Ec 181
Seminar in Economic Development
Week 8 Problem Set: Trade, Technology and Globalization

Professor S. O'Connell Fall 2018

Introduction. The common feature of outward-oriented trade policies is their focus on current exports as a source of dynamic benefits to the economy. In practice this means exploiting areas of existing comparative advantage while fostering the emergence of new export activities with high social returns. We first review theories of comparative advantage and then briefly consider the implications of recognizing the mobility of production and technologies – not just goods and services – across countries.

Many of the central ideas of international trade theory were developed for a world in which goods and services are tradable but factors of production – not just land, but also labor and capital – are immobile across national borders. In this kind of world a simple thought experiment turns out to be a powerful tool for predicting trade patterns. In this thought experiment we 'solve' for the competitive general equilibrium of each economy in isolation (*autarky*) and then compare relative prices across hypothetical autarchic economies. We say that an economy has *comparative advantage* in goods whose *relative* prices would be low by global standards in the absence of trade, and a comparative disadvantage in goods whose relative prices would be high. We then say that in a competitive, free-trade equilibrium with balanced trade, countries will become net sellers (exporters) of goods in which they have a comparative advantage and net buyers (importers) of goods in which they have a comparative disadvantage. In the background, global relative prices provide the signals for resource reallocations within each country, as profit opportunities generated by international exchange produce transitory earnings differentials across sectors, and factors of production respond to these earnings differentials by migrating towards sectors of comparative advantage.

Trade surpluses and deficits can exist in the world of trade theory and may temporarily shift the boundaries of what is exported and imported; but a ranking of goods and services by comparative advantage determines what might newly emerge as exports or import substitutes in the face of a sustained international financial outflow (or be squeezed out in the face of a financial outflow). And the trade deficit must in any case be roughly zero on average over time, so that the country's net international asset position does not contract or grow forever.[1] Trade theory therefore focuses on the case of trade that is balanced at least at the margin, leaving the determination of the trade deficit as a macroeconomic topic (which we visit briefly in question 6).

The leading theories of comparative advantage tie down relative prices in autarky from the supply side. These are the Ricardian theory, which relies on relative *productivity differences* across goods and countries, and the Heckscher-Ohlin-Samuelson (HOS) theory, which relies on differences in relative *factor intensity* across goods and relative *factor abundance* across countries.[2] These

[1] More accurately, the trade deficit must must be equal to net factor income in a stationary state for the net international asset position.

[2] Demand can matter too; in fact, if countries have identical PPFs (so that there are no supply-side differences), differences in demand completely determine autarky relative prices and therefore the structure of comparative advantage as long as the PPF is bowed out. But the typical assumption is that countries have identical and homothetic preferences (all income elasticities = 1) so that demand doesn't play a role.

theories capture different aspects of North-South trade and can readily accommodate natural-resource or other location-specific exports. They can be combined in a straightforward way, by introducing industry-level differences in total factor productivity into the HOS model. Below we also look briefly at alternative sources of comparative advantage, including cross-country differences in institutions or in public infrastructure capital. To generate differences in autarky relative prices, these influences must operate differentially across sectors.

A final potentially important source of trade and specialization is increasing returns. In this case autarky relative prices are much less helpful in predicting the pattern of trade, because specialization based on any initial cost advantage is not fundamentally equilibrating – it drives production costs further apart across industries and countries, rather than closer together. Trade and specialization are efficient in this case as in the standard case, but the *direction* of trade and specialization may be indeterminate. As we have seen in other contexts in which scale economies are important, history can trump structure: the first country that achieves scale in a particular set of activities, for whatever reason, is likely to become a net exporter.[3]

These are all theories of *static* comparative advantage. Any process that changes the underlying determinants of relative prices over time, however, converts these into theories of *dynamic* comparative advantage. Processes we have studied include human or physical capital deepening, sector-specific knowledge spillovers from production or innovation, and learning-by-doing at the factory level. These processes alter comparative advantage by changing relative costs across sectors. Human and physical capital accumulation, for example, shift comparative advantage in the direction of sectors that use these factors relatively intensively, and may help a country move 'up the ladder' of skill intensity in its exports.

