A Model of Procurement*

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Abstract

This paper analyzes the impact of government home bias on factor prices. I extend the $2 \times 2 \times 2$ Chamberlin-Heckscher-Ohlin Model (Helpman & Krugman, 1985, chapter 7) in two directions. First I introduce government demand as in Brüllhart & Trionfetti (2004). Second, I assume that the good produce in the monopolistically competitive sector is traded at a cost of the iceberg type. Performing simulations, I find that with a symmetric degree of home bias, the price of the scarce factor increase in each country when the governments are more home biased. Comparing to the skill abundant country, the price of the scarce factor is more favoured by an increase in the symmetric degree of home bias in the skill scarce country. I provide evidence in support of these results by using data from the Occupational Wages around the World database of Freeman & Oostendorp (2000) and from the International Financial Statistics. These results call for an political economy analysis of the consequences of home bias on factor prices in a global environment.

Keywords: Public expenditure, Factor prices, Democracy

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1 Introduction

Trade economists are well aware of both the potential barriers to trade - such as the presence of import tariffs in particular and any trade policies in general - and the important empirical literature that document an unprecedent increase in the volume of trade over the last decades (even between very dissimilar countries). For example, according to data from the World Bank, the share of imports from Developing countries in total merchandise imports of High income countries rose from 17.71% in 1998 to 25.11% in 2009 (WDI). This last pattern seems to indicate prima facie that the use of trade policies is nowadays no more important. Such a conclusion would be incorrect however. Indeed, according to the standard model of trade, the Heckscher-Ohlin Model, given some assumptions among which free trade, trade between countries that differ in their factor endowments should brings factor price equalisation. However, we do not observe such an outcome in practice since factor prices vary greatly across countries (Freeman & Oostendorp, 2000). This fact indicate that despite the importance of globalisation, trade is not entirely free. In this paper I analyzes the impact of an additional barrier to trade namely the home bias of governments expenditure, on the pattern of factor prices. Governments home bias is a pervasive fact for which figure 1 gives a glimpse. I compute the import shares of the private and the public sector for some europe union countries for the year 2005. For all countries, the import share of the public sector is consistently lower than the import share of the private sector, this figure clearly highlights a strong bias in governments purchases. In order to adress the question, I develops a model that builds on the Chamberlin-Heckscher-Ohlin Model that is exposed in the textbook of Helpman & Krugman (1985, chapter 7) or Dixit & Norman (1980, section 9.3). I add two modifications to the basic framework. First, I introduce government demand as in Brülhart & Trionfetti (2004). First, I assume that the good subject to increasing returns and monopolistically competition is traded at a cost of the iceberg type. These two modifications constitute two sources of market fragmentation that leads factor price to differ. The main result that I obtain can be summarised as follow: A symmetric degree of home bias increase

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1 See the chapters, 7, 8 and 9 of the textbook of Feenstra (2004)
2 The authors forcefully argue that:

The pattern for rising country differentials of occupational wages in a period of increased globalisation suggests that factors beyond trade pressures greatly affected the dispersion of pay across countries. Determining what those factors were [...] lies beyond the scope of this essay.

3 The countries included are France (FR), Belgium (BE), Spain (ES), Portugal (PT), Netherlands (NL), Italy (IT) and Denmark (DK). In addition, I use the letter p to denote the private sector and g to denote the public sector.
the relative price of the scarce factor in each country but the relative price of the scarce factor in the unskill abundant country is the most favoured by trade. Having developing the main theoretical message regarding the impact of home bias on factor prices, the paper takes it to the data. I use data from several sources, in particular I use the size of government purchases as a proxy for the degree of home bias. In the empirical part I also consider the potential problem of endogeneity of the main explanatory variable. The rest of the paper is organised as follow, section 2 gives a small review of the literature, section 3 develops the basic the model, section 4 performs some simulations and section 5 presents preliminary empirical results.

