to a broader literature that emphasizes the role of trade on domestic political cleavages and domestic policies and institutions; see, for example, Rogowski (1989) and O'Rourke and Taylor (2006). Here, we specifically analyze the consequences of taxes on foreign trade on factor incomes– in the setups described above–to discuss the effects of international prices' shifts and income redistribution. The introduction of the non-traded goods in the analysis implies that foreign trade taxes need not imply protection of import-competing activities (since these may be economically insignificant, as in the two-sector case) and that their implications for factor prices may depend strongly on the use of the tax revenues, apart from the effect of policies on the relative prices of traded goods, which is the change on which the typical HOS analysis concentrates.

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APPENDIX A. IMPORTS AS PRODUCTION INPUTS

Adding imported manufactures as an additional input in production implies changing equations (3) and (4) to:

$$\hat{p}_A = \theta_{TA}\hat{t} + \theta_{LA}\hat{w} + \theta_{MA}\hat{p}_M \tag{A.1}$$

and

$$\hat{p}_N = \theta_{HN}\hat{h} + \theta_{LN}\hat{w} + \theta_{MN}\hat{p}_M \tag{A.2}$$

Besides keeping equations (5) to (7) as they are and adding

$$\widehat{M} = \lambda_{MA}(\hat{y}_A + \hat{p}_A) + \lambda_{MN}(\hat{y}_N + \hat{p}_N) - \hat{p}_M \tag{A.3}$$

the balance of payment reads

$$p_A y_A = p_A c_A + p_M c_M + p_M M \tag{A.4}$$

which, in percentage deviations, may be written as:

$$\hat{p}_A + \hat{y}_A = \gamma_A{}'(\hat{p}_A + \hat{c}_A) + \gamma_M{}'\hat{c}_M + m\widehat{M} \tag{A.5}$$

where $\gamma_A{}' = \frac{p_A c_A}{p_A y_A}$, $\gamma_M{}' = \frac{p_M c_M}{p_A y_A}$, $m = \frac{p_M M}{p_A y_A}$, and $\gamma_A{}' + \gamma_M{}' + m = 1$. M stands for the volume of imported manufactures used in production and m for the share of manufactures as inputs in the supply of traded goods.

The price of imported manufactures remains unaltered, i.e., $\hat{p}_M = 0$, equation (3) equals equation (A.1) and equation (4) equals equation (A.2), with $\theta_{TA} + \theta_{LA} = 1 - \theta_{MA} < 1$ and $\theta_{HN} + \theta_{LN} = 1 - \theta_{MN} < 1$. Therefore:

$$\widehat{L} = 0 = \lambda_{LA}\hat{t} + \lambda_{LN}\hat{h} - \hat{w} \tag{A.6}$$

and

$$\hat{t} = (\gamma_A{}' + \gamma_M{}')\hat{c}_M + m\lambda_{MA}\hat{t} + m\lambda_{MN}\hat{h} \tag{A.7}$$

where we have taken into account that $\hat{t} = \hat{p}_A + \hat{y}_A$, $\hat{p}_A + \hat{c}_A = \hat{c}_M = \hat{c}_N + \hat{p}_N = \hat{y}_N + \hat{p}_N = \hat{h}$.

Rearranging equation (A.7), we observe that $(1 - m\lambda_{MA})\hat{t} = (1 - m - m\lambda_{MN})\hat{h} \Rightarrow (1 - m(1 - \lambda_{MN}))\hat{t} = (1 - m - m\lambda_{MN})\hat{h} \Rightarrow \hat{t} = \hat{h}$. Given the latter and equation (A.6), and the fact that $\lambda_{LA} + \lambda_{LN} = 1$, it necessarily holds that $\hat{t} = \hat{h} = \hat{w}$, as in Proposition 1.

APPENDIX B. DERIVATION OF EQUATIONS (25) AND (26) AND THE SIGN OF THE DETERMINANT

Equations (25) and (26) can be obtained as follows. Notice that the equilibrium system can be collapsed to:

$$\lambda_{LA}\hat{t} + \lambda_{LN}\hat{c}_M + \lambda_{LM}\hat{y}_M = -\frac{\theta_{HM}}{\Delta}\hat{p}_N \tag{B.1}$$

$$\lambda_{HN}\hat{c}_M + \lambda_{HM}\hat{y}_M = \frac{\theta_{LM}}{\Delta}\hat{p}_N \tag{B.2}$$

$$\hat{c}_M = \chi_A\hat{t} + \chi_M\hat{y}_M \tag{B.3}$$

$$\hat{p}_A = \theta_{TA}\hat{t} - \theta_{LA}\frac{\theta_{HM}}{\Delta}\hat{p}_N \tag{B.4}$$

Rearranging, we have a system in $\hat{t}$, $\hat{y}_M$, $\hat{w}$, $\hat{h}$ given by equations (3) and (19) and

$$(\lambda_{LA} + \lambda_{LN}\chi_A)\hat{t} + (\lambda_{LM} + \lambda_{LN}\chi_M)\hat{y}_M = \hat{w} \tag{B.5}$$

$$\lambda_{HN}\chi_A\hat{t} + (\lambda_{HM} + \lambda_{HN}\chi_M)\hat{y}_M = \hat{h} \tag{B.6}$$

which, in turn, can be collapsed into equations (25) and (26).