The sharp difference between internal and external factor mobility that is characteristic of trade theory must be modified if international movements of labor and capital are quantitatively important. Standard trade theory interprets *internal* migration as a response to inter-sectoral earnings differentials. Given large international differentials in factor earnings, the same logic suggests that there are strong economic incentives for *international* movements of labor and capital.

International factor mobility has complicated and potentially major implications for dynamic comparative advantage and for factor incomes.[4] The implications of factor mobility for comparative advantage depend on the underlying source of comparative advantage. If relative factor endowments drive comparative advantage (as in the HOS model), then any impediment to trade in goods will tend to reduce the incomes of relatively abundant factors and increase the incomes of relatively scarce factors (think of autarky as the extreme).[5] In this situation factors will tend to move to where they are scarce – e.g., labor will move 'north' and capital 'south.' Factor mobility will therefore tend to equalize factor abundance across countries, thereby muting the pattern of comparative advantage and reducing the impetus for specialization and trade. But as

[3] In the 2-good case, scale economies in one or both sectors produce a *bowed-in* PPF. In this case if two countries are identical, there is no pattern of comparative advantage at all in autarky. As soon as one of the countries begins to achieve greater scale economies than the other in some sector, however, a self-reinforcing process of relative cost advantages is underway.

[4] It also has lots of other implications for household, national, and world welfare. Unfortunately we are not going to do justice to international labor movements in the seminar. We'll do better with capital mobility by looking at direct foreign investment, aid, and the private capital account.

[5] Recall the Stolper-Samuelson Theorem, covered in Ravallion Chapter 9.

soon as comparative advantage is based in substantial part on the presence of immobile factors, as in the Ricardian case (technology) or in an HOS model with immobile factors (e.g., oil-rich land, or public infrastructure), international factor movements may well *reinforce* existing patterns of comparative advantage and increase trade, even as they contribute – over some horizon – to the equalization of factor incomes internationally.[6] In problem 7 we look briefly at how Adrian Wood and associates have exploited the relatively high mobility of capital to develop an account of regional comparative advantage based on endowments of human capital, labor, and land; in this account international capital movements heighten rather than erode patterns of specialization based on the immobile factors.

What about the international mobility of technology? At a basic level the productivity differences that are central to the Ricardian model are a summary of our ignorance: they absorb the net effects of public infrastructure or any other inputs we've left out of the analysis. Differences in total factor productivity across sectors can easily be accommodated within an HOS framework, as suggested above: non-uniform differences (where a country's productivity advantage is greater in some industries than others) add a Ricardian component to the determination of comparative advantage, while uniform differences introduce an element of absolute advantage that can generate cross-country income differentials (and pressure for international factor movements) even if factor endowments are identical. But what about technology *per se*: is it internationally mobile or not? The Pythagorean Theorem is mobile. But Evenson and Westphal (1995) argue convincingly that important aspects of technology are not in fact readily mobile across borders. In industry, this is because important aspects of production are *tacit* – they cannot be written down and must be learned through purposive and to some degree site-specific activity (e.g., production experience). In agriculture the problem is *circumstantial sensitivity*: agricultural technologies are sensitive to highly localized growing conditions and cannot be successfully applied without innovations specific to the new context.

These considerations suggest that the acquisition of technological capability is subject to both pecuniary and technological externalities (the former due to imperfect tradability, the latter to spillovers) and therefore to market failure.[7] They also imply that on the industrial side, technology policy should focus on supporting assimilation rather than outright invention. Westphal (2002) argues that the East Asian miracle economies embraced this approach, while also using exports as a performance yardstick. Within this broad context, the details of industrial policy differed substantially, including policies towards foreign direct investment.

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[6] See Caves, Jones and Frankel (any edition), *World Trade and Payments*, for a discussion of international factor movements from a trade theory perspective. Speculating, it seems likely that factor movements would also tend to increase trade when increasing returns are important (e.g., via agglomeration effects), but that in such cases there is less of a presumption that factor movements will narrow income differentials except in the very long run. In a celebrated theoretical analysis of global capital mobility and agglomeration effects in manufacturing, Krugman and Venables (1995) show that the initial effect of global capital mobility may be to create industrial growth in one set of countries (the *core*) and de-industrialization in another (the *periphery*), thereby causing a widening of international income differentials. This process continues until international wage differentials are big enough to overcome the advantages of agglomeration.