Figure 1: Private and public import shares, 2005 in 8 European Union countries
2 Related Literature

2.1 Consequences of government home bias

Academic research suggests that the impact of government home bias on a country’s international specialisation and trade flow depends on the market structure in which producers operate. For years, the conventional wisdom was that for sectors characterised by perfect competition, discriminatory procurement was most of the time inconsequential on specialisation and trade flows (Baldwin, 1970). This conclusion is still exact and today there is an important literature that investigates the impact of discriminatory procurement with alternative market structures. Among the contributors to this field, Miyagiwa (1991) and Chen (1995) show that the result of Baldwin holds for an oligopolistic market. Trionfetti (1997) and Trionfetti (2001) study the impact of public procurement on industrial location respectively within the original Core Periphery (CP) model of Krugman (1991) and the vertical-linkages version of the CP model (Krugman & Venables, 1995). See also Martin & Rogers (1995), Evenett & Hoekman (2005) and Brakman et al. (2008).

2.2 Causes of factor prices divergence

My paper is also indirectly related to the literature that adress the causes of the failure of the Factor Price Equalisation Theorem. Among the most important reasons, Debaere & Demiroglu (2003) and Schott (2003) show that countries are not in the same cone of diversification.
3 Model

The model follow closely follows Brüllhart & Trionfetti (2004) with two exeptions. First, I define explicit production technologies for the supply part. Second and more importantly, I delete one good (Brüllhart and Trionfetti consider a three goods model). This latter assumption allow me to study the impact of Home-bias on factors prices.  

3.1 Framework

Consider a world economy consisting of two countries $i = 1, 2$ and two production factors, skilled labour $L_i$ and unskilled labour $H_i$. The economy of each country is made up of two sectors, a perfectly competitive sector which produces a homogeneous agricultural good $Y_i$ and a monopolistically competitive sector which produces a composite differentiated good $X_i$. Throughout, we assume that the manufacturing sector is relatively skilled intensive while the agricultural sector is relatively unskilled intensive i.e.:

**Assumption 1** \[
\frac{H_{ix}}{L_{ix}} > \frac{H_{iy}}{L_{iy}}
\]

Factors are perfectly mobile between the two sectors but immobile internationally. I first study the demand side then the supply side before turning to the analysis of the equilibrium.

3.2 Preferences and consumers equilibrium

The demand side is composed of the Households (private demand) and the Governments (public demand). Let us start with analysis of the Households’ behavior.

Brüllhart and Trionfetti use a three goods (two perfectly competitive goods and one monopolistic competitive good), two factors (labor and capital) model. In their model, the monopolistic competitive good is trade at positive trade costs while there is free trade for both the perfect competitive goods. The same structure with a two goods two factors model results in an absence of factor prices equalisation. This can be explained as follow: From a mathematical viewpoint, the presence of trade costs segments the market for the monopolistic competitive good that results in a system with too many equations for factor prices to equalise. From a economic viewpoint, given the presence of trade costs, the prices of the monopolistic competitive good converge but fail to equalise (recall that in this model factor prices equalise through an equalisation of good prices). To obtain factor prices equalisation one need to add one more good (the solution of Brüllhart & Trionfetti (2004)) or to delete on factor (As in Helpman & Krugman (1985, Section 10.4)). Notice however that in a previous working paper, Brüllhart & Trionfetti (1998) use the same two goods, two factors model (with a general form for the technologies) that we consider here. Yet, they do not provide a study of the impact of home bias on the factor price since their focus is on the impact of this former on the location of industries. The analysis in this paper is therefore original.
3.2.1 Households

Households preferences are identical and homothetic and are defined over the consumption of the agricultural good and the manufacturing good. The utility function is assumed to take the Cobb-Douglas form as:

\[ U_j = C_{jx}^{v_x} C_{jy}^{v_y} \quad v_x + v_y = 1 \]