We can also show that Ω, the determinant of equations (25) and (26), is positive. As Ω is given by:

$$\begin{aligned}\frac{\Omega}{\theta_{LA}} = {} & \lambda_{LA}\lambda_{HM}\theta_{LA}\theta_{HM} + \lambda_{LA}\lambda_{HN}\chi_M\theta_{LA}\theta_{HM} \\ & + \lambda_{LN}\lambda_{HM}\chi_A\theta_{LA}\theta_{HM} + \lambda_{LN}\lambda_{HN}\chi_A\chi_M\theta_{LA}\theta_{HM} + \lambda_{HM}\theta_{TA}\theta_{HM} + \\ & + \lambda_{HN}\chi_M\theta_{HM}\theta_{TA} - \lambda_{HN}\lambda_{LM}\chi_A\theta_{LA}\theta_{HM} - \lambda_{LN}\lambda_{HN}\chi_A\chi_M\theta_{LA}\theta_{HM} \\ & + \lambda_{LM}\theta_{LM}\theta_{TA} + \lambda_{LN}\chi_M\theta_{TA}\theta_{LM}\end{aligned} \tag{B.7}$$

To figure out the sign of the previous expression, it is important to notice that

$$\begin{aligned}& \lambda_{LA}\lambda_{HN}\chi_M\theta_{LA}\theta_{HM} - \lambda_{HN}\lambda_{LM}\chi_A\theta_{LA}\theta_{HM} + \lambda_{HN}\chi_M\theta_{TA}\theta_{HM} \\ & > \lambda_{LA}\lambda_{HN}\chi_A\theta_{LA}\theta_{HM} - \lambda_{HN}\lambda_{LM}\chi_A\theta_{LA}\theta_{HM} + \lambda_{LA}\lambda_{HN}\chi_M\theta_{TA}\theta_{HM} \\ & = \lambda_{HN}\theta_{HM}[\lambda_{LA}\chi_M - \theta_{LA}\lambda_{LM}\chi_A] > 0\,.\end{aligned}$$

This inequality can be derived from the fact that

$$\lambda_{LA}\chi_M - \theta_{LA}\lambda_{LM}\chi_A = \frac{wL_A}{wL}\frac{p_M y_M}{Y_T} - \frac{wL_A}{p_A y_A}\frac{wL_M}{wL}\frac{p_A y_A}{Y_T} = \frac{wL_A}{(wL)(Y_T)}(p_M y_M - wL_M) > 0\,,$$

with Y_T being the total value of production of traded goods.

Appendix C. Proof of Proposition 3

Proof that $\hat{t} > 0$ and $\hat{y}_M < 0$

Solving the system of equations (25) and (26), we obtain:

$$\frac{\hat{t}}{\hat{p}_A} = \frac{\theta_{LA}}{\Omega}[(\lambda_{HM} + \lambda_{HN}\chi_M)\theta_{HM} + (\lambda_{LM} + \lambda_{LN}\chi_M)\theta_{LM}] > 0 \tag{C.1}$$

$$\begin{aligned}\frac{\hat{y}_M}{\hat{p}_A} &= -\frac{1}{\Omega}\{[(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA}]\theta_{LM} + \lambda_{HN}\chi_A\theta_{HM}\theta_{LA} - \theta_{LM}\theta_{TA}\} \\ &= -\frac{\theta_{LA}}{\Omega}\left[(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LM} + \lambda_{HN}\chi_A\theta_{HM}\right] < 0\end{aligned} \tag{C.2}$$

Proof that $\hat{t} > \hat{p}_A$

We can rearrange equation (B.7) as:

$$\begin{aligned}\frac{\Omega}{\theta_{LA}} = &\left[(\lambda_{LA} + \lambda_{LN}\chi_A)\theta_{LA} + \theta_{TA}\right]\left(\lambda_{HM} + \lambda_{HN}\chi_M\right) \\ &- \left(\lambda_{HN}\chi_A\theta_{HM}\theta_{LA} - \theta_{LM}\theta_{TA}\right)\left(\lambda_{LM} + \lambda_{LN}\chi_M\right)\end{aligned} \tag{C.3}$$

Notice that in the first term:

$$[(\lambda_{LA} + \lambda_{LN}\chi_A)\,\theta_{LA} + \theta_{TA}] < \theta_{LA} + \theta_{TA} = 1 \tag{C.4}$$

The latter results from the fact that $\lambda_{LA} + \lambda_{LN}\chi_A < 1$, since it can be also written as $\lambda_{LA} + \lambda_{LN}(1-\chi_M) = \lambda_{LA} + \lambda_{LN} - \lambda_{LN}\chi_M = 1 - \lambda_{LM} - \lambda_{LN}\chi_M < 1$.