[7] Pecuniary externalities alone (third-party effects transmitted through market prices) cannot generate a market failure, as long as markets are complete and everyone is a price taker. But we have seen that in concert with other distortions (like an inter-sectoral wage differential) they can generate coordination failures.

Problem set (CA = Comparative Advantage).

1. **CA1: Productivity.** Consider the Ricardian model of trade you encountered in Ec 1. France and Tunisia can each produce food, clothing, or both. Labor is the only factor of production, and production displays constant opportunity costs with technologies that differ across the two countries. Each industry's technology is therefore fully described by the amount of domestic labor it takes to produce one unit of output: these *unit labor requirements* are a_F^T, a_C^T in Tunisia and a_F^F, a_C^F in France. Briefly explain which country will export clothing under free trade, and how this can be traced to a comparison of relative prices in autarky.

2. **CA2: Factor abundance.** In the Heckscher-Ohlin-Samuelson (HOS) model, technologies are identical across countries but sectors differ in *factor intensity* – clothing uses more capital per unit of labor than food does, for any relative price of these two inputs. Explain why differing factor intensities in food and clothing cause the PPFs of the two countries to be shaped as in Figure 1, as long as Tunisia's economy-wide ratio of capital to labor is lower than France's. Now assume a very simple structure for demand: consumers in both countries always purchase one unit of food for each unit of clothing, regardless of relative prices. Where will the two countries produce in autarky? Which country will have the lower relative price of clothing? Which country will export clothing in free trade, and what will trade do to the pattern of production in each country?

3. **CA3: Natural resource abundance.** The developing world is a net exporter of many primary commodities, including nonrenewable resources (oil, coltan, copper) and tropical commodities (coffee, cocoa, rubber). Consider expanding the HOS theory to include land as a third productive factor along with labor and capital (in principle, you could incorporate different types of land). Can you now interpret North-South trade in primary commodities in terms of factor abundance and factor intensities?

4. **[Optional] CA4: Institutions [Chichilnisky 1994].** The HOS model is built on the idea that because goods have different factor intensities, differences in relative factor endowments translate into differences in relative production costs. Suppose that clothing (C), food (F), and timber (T) each require only labor (L) and land (A), and that the production functions in these three sectors are identical (and display constant returns to scale) in France and Tunisia. The factor intensity ranking is $(A/L)_T > (A/L)_F > (A/L)_C$ for all possible ratios of land rents to wages. Assume that demand patterns are identical across countries (and homothetic: i.e., income-expansion curves are rays from the origin). [The CRS and homotheticity assumptions simply make this analysis scale-free.]

   4.1. Explain why, if factor endowments are identical between the two countries, relative prices will be identical in the two countries in autarky, and there will be no trade.

   4.2. Now suppose that industrialization and internal migration undermine traditional land use systems in Tunisia, with the result that land rights are no longer well defined. Where will timber be cheaper in autarky? Who will export timber, and who will export clothing? What is the source of comparative advantage in this example? What happens to the classical

argument about gains from trade? Should the government levy an export tax on timber? [Hint: When land rights are poorly defined, will land be over-priced or underpriced?]

5. **[Optional] CA5: Infrastructure.** In the previous example, suppose that land rights systems are comparable but that clothing production is more intensive in publicly supplied telecoms and power than either food or timber. Can differences in the level and quality of public infrastructure drive the pattern of trade?

6. **The Australian model and the Dutch disease.** The *Dutch disease* refers to the tendency for natural resource abundance to undermine export competitiveness in manufacturing and other non-resource-based sectors that produce traded goods. This phenomenon is best viewed in general equilibrium terms, and to do so we will develop the 'Australian' or 'dependent economy' or 'Salter/Swan' model – an apparatus we'll use again in a few weeks.

   You're familiar with the 2-sector "PPF and indifference curves" diagram used to analyze the general equilibrium of a closed or open economy. In that diagram the indifference curves are implicitly taken to refer to *total* spending by domestic residents, whether for consumption or investment, and whether by the public sector or the private sector. We'll use the same approach in the Australian model, but to this we first need to boil a multi-sector economy down into a 2-sector economy. To do this, start with 4-sectors: natural resources, other exports, import-competing goods, and nontraded goods. As a first step, assume that the output of the natural resource sector is not consumed at home but only exported (coffee or diamonds). Next (and more restrictively), confine the analysis to a natural resource sector that is a production *enclave* – a sector that runs on its own sector-specific inputs and does not compete for land, labor or capital with the rest of the economy. These steps get us down to three mutually interacting consumption and production sectors plus a natural resource sector that operates as an enclave off to the side.