\( C_{jy} \) denotes consumption of the homogeneous agricultural good and \( C_{jx} \) corresponds to a consumption index of the composite manufacturing good. I follow Redding & Schott (2003) by denoting \( i \) a country that is producing or exporting a good and \( j \) a country that is demanding or importing a good. The consumption index of the manufacturing good takes the following form:

\[
C_{jx} = \left[ \sum_{i=1}^{2} n_i x_{ij}^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)}
\]

Where \( \sigma \in (0, \infty) \) is the elasticity of substitution between manufacturing varieties, \( n_i \) denotes the number of varieties produced in country \( i \) and \( x_{ij} \) denotes the amounts of each variety produced in country \( i \) for final consumption in country \( j \). Dual to the consumption index is a manufacturing goods price index which is express as:

\[
P_j = \left[ \sum_{i=1}^{2} n_i p_{ijx}^{1-\sigma} \right]^{1/(1-\sigma)}
\]

Where \( p_{ijx} \) denotes the prices of a variety produced in \( i \) and sold in \( j \). We assume that trade costs take the iceberg form. This means that for one unit of a traded good \( s = x, y \) to arrive in location \( j \) from location \( i \), \( \tau_{ijs} \geq 1 \) units must be shipped. When \( \tau_{ijs} = 1 \), trade is costless. Therefore, the mill price (i.e. the price charged by a firm prior to trade costs) is \( p_{is} = \kappa_{ijs} p_{ijs} \), where \( \kappa_{ijs} \equiv 1/\tau_{ijs} \in (0, 1] \) is the fraction of the traded good that arrives at its destination.

Assumption 2 For all \( i \) and \( j \), \( \tau_{ijy} = 1 \)

This assumption is standard in the litterature, the homogenous agricultural good is assumed to be trade at zero costs. Obviously, \( \tau_{ijs} = 1 \) for any \( s \) when \( i = j \). On the policy side, households are taxed in a
lump-sum, non distortionary fashion. We denote $\delta_i$ a taxation parameter. Households’ disposable income is then given by $I_d^j = (1 - \delta_j) I_j$. Where $I_j$ is national income in country $j$ ($I_j = w_j L_j + r_j H_j$). If $p_{jy}$ denotes the price of the agricultural good in country $j$, one can solve the maximisation problem using a “two stage budgeting”.\(^5\) In the first stage households allocate expenditure between the manufacturing good and the agricultural good by maximising the utility function subject to the budget constraint $I_d^j$. This maximization yields:

$$p_{jy} C_{jy} = v_y (1 - \delta_j) I_j \equiv E_{jy}^P$$

$$P_j C_{jx} = v_x (1 - \delta_j) I_j \equiv E_{jx}^P$$

In the second stage, the households maximises the sub-utility function $C_{jx}$ subject to the budget constraint $E_{jx}^P$, to derive the demand for a variety. We find that:

$$x_{ij} = p_{ijx}^{\sigma} E_{jx}^P p_j^{\sigma-1}$$

### 3.2.2 Governments

Governments purchase goods which they use for their final consumption. Balanced budget assures that expenditure equal tax collection i.e. $T_j \equiv \delta_j I_j$. Let $\gamma_s$ denotes the share of government revenue that is allocated to good $s$ (we assume that the share for a good is the same for all $j$). Governments expenditure on each goods are:

$$\gamma_x \delta_j I_j \equiv E_{jx}^G$$

$$\gamma_y \delta_j I_j \equiv E_{jy}^G$$

\(^5\)See Helpman & Krugman (1985, Chapter 6)
The governments’ bias for domestically produced goods is introduced as follow. For any purchase of a good in country , a fraction is reserved to domestic producers.

**Assumption 3** For all ,

This assumption is of pure convenience. The results in this paper would apply if one allowed a positive bias for the purchase of the agricultural good, as long as the bias for the manufacturing good exceed the bias for the agricultural good.