In the second term, considering the second factor and taking into account that $\theta_{LM} = 1 - \theta_{HM}$ and $\theta_{TA} = 1 - \theta_{LA}$, after some manipulations we can show that:

$$\lambda_{HN}\chi_A\theta_{HM}\theta_{LA} - \theta_{LM}\theta_{TA} = -1 + \theta_{LA}\,(1 + \lambda_{HN}\chi_A\theta_{HM}) + \theta_{HM}\theta_{TA} \tag{C.5}$$

Thus, the second term can be written as:

$$\begin{aligned}(\lambda_{LM} + \lambda_{LN}\chi_M) - &\left\{(\lambda_{LM} + \lambda_{LN}\chi_M)\left[\theta_{LA}\,(1 + \lambda_{HN}\chi_A\theta_{HM}) + \theta_{HM}\theta_{TA}\right]\right\} \\ &< \lambda_{LM} + \lambda_{LN}\chi_M\end{aligned} \tag{C.6}$$

Finally, from equation (C.1) we can obtain

$$\frac{\hat{t}}{\hat{p}_A} = \frac{(\lambda_{HM} + \lambda_{HN}\chi_M)\theta_{HM} + (\lambda_{LM} + \lambda_{LN}\chi_M)\theta_{LM}}{\Omega/\theta_{LA}} > 0 \tag{C.7}$$

and given the results in equations (C.4) and (C.6), it must necessarily be the case that $\hat{t} > \hat{p}_A$. The latter ensures that $\hat{y}_A > 0$.

Proof that $\hat{c}_M/\hat{p}_A > 0$

To see that $\hat{c}_M/\hat{p}_A > 0$, take the system of equations (B.1) and (B.2) and solve for $\hat{c}_M$ to obtain:

$$\hat{c}_M = \frac{1}{\Lambda}\left[\lambda_{LA}\lambda_{HM}\hat{t} + (\lambda_{HM}\theta_{HM} + \lambda_{LM}\theta_{LM})\frac{\hat{p}_N}{\Delta}\right] \tag{C.8}$$

$$\hat{y}_M = -\frac{1}{\Lambda}\left[\lambda_{LA}\lambda_{HN}\hat{t} + (\lambda_{HN}\theta_{HM} + \lambda_{LN}\theta_{LM})\frac{\hat{p}_N}{\Delta}\right] \tag{C.9}$$

where $\Lambda = \lambda_{HN}(1-\lambda_{LA}) - \lambda_{LN} > 0$ if the non-traded sector is skilled-labor intensive, i.e., large λ_{HN}, and manufactures labor-intensive, i.e., large λ_{LM} .

Proof that $\hat{p}_A/\hat{p}_N > 0$

Plugging equations (C.8) and (C.9) into equation (B.3), using the definition of Λ, and considering that $\chi_A + \chi_M = 1$ and $\lambda_{HN} + \lambda_{HM} = 1$, we can show that:

$$\hat{t}\left[\chi_A(\lambda_{HN} - \lambda_{LN}) - \lambda_{LA}\right] = \frac{\hat{p}_N}{\Delta}\left[\lambda_{HM}\theta_{HM} + \lambda_{LM}\theta_{LM} + \chi_M(\lambda_{HN}\theta_{HM} + \lambda_{LN}\theta_{LM})\right] \tag{C.10}$$

Replacing $\hat{t}$ in the previous equation with the expression in equation (C.1) gives

$$\hat{p}_N = \frac{\theta_{LA}}{\Omega}\left[\chi_A\left(\lambda_{HN} - \lambda_{LN}\right) - \lambda_{LA}\right]\Delta\hat{p}_A \tag{C.11}$$

Since by assumption non-traded goods are skilled-labor intensive and manufactures are unskilled-labor intensive, then $\Delta = \theta_{HN} - \theta_{HM} = \theta_{LM} - \theta_{LN} > 0$. Conditional on $\lambda_{LA} \to 0$, or more generally, $\chi_A(\lambda_{HN} - \lambda_{LN}) - \lambda_{LA}) = \chi_A(\lambda_{LM} - \lambda_{HM}) + \lambda_{LA}\chi_M > 0$, equation (C.11) is greater than zero, i.e., $\frac{\partial \hat{p}_N}{\partial \hat{p}_A} > 0$.