   A key analytical step in the dependent-economy model is to simplify further by consolidating non-resource-based exports and import-competing goods into a single *traded good* that is a constant-price aggregate of its two components. *This step is analytically legitimate if and only if the relative price of these two traded commodities is constant over time.* This in turn means that (a) the international terms of trade between these two goods must be constant (holding this constant is not a problem in our application here, because it is going to be the price of the natural resource export we're interested in) *and* (b) there must be no changes in trade policy (because these would obviously change the relative price of exports and import-competing goods). Under these assumptions we can work with a standard 2-dimensional "PPF and indifference curves" diagram in traded and nontraded goods – knowing that behind the scenes, the traded good represents an aggregate of both non-resource-based exports and import substitutes. There is a single relative price of goods in this economy: the *real exchange rate*, defined as the price of nontraded goods in terms of traded goods.

   By a *dependent economy* the Australians meant a small open economy, i.e., one that is too small to influence the international prices of traded goods. If we treat these exogenous international prices as fixed and assume that the country's trade policy is also not changing over time (thereby holding constant whatever implicit import tariffs and export tax/subsidies may be in place), we have satisfied the conditions for aggregating non-resource-based exports and import substitutes into a single traded good. The nominal value of any given combination

of these two goods can therefore be expressed as the product of a single price index for traded goods and a single real quantity index for traded goods. For example, we can choose a price index P_T that is a function of P_M and P_X and then write $P_T Q_T = P_M Q_M + P_X Q_X$ where Q_M and Q_X are the domestic outputs of import-substitutes and non-resource-based exports. Given our choice of the price index P_T, this defines the quantity index for traded goods as $Q_T = (P_M Q_M + P_X Q_X)/P_T$.

With this consolidation in place, we can treat our 4-sector economy as a standard 2-sector economy that produces and consumes nontraded goods and the traded-goods composite, plus an enclave natural-resource sector that that generates export revenues but does compete in production or consumption with the rest of the economy. Total nominal GDP in this economy is $P_N Q_N + P_M Q_M + P_X Q_X + P_Z Q_Z$, where Q_Z is the quantity of exports (= output) from the natural resource sector and where all domestic prices except P_N satisfy the Law of One Price (as modified by trade taxes and subsidies: the key is simply that these are fixed so the domestic prices of traded goods move one-for-one with the world prices). Substituting for the middle two terms with $P_T Q_T$ and dividing by P_T, we see that real GDP measured in terms of traded goods is simply $\boldsymbol{eQ_N + Q_T + zQ_Z}$ where $e \equiv P_N/P_T$ is the ***real exchange rate*** (a very important variable: when defined this way, an increase in *e* is a *real appreciation*, and a decrease is a *real depreciation*[8]) and $z \equiv P_Z/P_T = EP_Z^*/EP_T^*$ is the purchasing power of a unit of natural resources in terms of traded goods – in effect, the terms of trade for the country's primary commodity export.

Total nominal spending is $P_N C_N + P_M C_M + P_X C_X$ (we are ignoring investment and government spending, or incorporating them in C). Measured in terms of traded goods, this is simply $\boldsymbol{eC_N + C_T}$. (Use the price index P_T to replace $P_M C_M + P_X C_X$ with $P_T C_T$, where C_T is real consumption of traded goods; then divide by P_T.)

6.1. The country's overall trade balance in nominal terms is

$$EP_X^*(Q_X - C_X) - EP_M^*(C_M - Q_M) + EP_Z^* Q_Z$$

Show that this expression for the trade balance can be re-stated, in terms of traded goods, as $B = Q_T - C_T + zQ_Z$.

6.2. So in terms of national income accounting, it looks like we can easily boil down the economy into a 2-sector economy (*T* and *N*) with a natural-resource add-on. Using your answers to parts 1 and 2, show that *the expression you just derived for the trade balance equals the difference between GDP and total spending, each measured in traded goods* (you will need to use the following identity, which equates output and spending on nontraded goods: $Q_N = C_N$). Explain this result in terms of the basic macro accounting identities of an open economy. Notice also that the natural resource sector 'drops out' nicely: the same relationship between the trade balance and the difference between total output and total spending holds if we focus only on the non-resource economy.