If , (wholly home biased procurement), government purchases only domestic manufacturing goods while when , it is fully liberalised. In general for , governments purchases both domestic and foreign manufacturing goods.

### 3.2.3 Demand equilibrium

Total private demand for a manufacturing product produced in is:

\[
x^P_i = \sum_{j=1}^{2} p_{ix}^{-\sigma} E^P_{jx} (P_j^{-\sigma - 1} r_{ij}^{-1})
\]

Where we have multiply by because trade for the manufacturing products is costly. Total public demand for a manufacturing product produced in is:

\[
x^G_i = \sum_{j=1}^{2} (1 - \phi_{jx}) p_{ix}^{-\sigma} E^G_{jx} P_{jx}^{-\sigma - 1} r_{ij}^{-1} + \frac{\phi_{ix}}{p_{ix} n_i} E^G_{ix}
\]

Therefore, total demand for a variety produced in country is:

\[
x_i = \sum_{j=1}^{2} p_{ix}^{-\sigma} P_j^{-\sigma - 1} r_{ij}^{-1} - \sigma \left[ E^P_{jx} + (1 - \phi_{jx}) E^G_{jx} \right] + \frac{\phi_{ix}}{p_{ix} n_i} E^G_{ix}, \quad i = 1, 2
\]

Equation (1) is the first equation of our system. It represent the equality of supply and demand for the manufacturing good in each country (trade costs segment the market for the manufacturing good). By Walras’ law, the equilibrium condition for the agricultural sector is redundant, therefore we will not report it here.
3.3 Production technologies and producers equilibrium

3.3.1 Agriculture

In every country, the agricultural good is produced under conditions of perfect competition with the following constant returns to scale production function:

\[ Y_i = CL^{\alpha} H^{1-\alpha}_i, \quad 0 < \alpha < 1 \]

Where \( C \equiv \alpha^{-\alpha}(1-\alpha)^{\alpha^{-1}} \) is a positive constant chosen such that the coefficient of the cost function is normalized to unity. \( L_iy \) and \( H_iy \) denote respectively, the amount of skilled labour and the amount of unskilled labour employed by the agricultural sector in country \( i \). We make the following assumption:

**Assumption 4** For all \( i \) \( p_{iy} = y = 1 \).

In other words, the price of the agricultural good is take as numeraire in each country. Profit maximisation give us the usual condition that marginal revenue (price) equal marginal cost, we have that:

\[ 1 = w_i^\alpha r_i^{1-\alpha}, \quad i = 1, 2 \]  

Where \( w_i \) and \( r_i \) are respectively, the wage of unskilled labour and the wage of skilled labour respectively. Both skilled and unskilled workers are perfectly mobile between the two sectors, therefore their factor price are equalised \( (w_is = w_i \text{ and } r_is = r_i \text{ for } s = x, y) \).

3.3.2 Manufacturing

In that sector, the technology of production requires a fixed cost \( f \) that gives rise to increasing returns and a constant marginal input requirement \( c \). The production function for each variety of monopolistically competitive good is:

\[ L_i^\mu H_i^{1-\mu} = f + cx_i, \quad 0 < \mu < 1 \]

Profits of each firm are given by total revenue less total costs as:
\[ \pi_i = p_i x_i - w_i^\mu r_i^{1-\mu} (f + cx_i) \]

Where \( x_i \) is the total demand (public plus private) for a product produced in country \( i \) given by the equation (1). Going forward, I impose the following normalisation: \( c \equiv (\sigma - 1)/\sigma \) and \( f \equiv v_x/\sigma \).\(^6\)

Replacing (1) in the profit function and solving for the firm equilibrium price give us the following result:

\[ p_i x = w_i^\mu r_i^{1-\mu}, \quad i = 1, 2 \]  

(3)

In this expression, the usual constant relative markup boils down to unity because of our normalisation.