Proof that $\hat{t} > \hat{p}_N$

To show that $\hat{t} > \hat{p}_N$, we need to notice from equation (C.10) that the following holds:

$$\frac{\lambda_{HM}\theta_{HM} + \lambda_{LM}\theta_{LM} + \chi_M(\lambda_{HN}\theta_{HM} + \lambda_{LN}\theta_{LM})}{\chi_A(\lambda_{HN} - \lambda_{LN}) - \lambda_{LA}} > 1 \tag{C.12}$$

After some manipulations and taking into account that $\chi_A = 1 - \chi_M$ and $1 - \lambda_{LM} = \lambda_{LN} + \lambda_{LA}$, it can be shown that equation (C.12) can be re-written as:

$$\begin{aligned}(\lambda_{HM} + \lambda_{HN}\chi_M)\theta_{HM} &+ (\lambda_{LM} + \lambda_{LN}\chi_M)\theta_{LM} \\ &> \lambda_{HN}[-(1+\chi_M)\theta_{HN} + \theta_{HM}(1+\chi_M)] + (\lambda_{LM} + \lambda_{LN}\chi_M)(\theta_{LM} - \theta_{LN})\end{aligned} \tag{C.13}$$

Comparing the second term on the RHS with the second term on the LHS, as $\theta_{LM} > \theta_{LM} - \theta_{LN}$ the term on the LHS is greater than the the second term on the RHS. Likewise, comparing the first term on the LHS and the RHS, one finds:

$$\begin{aligned}(\lambda_{HM} + \lambda_{HN}\chi_M)\theta_{HM} &> \lambda_{HN}(1+\chi_M)(\theta_{LM} - \theta_{HN}) \\ &= \lambda_{HN}(1+\chi_M)(1 - \theta_{HM} - \theta_{HN}) \qquad = 0\end{aligned}$$

Therefore, since both terms on the LHS of equation (C.13) are greater than the ones on the RHS, $\hat{t} > \hat{p}_N$ necessarily.

APPENDIX D. FACTOR RETURNS WITH RESPECT TO AN "AGGREGATE" PRICE INDEX

Define an aggregate price index $\hat{p} = \gamma_A{}'\hat{p}_A + \gamma_M{}'\hat{p}_M + \gamma_N{}'\hat{p}_N$. Taking into account equation (C.11) and the fact that $\hat{p}_M = 0$, then:

$$\hat{p} = \left\{\gamma_A{}' + \frac{\gamma_M{}'\theta_{LM}}{\Omega}\left[\chi_A\left(\lambda_{HN} - \lambda_{LN}\right) - \lambda_{LA}\right]\Delta\right\}\hat{p}_A \tag{D.1}$$

where $\Delta = \theta_{HN} - \theta_{HM} = \theta_{LM} - \theta_{LN}$. Since $\hat{h} = \theta_{LM}(\hat{p}_N/\Delta)$ and $\hat{w} = -\theta_{HM}(\hat{p}_N/\Delta)$, and considering equation (D.1), we have:

$$\hat{w} - \hat{p} = \left\{-\frac{\theta_{LA}}{\Omega}\left[\chi_A\left(\lambda_{HN} - \lambda_{LN}\right) - \lambda_{LA}\right]\left((1-\gamma_M{}')\theta_{HM} + \gamma_M{}'\theta_{HN}\right) - \gamma_A{}'\right\}\hat{p}_A \tag{D.2}$$

$$\hat{h} - \hat{p} = \left\{\frac{\theta_{LA}}{\Omega}\left[\chi_A\left(\lambda_{HN} - \lambda_{LN}\right) - \lambda_{LA}\right]\left((1-\gamma_M{}')\theta_{LM} + \gamma_M{}'\theta_{LN}\right) - \gamma_A{}'\right\}\hat{p}_A \tag{D.3}$$

where we have taken into account Δ.

Thus, $\hat{w} - \hat{p} < 0$ if non-traded goods are sufficiently skilled-labor intensive and $\hat{w} - \hat{p} > 0$ otherwise, with the threshold given by:

$$\lambda_{HN} = \lambda_{LN} + \frac{\gamma_A{}'\Omega}{\chi_A\theta_{LA}\left[(1-\gamma_M{}')\theta_{HM} + \gamma_M{}'\theta_{HN}\right]} \tag{D.4}$$

Likewise, $\hat{h} - \hat{p} > 0$ if non-traded goods are sufficiently skilled-labor intensive and $\hat{h} - \hat{p} < 0$ otherwise, with the threshold given by:

$$\lambda_{HN} = \lambda_{LN} + \frac{\gamma_A{}'\Omega}{\chi_A\theta_{LA}\left[(1-\gamma_M{}')\theta_{LM} + \gamma_M{}'\theta_{LN}\right]} \tag{D.5}$$