[8] In PRLB Chapter 18 (p. 695) they define the real exchange rate as the reciprocal of this. The conventional IMF definition is the one given here in problem 6. Either way is fine as long as you keep track.

6.3. Figure 2 shows a PPF and a set of indifference curves. For convenience I have assumed that the utility function is 'homothetic' – i.e., that all income elasticities are 1 so that the indifference curves have identical slope along any ray from the origin. Consider an economy that has no natural resource sector at all. Suppose that net capital inflows are zero, so that the trade balance is zero ($TB = 0$). Show the equilibrium pattern of consumption and production and identify the **equilibrium real exchange rate**. [Hint: If the trade balance is zero, then not only do we have $Q_N = C_N$ but we also have $Q_T = C_T$. In this case the set of possible consumption points – you could call this the 'expenditure possibility curve' – is simply the PPF itself. To locate the competitive equilibrium, find the point of tangency between an indifference curve and this expenditure-possibility curve. What is the relationship between the equilibrium value of the real exchange rate and the slope of a tangent to the PPF and/or indifference curve at this point?]

6.4. Now compare the economy in question 6.4 with one that has a natural resource sector ($Q_Z > 0$) but is otherwise identical. What happens to the equilibrium real exchange rate? What happens to the production of traded goods? What happens (in the background) to the production of exports and import-substitutes? [Hint: to construct the new expenditure-possibility curve, 'slide' the PPF to the right by the distance $z \cdot Q_Z > 0$. Do not move the indifference curves: preferences have not changed! Find the new tangency point. What has happened to national spending (at the tangency of an indifference curve and the new expenditure-possibility curve)? What has happened to production (at the corresponding point back on the PPF between traded and nontraded goods, which itself has not moved)? What has happened to the real exchange rate – a real appreciation or a real depreciation?]

6.5. The real appreciation and shrinkage of the non-resource traded-goods sector you identified in part 6.5 is the heart of the **Dutch disease**. Does this equilibrium phenomenon really deserve to be called a disease? Is there a welfare loss involved in the reallocation you just studied? Under what conditions would you associate this reallocation with a welfare loss?

7. The development impact of FDI [PRLB Chapter 10, pp. 357-374] "The evidence on the relationship between FDI and development suggests that it is hard to make broad generalizations and that the impact depends critically on the purpose and type of the investment, as well as policies and institutions in the recipient country." (PRLB p. 364). What are the key distinctions in terms of the purpose and type of foreign direct investment, and the policies and institutions in the host country?

8. Wood: immobile factors and deep comparative advantage. Adrian Wood and co-authors (Owens and Wood 1997, Wood and Berge 1997) develop a modified HOS analysis to study the composition of merchandise exports between 'narrow' (=raw or very lightly processed) primary commodities (NP), processed primary commodities (PP), and 'narrow' (=not based on primary commodities) manufactured goods (NM). They argue that since capital is internationally mobile, national endowments of capital per worker are less important in determining comparative advantage across these sectors than are a country's relative endowments of the less mobile factors: raw labor, human capital, and 'land' adaptable for natural resource

production. Let's call raw labor *L*, human capital *H*, and land area *A*. Owens and Wood make the following assumptions about the factor intensities of the three sectors:

$$(H/L)_{NM} > (H/L)_{PP} > (H/L)_{NP} \quad \text{and} \quad (A/L)_{NM} < (A/L)_{PP} < (A/L)_{NP}.$$

In other words, they assume that for any given relative prices of human capital to raw labor and land to labor, narrow manufacturing (for example) uses less land per worker and more human capital per worker than the other two activities. They present data suggesting the following broad generalizations about country-level factor endowments in Africa, East Asia, South Asia, and Latin America:

		Land per worker	
		Moderate/Low	*High*
Human capital per worker	*Moderate /Low*	South Asia	Sub-Saharan Africa
	High	High-Performing Asian Economies	Latin America

8.1. Using the logic of the HOS model, what pattern of regional comparative advantage is suggested by this combination of factor intensities and factor endowments? Which regions would you expect to display the highest ratios of manufactured goods, primary commodities and processed primary commodities to total exports?