Given this equilibrium price, the profit of a firm in country \( i \) can be written as:

\[ \pi_i = \frac{w_i^\mu r_i^{1-\mu}}{\sigma} (x_i - v_x) \]

The zero profit condition implies that the equilibrium output of any active firm is:

\[ x^* = v_x \]  

(4)

### 3.4 Factor market equilibrium

Making use of the Shephard’s lemma, we have that the market clearing condition for factor in country \( i \) can be express as follow:

\[ \alpha w_i^{\alpha-1}r_i^{1-\alpha} Y_i + \mu w_i^{\mu-1}r_i^{1-\mu} \left[ \frac{v_x + (\sigma - 1)x^*}{\sigma} \right] n_i = L_i, \quad i = 1, 2 \]  

(5)

\[ (1 - \alpha)w_i^{\alpha}r_i^{-\alpha} Y_i + (1 - \mu)w_i^{\mu}r_i^{-\mu} \left[ \frac{v_x + (\sigma - 1)x^*}{\sigma} \right] n_i = H_i, \quad i = 1, 2 \]  

(6)

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\(^6\)This choice of units are quite standard in the litterature and are imposed only for simplications purpose. See for example Fujita et al. (1999).
4 Calibrations of the model

Inspection of the systems (1) to (6) allow us to see that we have in fact eight equations and eight unknowns, $w_1, w_2, r_1, r_2, Y_1, Y_2, n_1$ and $n_2$. Given the nonlinearity of the model, we cannot find simple analytic solutions. Therefore, we solve numerically the model by considering two "worlds". In the first one, countries differ in their relative factors endowment. In this latter world, a special case is the Heckscher-Ohlin-Chamberlin Model of trade that we will use as a benchmark. In the second world, relative factor endowments are identical and a special case that again will use as benchmark is the Krugman (1980) model of trade. We also consider two measure of trade liberalisation:

1. *Public procurement market liberalisation*, where the degree of home bias vary at constant trade cost $\tau = 1$.

2. *Economic integration*, where the trade cost vary with no home-bias procurement, $\phi_j = \phi$ for all $j$.

In the first measure of trade liberalisation we study both the symmetric case where $\phi_1 = \phi_2 = \phi$ and the asymmetric case where $1 - \phi_1 = \phi_2$. In the following, we make use of the following ratio:

\[ \rho_1(\phi_1, \phi_2, \tau) = \frac{r_1}{w_1} \quad \text{and} \quad \rho_2(\phi_1, \phi_2, \tau) = \frac{r_2}{w_2} \]

\[ \chi_1(\phi_1, \phi_2, \tau) = \frac{n_1 x}{Y_1} \quad \text{and} \quad \chi_2(\phi_1, \phi_2, \tau) = \frac{n_2 x}{Y_2} \]

\[ \omega_1(\phi_1, \phi_2, \tau) = \frac{1}{\rho_1} \quad \text{and} \quad \omega_2(\phi_1, \phi_2, \tau) = \frac{1}{\rho_2} \]

\[ \eta_1(\phi_1, \phi_2, \tau) = \frac{1}{\chi_1} \quad \text{and} \quad \eta_2(\phi_1, \phi_2, \tau) = \frac{1}{\chi_2} \]

Where $\rho_i$ and $\chi_i$ are the relative factor price and the relative output in country $i$.

4.1 Factor proportions differences

We assume that:
Relative factor price | Relative output
---|---
$\rho_1$ | $\chi_1$
$\rho_2$ | $\chi_2$
1 | 4
1 | 0.25

Table 1: The Hecksher-Ohlin-Chamberlin Model

$$\frac{K_1}{L_1} > \frac{K_2}{L_2}$$

Such that the country 1 is relatively capital abundant. In this world where relative factor endowment can have a potential impact on the pattern of trade a famous case is the Hecksher-Ohlin-Chamberlin Model with costless trade in both goods and without home-biased procurement.\(^7\) We now turn to the analysis of this model.