Appendix E. Distributive Effects with Different Factor Intensities

The only change that should be considered here is that manufactures are skilled-labor intensive while non-traded goods are unskilled-labor intensive. Notice that this implies that $\Delta = \theta_{HN} - \theta_{HM} = \theta_{LM} - \theta_{LN} < 0$. Also, it is straightforward to show that $\hat{p}_N$ increases in $\hat{p}_A$ unambiguously. To clarify the situation, notice that

$$\begin{aligned} \chi_A(\lambda_{HN} - \lambda_{LN}) - \lambda_{LA} &= \chi_A \lambda_{HN} - \chi_A(1 - \lambda_{LM} - \lambda_{LA}) - \lambda_{LA} \\ &= \chi_A \lambda_{HN} - \chi_A + \chi_A \lambda_{LM} - \lambda_{LA}(1 - \chi_A) \\ &= \chi_A(\lambda_{LM} - \lambda_{HM}) - \lambda_{LA} \chi_M \,. \end{aligned}$$

Observe that if manufactures are skilled-labor intensive ($\lambda_{LM} < \lambda_{HM}$), then the latter expression is negative. This, together with $\Delta < 0$, implies, by equation (C.11), that the price of the non-traded good moves in the same direction as the price of the agricultural good. Then, by equations (23) and (24), h necessarily decreases and w necessarily increases if the price of A increases (since $\hat{p}_N > 0$ and $\Delta < 0$).

The proof related to the return to land, t, is similar to the one previously shown in spite of the changes in factor intensity.

APPENDIX F. EXPORT TAXES IN THE THREE-SECTOR MODEL

The system that characterizes export taxes in the three-sector economy can be written as

$$-\alpha = \theta_{TA}\hat{t} + \theta_{LA}\hat{w} \tag{F.1}$$
$$0 = \theta_{LM}\hat{w} + \theta_{HM}\hat{h} \tag{F.2}$$
$$\hat{p}_N = \theta_{LN}\hat{w} + \theta_{HN}\hat{h} \tag{F.3}$$
$$\hat{t} = -\alpha + \hat{y}_A \tag{F.4}$$
$$\hat{w} = \lambda_{LA}(-\alpha + \hat{y}_A) + \lambda_{LM}\hat{y}_M + \lambda_{LN}(\hat{p}_N + \hat{y}_N) \tag{F.5}$$
$$\hat{h} = \lambda_{HM}\hat{y}_M + \lambda_{HN}(\hat{p}_N + \hat{y}_N) \tag{F.6}$$
$$-\alpha + \hat{c}_A = \hat{c}_M = \hat{p}_N + \hat{c}_N = \hat{p}_N + \hat{y}_N \tag{F.7}$$
$$\chi_A\hat{y}_A + \chi_M\hat{y}_M = \gamma_A\hat{c}_A + \gamma_M\hat{c}_M + (1 - \delta\gamma_M)\alpha \tag{F.8}$$

which can be reduced to

$$-\alpha = \theta_{TA}\hat{t} + \theta_{LA}\hat{w} \tag{F.9}$$
$$\lambda_{LN}(\chi_M - \gamma_M\delta)\alpha = (\lambda_{LA} + \chi_A\lambda_{LN})\hat{t} - \hat{w} + (\lambda_{LM} + \chi_M\lambda_{LN})\hat{y}_M \tag{F.10}$$
$$\lambda_{HN}(\chi_M - \gamma_M\delta)\alpha = \lambda_{HN}\chi_A\hat{t} + \frac{\theta_{LM}}{\theta_{HM}}\hat{w} + (\lambda_{HM} + \chi_M\lambda_{HN})\hat{y}_M \tag{F.11}$$

Notice, for later use, that because M is the importable good, $\chi_M - \gamma_M < 0$.

Computing $\hat{w}$ from equation (F.1) and plugging it into equations (F.10) and (F.11), we obtain the following system:

$$\begin{pmatrix} \lambda_{LN}(\chi_M - \gamma_M\delta)\alpha - \alpha/\theta_{LA} \\ \lambda_{HN}(\chi_M - \gamma_M\delta)\alpha + \alpha\frac{\theta_{LM}}{\theta_{LA}\theta_{HM}} \end{pmatrix} = \begin{pmatrix} \lambda_{LA} + \chi_A\lambda_{LN} + \frac{\theta_{TA}}{\theta_{LA}} & \lambda_{LM} + \chi_M\lambda_{LN} \\ \lambda_{HN}\chi_A - \frac{\theta_{TA}\theta_{LM}}{\theta_{LA}\theta_{HM}} & \lambda_{HM} + \chi_M\lambda_{HN} \end{pmatrix} \begin{pmatrix} \hat{t} \\ \hat{y}_M \end{pmatrix} \tag{F.12}$$