8.2. Wood and Berge (1997) estimate the following regression model relating the gross export ratio *GXR* (= ratio of exports of manufactures to exports of primary commodities) to human capital per worker and land per worker:

$$\ln GXR_i = \alpha + \beta_H \ln(H/L)_i + \beta_A \ln(A/L)_i + \varepsilon_i$$

The observations here are countries. What does their theory predict for the signs of β_H and β_A?

8.3. Use the properties of logs to rewrite the equation in (8.2) as

$$\ln GXR_i = \alpha + \beta_H \ln H_i + \beta_A \ln A_i - (\beta_H + \beta_A) \ln L_i + \varepsilon_i,$$

and to show that if β_H and β_A have equal and opposite signs this equation becomes

$$\ln GXR_i = \alpha + \beta \ln(H/A)_i + \varepsilon_i$$

for some $\beta > 0$. They find that they cannot reject this restriction, so they end up working with this simplified equation.

8.4. Owens and Wood argue that foreign direct investment tends to be attracted into sectors in which immobile factors confer a deep comparative advantage. The bulk of FDI into Sub-Saharan Africa is in the primary commodity sector, particularly in minerals and energy. Is this consistent with the Owens and Wood thesis about comparative advantage? Can you think of other reasons?

8.5. Working with equation (4), Wood and Berge find that β is positive and statistically significant, and that when trade policy variables are included on the right-hand-side they have relatively little leverage over *GXR*. They report, moreover, that the regression of *GXR* in 1989 on endowments in 1960 fits better than the regression of *GXR* in 1960 on endowments in 1960. What do you make of these empirical results?

8.6. What does the opening of India (major trade liberalization in 1990-91) and China (WTO membership 2001) to international trade suggest for the comparative advantage of the main developing regions of the world?

9. Exchange rates and inward investment. This problem asks you to think about how policies affecting the nominal and/or real exchange rate may affect inward investment and employment in manufacturing.

Figure 3 below shows a two-sector general-equilibrium diagram you encountered in studying the Lewis and Harris-Todaro models. Last week (in an optional problem) we showed that if the modern sector has diminishing returns to capital and labor together, we can distinguish the short-run demand curve for labor that prevails for a given level of the manufacturing-sector capital stock from a long-run demand curve for labor that prevails if there is perfect capital mobility and inward investment occurs until the marginal product of capital in manufacturing equals the global user cost of capital (the sum of the real interest rate and the rate of depreciation). Starting from any long-run equilibrium, the short-run curve is relatively steep because the capital stock is fixed. In the background, however, any change in employment along this curve moves the marginal product of capital in the same direction, and therefore induces reinforcing changes in the capital stock. The long-run labor demand curve is therefore flatter than the short-run curve.

The supply curve of labor into manufacturing comes from "Other" activities, where we simply assume that employment is a decreasing function of the real product wage in measured in other goods, ω_{Other}. To convert this into a supply price of labor into manufacturing we need to multiply by the relative price. This gives us $(P_{Other}/P_M) \cdot \omega_{Other}$, which is the upward-sloping labor-supply curve shown in the diagram. For part 1 of this problem we will assume that both goods are traded, so that P_{Other}/P_M will be constant and equal to the world relative price of other goods in terms of manufactured goods. It will therefore play no role in the analysis. For part 2, we will assume that manufactured goods are traded but other goods are nontraded – in which case the same relative price is equal to the real exchange rate, which may change.

Point 1 is a LR equilibrium with a real minimum wage $\overline{\omega}$ that applies only to the manufacturing sector. The minimum wage is inefficient: the manufacturing sector is too small

and the other sector too large. If the minimum wage were to be eliminated, the economy would go to point 2 in the short run, and then gradually move to point 3 through a process of capital accumulation in manufacturing.

9.1. Suppose the minimum wage is fixed in nominal rather than real terms. In other words, letting W_M be the nominal wage in manufacturing, $\bar{\omega} = \overline{W_M}/P_M$. If both goods are traded, their domestic prices are given by $P_M = E \cdot P_M^{\$}$ and $P_{Other} = E \cdot P_{Other}^{\$}$ where E is the exchange rate in local currency per dollar and where the global prices in dollars are exogenous. What happens to the distortions imposed by the minimum wage if the government allows the exchange rate to depreciate in nominal terms? [Hint: Nothing happens to P_{Other}/P_M, so the curves don't move. What happens to $\bar{\omega}$? What does the change in $\bar{\omega}$ do to employment and inward investment?]