### 4.1.1 Hecksher-Ohlin-Chamberlin Model

We consider the same framework as before but now make the following assumptions:

**Assumption 5** (*Hecksher-Ohlin-Chamberlin*) *For all* $i,j$, $\tau_{ijx} = 1$ *and* $\phi_{jx} = 0$

Together with assumption 2 and 3, this implies that there is free trade in both goods with no home bias procurement. Table 1 give us the results for the simulation of this model.\(^8\) In this framework with costless trade in goods and absence of home bias procurement, factor prices are equalized in the international equilibrium. This means that countries’ factor endowment belongs to the same cone of diversification. In addition, both countries produce both goods after trade opening with the country 1 relatively specialised in the production of the manufacturing good and the country 2 relatively specialised in the production of the agricultural good. Concerning the pattern of trade, this model have clear predictions (provided that the number of traded goods is equal to the number of factors of production), it predicts that the pattern

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\(^7\)We add the name Chamberlin to the Hecksher-Ohlin model because it is a model with a perfectly competitive good and a monopolistically competitive good. In contrast to the original model with two competitive industries, this model is able to explain both intra-industry trade and inter-industry trade. See Dixit & Norman (1980, Chapter 9) and Helpman & Krugman (1985, Chapter 7) for a thorough study of the properties of this model.

\(^8\)The parameters values are: $L_1 = 40$, $K_1 = 60$, $L_2 = 60$, $K_2 = 40$, $\sigma = 2$, $\nu_{1x} = 1/2$, $\nu_{2x} = 1/2$, $\gamma_{1x} = 1/2$, $\gamma_{2x} = 1/2$, $\delta_1 = 1/2$, $\delta_2 = 1/2$, $\alpha = 2/3$, and $\mu = 1/3$. In addition, $\kappa = 1$ and $\phi_1 = \phi_2 = 0$.
of trade of a country is determined by its relative factor abundance. More precisely, in this model, given a number of assumptions among which, identical homothetic preferences and identical technologies, each country will export the good that uses its abundant factor intensively (Heckscher-Ohlin Theorem). We can check this proposition with the results reported in Table 1. To do so, let $s_j$ be the share of country $j$'s income in world income. Given homothetic preferences (3.2.1), it is well known that country $j$ consumes the same fraction $s_j$ of the world output of each good. Therefore, we have that:

$$C_{1x} = s_1 (n_1x + n_2x) \quad \text{and} \quad C_{2x} = s_2 (n_1x + n_2x)$$

For the consumption of the manufacturing good and:

$$C_{1y} = s_1 (Y_1 + Y_2) \quad \text{and} \quad C_{2y} = s_2 (Y_1 + Y_2)$$

For the consumption of the agricultural good. Given the values in Table 1 and the endowments, we have that $I_1 = w_1L_1 + r_1K_1 = 100$ and $I_2 = w_2L_2 + r_2K_2 = 100$. Therefore, $s_1 = I_1/I_1 + I_2 = 100/200 = 0.5$ and $s_2 = I_2/I_1 + I_2 = 100/200 = 0.5$. Given the symmetry in the factor endowment and the fact that factor prices are equalised, both countries have the same income and therefore the same share in world income. The consumption of the manufacturing good for each country is therefore:

$$C_{1x} = 0.5 (80 + 20) \quad \text{and} \quad C_{2x} = 0.5 (80 + 20)$$

And the consumption of the agricultural good is:

$$C_{1y} = 0.5 (20 + 80) \quad \text{and} \quad C_{2y} = 0.5 (20 + 80)$$

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9When the number of traded goods is lower than the number of production factors (as in the Ricardo-Viner model of trade), the factor price equalisation set is empty and the pattern of trade is determined when in each country, the traded goods are produced with different amounts of the specific factors. When the number of traded goods is larger than the number of factors, the factor price equalisation theorem holds in general but the pattern of production and the pattern of trade are not uniquely determined. However, the net factor content of trade is uniquely determined.
We can see that the country 1 (country 2) exports (imports) 40 \((0.5 \times 80)\) units of the manufacturing good and imports (exports) 10 \((0.5 \times 20)\). Therefore, the country 1 (country 2) is a net exporter (net importer) of the manufacturing good with a surplus (deficit) of 30 units \((40 - 10)\). This intra industry trade comes along with inter industry trade as the country 2 exports the agricultural good so that its balance of trade is in equilibrium. Indeed, the country 2 consumes \(C_{2y} = 50\) units of the agricultural good and produces \(Y_2 = 80\). This country has therefore an excess supply of 30 that is exported to the country 1. The Heckscher-Ohlin Theorem applies since the country 1 which is relatively capital rich exports the relatively capital intensive good \(X\) and it imports the relatively labor intensive good \(Y\). The trade balance condition holds in each country. For example, the value of country 1 net export (i.e. 30) is equal to the value of its import from country 2. The volume of trade is given by the sum of exports of the two countries as:

\[
VT(\phi_1, \phi_2, \kappa) = [s_2 p_{1x} n_1 x + s_1 p_{2x} n_2 x] + [Y_2 - C_{2y}]
\]

Where we have again put \(\phi_1, \phi_2\) and \(\kappa\) in brackets to indicate that the volume of trade is function of these parameters. The first term \((s_2 p_{1x} n_1 x)\) represents exports of manufactures by the country 1. The second \((s_1 p_{2x} n_2 x)\) and third component represents exports of manufactures and exports of the agricultural good by the country 2. Applying, this formula, the volume of trade is given by:

\[
VT = [40 + 10] + 30 = 80
\]

### 4.1.2 Public procurement market liberalisation

1) Relative Specialisation

Figure ?? graphs the relative specialisation in the manufacturing sector as a function of the degree of public market liberalisation in the case of free trade for the manufacturing good \(\kappa_{ijx} = 1\) for all \(i\) and \(j\) and with symmetric home bias \(\phi_{ix} = \phi_x\) for all \(i\).\(^{10}\) Since \(\phi_x\) measure the degree of home-bias procurement in the symmetric case, \(1 - \phi_x\) will be our measure of the degree of public procurement market.

\(^{10}\)Recall that \(\kappa_{ijx} \equiv 1/\tau_{ijx}\).
liberalisation. For any values of the home bias, each country is specialised according to its comparative advantage. Thereby, the relatively labor abundant country (country 2) is relatively specialised in the production of the relatively labor intensive good (good 2) and the other country is relatively specialised in the production of the capital intensive good 1. In the absence of home bias $\phi_x = 0$, comparative advantages are fully exploited and we have the results of the Hecksher-Ohlin-Chamberlin Model in table 1. As the degree of home bias tend to its limit value of 1, each country tends to be relatively more specialised in the production of the good for which it has a relatively comparative disadvantage. Thus, the relative specialisation in the manufacturing good increase for the country 2 but it decrease for the country 1. This fact can be explain as follow: In the absence of home bias, given its relative abundance in the factor that it use intensively by the manufacturing sector, the share of total expenditure in the output of the manufacturing good is lower in country 1 than it is in country 2. When the degree of home bias start to increase, consumers in the country 2 increase sharply their demand for the domestic manufacturing good and given the presence of increasing returns in this sector, such an increase in the domestic demand leads firms to agglomerate in country 2 at the expense of country 1. Therefore, the share of total expenditure in the output of the manufacturing good rise in the country 1 and decline in country 2. In addition, this

Figure 2: Public procurement market liberalisation and patterns of specialisation
figure make it clear that with free trade in both goods and home bias in government purchase, factor endowments do not play any direct role in the specialisation of the countries.\footnote{11} To see this mechanism we follow Brühart & Trionfetti (1998). First, start by solving the equation (1) with $\phi_{jx} = 0$ for all $j$ and $\tau_{ijx} = 1$, we find that:

$$N_{p_{ix}x_i} = 2 \sum_{j=1}^{2} \left[ E^P_{jx} + (1 - \phi_{jx})E^G_{jx} \right]$$

Where we have use the fact that $p^1_{ix} - \sigma P^x_i = 1/N$ (this is the case when $\tau_{ijx} = 1$) where $N = n_1 + n_2$.