Observe that by factoring out $1/\theta_{LA}$ in the first row and $1/(\theta_{LA}\theta_{HM})$ in the second row, the determinant of the system is Ω, which we have shown to be positive. Thus, the system can be re-written as

$$\begin{pmatrix} \theta_{LA}\lambda_{LN}(\chi_M - \gamma_M\delta) - 1 \\ \theta_{LA}\theta_{HM}\lambda_{HN}(\chi_M - \gamma_M\delta) + \theta_{LM} \end{pmatrix} \alpha = \Omega \begin{pmatrix} \hat{t} \\ \hat{y}_M \end{pmatrix} \tag{F.13}$$

Solving for $\hat{t}$:

$$\frac{\hat{t}}{\alpha} = \frac{\theta_{LA}}{\Omega}\Big\{\big[\theta_{LA}\lambda_{LN}(\chi_M - \gamma_M\delta) - 1\big](\lambda_{HM} + \chi_M\lambda_{HN})\theta_{HM} \\ - \big[\theta_{LA}\theta_{HM}\lambda_{HN}(\chi_M - \gamma_M\delta) + \theta_{LM}\big](\lambda_{LM} + \chi_M\lambda_{LN})\Big\} \quad \text{(F.14)}$$

After some simple but tedious algebra it can be shown that the terms in curly brackets equal

$$\theta_{HM}\theta_{LA}(\chi_M - \gamma_M\delta)(\lambda_{HM}\lambda_{LN} - \lambda_{LM}\lambda_{HN}) - (\theta_{HM}\lambda_{HM} + \lambda_{LM}\theta_{LM}) \\ + \chi_M\lambda_{LN}\big[\theta_{HM}\theta_{LA}(\chi_M - \gamma_M\delta)(\lambda_{LN} - \lambda_{HN}) - 1\big] \quad \text{(F.15)}$$

If $\delta = 0$, equation (F.15) simplifies to

$$\theta_{HM}\theta_{LA}\chi_M(\lambda_{HM}\lambda_{LN} - \lambda_{LM}\lambda_{HN}) - (\theta_{HM}\lambda_{HM} + \lambda_{LM}\theta_{LM}) \\ + \chi_M\lambda_{LN}\big[\theta_{HM}\theta_{LA}\chi_M(\lambda_{LN} - \lambda_{HN}) - 1\big] \quad \text{(F.16)}$$

If the non-tradable sector is skilled-labor intensive (and therefore manufactures are unskilled-labor intensive): $\lambda_{HM}\lambda_{LN} - \lambda_{LM}\lambda_{HN} < 0$ and $\lambda_{LN} < \lambda_{HN}$. Thus, $\hat{t}/\alpha < 0$.

If the non-tradable goods are unskilled-labor intensive (and therefore manufactures are skilled-labor intensive), $\lambda_{HM}\lambda_{LN} - \lambda_{LM}\lambda_{HN} > 0$ and $\lambda_{HM} > \lambda_{HN}$. Notice that equation (F.16) can be re-written as

$$\theta_{HM}(\lambda_{LA}\chi_M\lambda_{HN}\lambda_{LN} - \lambda_{HM}) - \lambda_{LM}\big[\theta_{HM}\theta_{LA}\chi_M\lambda_{HN} + \theta_{LM}\big] \\ + \chi_M\lambda_{LN}\big[\theta_{HM}\theta_{LA}\chi_M(\lambda_{LN} - \lambda_{HN})\big] \quad \text{(F.17)}$$

Given that $\lambda_{HM} > \lambda_{HN} > \theta_{LA}\chi_M\lambda_{LN}\lambda_{HN}$, it follows that $\hat{t}/\alpha < 0$.

If $\delta = 1$, equation (F.15) changes to

$$\theta_{HM}\theta_{LA}(\chi_M - \gamma_M)(\lambda_{HM}\lambda_{LN} - \lambda_{LM}\lambda_{HN}) - (\theta_{HM}\lambda_{HM} + \lambda_{LM}\theta_{LM}) \\ + \chi_M\lambda_{LN}\big[\theta_{HM}\theta_{LA}(\chi_M - \gamma_M)(\lambda_{LN} - \lambda_{HN}) - 1\big] \quad \text{(F.18)}$$

After some manipulations, equation (F.18) can be re-written as

$$\theta_{HM}\lambda_{HM}\left[\theta_{LA}(\chi_M-\gamma_M)\lambda_{LN}-1\right]-\lambda_{LM}\left[\theta_{HM}\theta_{LA}(\chi_M-\gamma_M)\lambda_{HN}+\theta_{LM}\right]$$
$$+\chi_M\lambda_{LN}\left[\theta_{HM}\theta_{LA}(\chi_M-\gamma_M)(\lambda_{LN}-\lambda_{HN})-1\right]$$