9.2. Now consider a reinterpretation in which manufactured goods are traded but other goods are nontraded. The supply price of labor to manufacturing is now equal to the real wage in the other (N = nontraded) sector, multiplied by the real exchange rate: $\omega^S = e \cdot \omega_N$ where $e = P_N/E \cdot P_T^{\$}$ and where employment in the nontraded sector is a function of ω_N. The L^S curve therefore looks the same as in Figure 1, but is shifted up or down by any change in the real exchange rate. Assume for the purposes of this analysis that shifts in labor between sectors do not themselves alter the real exchange rate (you would have to allow for changes in a full analysis). What is the impact of a once-for-all real depreciation on the equilibrium of the economy, under a real minimum wage in manufacturing versus no minimum wage?

9.3. Consider taking the exchange rate in the opposite direction: a strengthening of the nominal exchange rate in part 1, or a real appreciation in part 2. What impacts do these macroeconomic developments have on inward investment and equilibrium with and without a minimum wage? What's going on here?

10. Discussion of UP Chapter 7 (Bardhan) What are the main channels through which globalization affects the jobs, wages and incomes of poor people in developing countries? What institutional mechanisms are available to compensate the losers from liberalized trade?

Figure 1

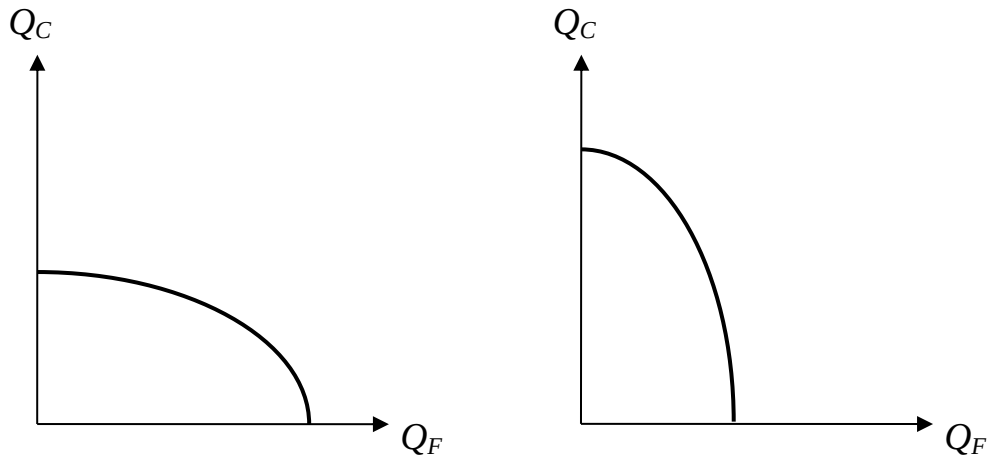


Figure 2

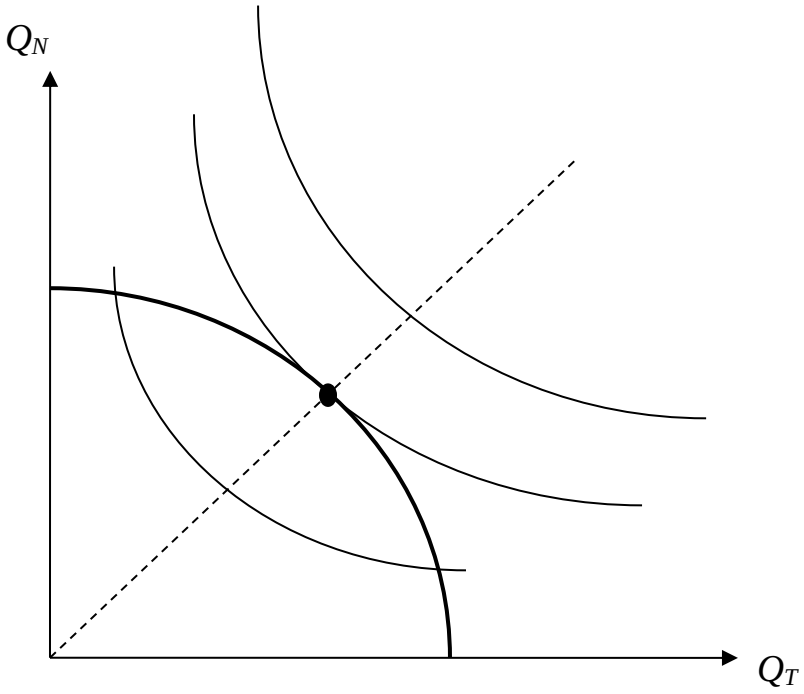
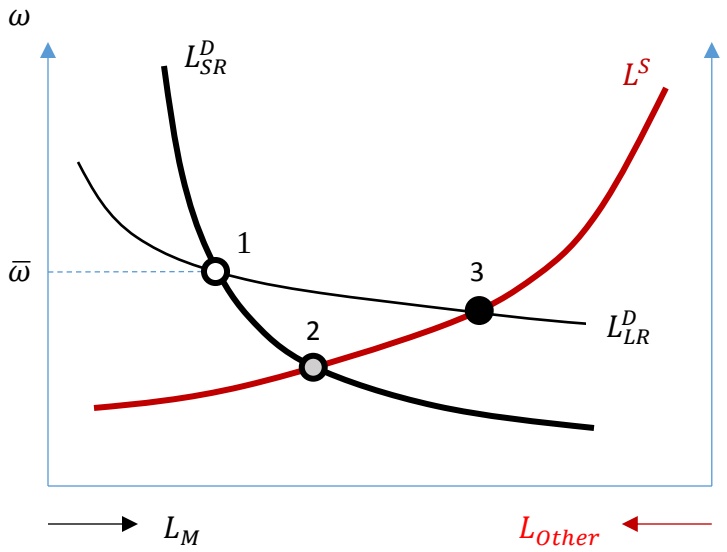


Figure 3 *Short- and long-run equilibrium with international capital mobility and a minimum wage in the manufacturing sector*



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Appendix: consolidating traded goods in the Australian 'dependent economy' model

To see how the consolidation actually works, begin by constructing a constant-price index of production or spending on traded goods. For example, the following is an index of real output of traded goods in year *t* at base-year prices, where we have arbitrarily chosen to measure everything in terms of imported goods:

$$Q_{T,t} \equiv \frac{E_0 P^*_{M0} \cdot Q_{M,t} + E_0 P^*_{X0} \cdot Q_{X,t}}{E_0 P^*_{M0}} \tag{A1}$$

Here $Q_{M,t}$ and $Q_{X,t}$ are outputs of import-substitutes and 'other exports', respectively, *E* is the nominal exchange rate, and * denotes an international price measured in dollars (we are applying the Law of One Price to all traded goods, so that domestic prices always equal the exchange rate multiplied by the world price). The associated domestic price index for traded goods is defined as the ratio of nominal to real output,

$$P_{T,t} \equiv \frac{E_t \cdot P^*_{M,t} \cdot Q_{M,t} + E_t \cdot P^*_{X,t} \cdot Q_{X,t}}{Q_{T,t}}. \tag{A2}$$

With P_T defined in this way, the two indexes work together to decompose <u>current</u> output into quantity and price:

$$E_t \cdot P^*_{M,t} \cdot Q_{M,t} + E_t \cdot P^*_{X,t} \cdot Q_{X,t} = P_{T,t} \cdot Q_{T,t}.$$

You can show that with our assumption of a constant international terms of trade, equations (A1) and (A2) come down to $Q_{T,t} = Q_{M,t} + \tau^* Q_{X,t}$ and $P_{T,t} = E_t P^*_{M,t}$, where $\tau^* = P^*_X / P^*_M$. In other words, our consolidated traded good is simply the total value of traded goods, measured in terms of imports, and our price index is simply the domestic price of imports. (We could alternatively have defined a more 'representative' price index involving both types of traded good, and then constructed the implied real quantity index.)

This consolidation is very handy, because it turns out the original utility function $U(C_M, C_X, C_N)$ now implies a new utility function $\tilde{U}(C_T, C_N)$ with the same qualitative properties (positive and diminishing marginal utility of each 'good'). Similarly, the PPF $f(Q_M, Q_X, Q_N) = 0$ now implies a new PPF $\tilde{f}(Q_T, Q_N)$ with the same qualitative properties (bowed-out: an increasing marginal rate of transformation between the two 'goods').