Given that M is an exportable good, i.e., $\chi_M-\gamma_M<0$, and that $\theta_{HM}\theta_{LA}(\chi_M-\gamma_M)\lambda_{HN}<\theta_{HM}<\theta_{LM}$ if non-tradable goods are skilled-labor specific, then $\hat{t}/\alpha<0$. On the other hand, if non-tradable goods are unskilled-labor specific, then $\lambda_{HN}\lambda_{LN}-\lambda_{LM}\lambda_{HN}>0$ and $\lambda_{LN}>\lambda_{HN}$. Then, by inspecting equation (F.18) is is straightforward to observe that $\hat{t}/\alpha<0$.

To compute the return to unskilled-labor we use the fact that the system can be reduced to

$$\begin{aligned}\Big\{\lambda_{HM}+\chi_M\lambda_{HN}+\frac{\theta_{LM}}{\theta_{HM}}(\lambda_{LM}+\chi_M\lambda_{LN})\\
+\frac{\theta_{LA}}{\theta_{TA}}\left[(\lambda_{HM}+\chi_M\lambda_{HN})(\lambda_{LA}+\chi_A\lambda_{LN})-\lambda_{HN}\chi_A(\lambda_{LM}+\chi_M\lambda_{LN})\right]\Big\}\hat{w}\\
=\alpha\Big\{(\chi_M-\gamma_M\delta)\left[\lambda_{HN}(\lambda_{LM}+\chi_M\lambda_{LN})-\lambda_{LN}(\lambda_{HM}+\chi_M\lambda_{HN})\right]\\
-\frac{1}{\theta_{TA}}\left[(\lambda_{HM}+\chi_M\lambda_{HN})(\lambda_{LA}+\chi_A\lambda_{LN})-\lambda_{HN}\chi_A(\lambda_{LM}+\chi_M\lambda_{LM})\right]\Big\}\end{aligned}\tag{F.19}$$

which, in turn, can be simplified to

$$\begin{aligned}\Big\{\lambda_{HM}+\chi_M\lambda_{HN}+\frac{\theta_{LM}}{\theta_{HM}}(\lambda_{LM}+\chi_M\lambda_{LN})\\
+\frac{\theta_{LA}}{\theta_{TA}}\left[\lambda_{HM}(\lambda_{LA}+\chi_A\lambda_{LN})+\lambda_{HN}(\chi_M\lambda_{LA}-\chi_A\lambda_{LM})\right]\Big\}\hat{w}\\
=\alpha\Big\{(\chi_M-\gamma_M\delta)\left[\lambda_{HN}\lambda_{LM}-\lambda_{LN}\lambda_{HM}\right]\\
-\frac{1}{\theta_{TA}}\left[\lambda_{HM}(\lambda_{LA}+\chi_A\lambda_{LN})+\lambda_{HN}(\chi_M\lambda_{LA}-\chi_A\lambda_{LM})\right]\Big\}\end{aligned}\tag{F.20}$$

Notice that a sufficient condition for the LHS to be positive is

$$\chi_M\lambda_{HN}+\frac{\theta_{LA}}{\theta_{TA}}\lambda_{HN}(\chi_M\lambda_{LA}-\chi_A\lambda_{LM})>0\tag{F.21}$$

Given that $\chi_M = \frac{\lambda_{LM}\theta_{LA}}{\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM}}$, the sign of the previous expression is the sign of

$$\begin{aligned}\theta_{TA}\chi_M + \theta_{LA}(\chi_M\lambda_{LA} - \chi_A\lambda_{LM}) \\ = \frac{1}{\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM}}\left[\theta_{TA}\lambda_{LM}\theta_{LA} + \theta_{LA}\lambda_{LM}\theta_{LA}\lambda_{LA} - \lambda_{LA}\theta_{LM}\theta_{LA}\lambda_{LM}\right]\end{aligned} \tag{F.22}$$

which in turn is the sign of

$$(1-\lambda_{LA})\lambda_{LM}\theta_{TA}\theta_{LA} + \lambda_{LM}\lambda_{LA}\theta_{LA}(\theta_{TA}+\theta_{LA}-\theta_{LM}) > 0 \tag{F.23}$$

Therefore, the LHS is unambiguously positive.

Thee sign of $\hat{w}/\alpha$ therefore depends on the sign of the RHS:

$$\begin{aligned}(\chi_M - \gamma_M\delta)\left[\lambda_{HN}\lambda_{LM} - \lambda_{LN}\lambda_{HM}\right] \\ - \frac{1}{\theta_{TA}}\left[\lambda_{HM}(\lambda_{LA}+\chi_A\lambda_{LN}) + \lambda_{HN}(\chi_M\lambda_{LA} - \chi_A\lambda_{LM})\right]\end{aligned} \tag{F.24}$$

Regarding the RHS, given that $\chi_M = \frac{\lambda_{LM}\theta_{LA}}{\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM}}$ and $\chi_A = \frac{\lambda_{LA}\theta_{LM}}{\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM}}$, the RHS of equation (F.20) simplifies to

$$(\chi_M - \gamma_M\delta)[\lambda_{HN}\lambda_{LM} - \lambda_{LN}\lambda_{HM}] - \frac{1}{\theta_{TA}}\left[\lambda_{HM} + \lambda_{HN}\frac{\lambda_{HM}\lambda_{LM}\lambda_{LA}(\theta_{LA}-\theta_{LM})}{(\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM})}\right] \tag{F.25}$$

which can be re-written as

$$\frac{\lambda_{HN}}{\lambda_{LN}} - \frac{\lambda_{HM}}{\lambda_{LM}} = \frac{\lambda_{HM} + \lambda_{HN}\frac{\lambda_{HM}\lambda_{LM}\lambda_{LA}(\theta_{LA}-\theta_{LM})}{(\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM})}}{\lambda_{LN}\lambda_{LM}\theta_{TA}(\chi_M - \gamma_M\delta)} \tag{F.26}$$

As the threshold value that makes the RHS equal to 0. Notice that the numerator of the latter expression is necessarily negative. To show this, observe that from

$$\lambda_{HM}\left[1 + \lambda_{HN}\frac{\lambda_{LM}\lambda_{LA}(\theta_{LA}-\theta_{LM})}{\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM}}\right] \tag{F.27}$$

of which the second term is greater than negative one, as shown below:

$$
\begin{aligned}
\frac{\lambda_{HN}\lambda_{LM}\lambda_{LA}(\theta_{LA}-\theta_{LM})}{\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM}} &> -1 \\
\lambda_{HN}\lambda_{LM}\lambda_{LA}\theta_{LA}-\lambda_{HN}\lambda_{LM}\lambda_{LA}\theta_{LM} &> -(\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM}) \\
\theta_{LA}\lambda_{LM}(1+\lambda_{HN}\lambda_{LA})+\theta_{LM}\lambda_{LA}(1-\lambda_{HN}\lambda_{LM}) &> 0
\end{aligned}
\tag{F.28}
$$

The latter ensures that the numerator of equation (F.26) is positive. Thus, for $\delta = 0$ the RHS of equation (F.20) is positive (negative) if the non-tradable sector is (is not) sufficiently skilled-labor intensive. The threshold given by

$$
\frac{\lambda_{HN}}{\lambda_{LN}} > \frac{\lambda_{HM}}{\lambda_{LM}} + \frac{\lambda_{HM}+\lambda_{HN}\frac{\lambda_{HM}\lambda_{LM}\lambda_{LA}(\theta_{LA}-\theta_{LM})}{(\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM})}}{\lambda_{LN}\lambda_{LM}\theta_{TA}(\chi_M-\gamma_M\delta)} \tag{F.29}
$$

Under these conditions the rate of return of the unskilled-labor increases, $\hat{w} > 0$; negative otherwise. Finally, since $\hat{h} = -\frac{\theta_{LM}}{\theta_{HM}}\hat{w}$, the opposite happens to the return of skilled-labor.

For $\delta = 1$, the RHS of equation (F.26) is unambiguously negative since $\chi_M - \gamma_M < 0$. In this case, the RHS of equation (F.20) is positive (negative) if the manufacture sector is (is not) sufficiently skilled-labor intensive, the threshold given by

$$
\frac{\lambda_{HN}}{\lambda_{LN}} + \frac{\lambda_{HM}+\lambda_{HN}\frac{\lambda_{HM}\lambda_{LM}\lambda_{LA}(\theta_{LA}-\theta_{LM})}{(\lambda_{LM}\theta_{LA}+\lambda_{LA}\theta_{LM})}}{\lambda_{LN}\lambda_{LM}\theta_{TA}(\gamma_M-\chi_M)} < \frac{\lambda_{HM}}{\lambda_{LM}} \tag{F.30}
$$

In turn, the latter implies that for $\delta = 1$ the return to unskilled-labor, $\hat{w}$, increases (decreases) if manufactures are (not) sufficiently skilled-labor intensive. As before, the opposite effect occurs to the return to skilled-labor.

In turn, since $\widehat{I}' = \widehat{I} + \alpha\delta\gamma_M{}'$ for $I = w, t$, and h, the latter imply that for $\delta = 0$ $\hat{w}' = \hat{w}$, $\hat{h}' = \hat{h}$, and $\hat{t}' = \hat{t}$.