Now, let us solve (1) for $\phi_{jx} \neq 0$ and $\tau_{ijx} = 1$. We have that:

$$N_{p_{ix}x_i} = 2 \sum_{j=1}^{2} \left[ E^P_{jx} + (1 - \phi_{jx})E^G_{jx} \right] + \frac{\phi_{ix}}{n_i} E^G_{ix}$$

Combining this two equations we find that:

$$\psi_i \equiv \frac{n_i}{N} = \frac{\phi_{ix} E^G_{ix}}{\sum_{j=1}^{2} \phi_{jx} E^G_{jx}}$$

This latter equation make it clear that the pattern of specialisation is determined by the degree of home bias but not by factor endowments. Finally, we observe that the degree of home bias (though symmetric) hurts the countries in a disymmetrical ways. Indeed the specialisation in the good intensive in the scarce factor is faster for the country 1 than it is for the country 2. This outcome comes from the values that we have chosen for the parameters and by our assumptions that the country 1 is relatively capital abundant and there is no home bias for the relatively labor abundant good ($\phi_{iy} = 0$).

As seen in figure ??, when the degree of home bias increase, each country relatively specialise in the production of the good which is intensive in the scarce factor. Figure ?? allow us to see which relatively disadvantaged sector benefit more from an increase in the degree of home bias. On the horizontal axis, we have plot the symmetric degree of home bias $\phi_x$ and on the vertical axis, the relative specialisation in the good intensive in the scarce factor (in the case of free trade in both goods). Given the fact that the relatively disadvantaged sector in country 1 is the agricultural sector, we define the ratio $\eta_1 = 1/\xi_1$ as the relative specialisation in that sector for this country. As the degree of home bias tend to it limit value of 1, the relative specialisation in the comparative disadvantaged sector increase in the two countries. However,
we can see that the relatively disadvantaged sector in country 2 benefit more from an increase in $\phi_x$ that the relatively disadvantaged sector in country 1. Indeed, for any positive degree of the symmetric home bias, the line representing the specialisation for the country 2 (i.e. $\chi_2$) is above the line representing the specialisation for the country 1 ($\eta_1$). This is so because an increase in the symmetric degree of home bias leads to an increase in the total demand for the domestic products in country 2 as we have seen in figure ???. Given our assumption of a greater degree of home bias directed toward the manufacturing products, the increase in the demand from the consumers in country 2 is greater than the decrease in the demand in country 1. Therefore, the number of manufacturing firm locate in country 2 increase more than the decrease in the number of manufacturing firm in the country 1.

Figure 4 plots the relative specialisation in the manufacturing sector as a function of the degree of public market liberalisation for the country 1 (function of the degree of home bias for the country 2) in the case of free trade. In this figure we consider the assymetric case where $\phi_{2x} = 1 - \phi_{1x}$. Starting in a situation where there is no home bias in governement purchase of country 2 ($\phi_{2x} = 0$), all manufacturing firms are agglomerate in country 1 where the demand for the domestic products is high ($\phi_{1x} = 1$). As the degree of home start to decline in country 1, the governement in this country start to consume some of the foreign
varieties which result in a decrease in the domestic demand in this country. Since the reverse mechanism is at work in country 1 (domestic demand increase), and again because of increasing return to scale, firms in the manufacturing sector start to leave the country 1 for the country 2. This process continues until we reach a point of reversal of Heckscher-Ohlin type specialisation in which the labour abundant country (capital abundant country) become relatively specialised in the production of the capital intensive good (labour intensive good). Contrary to the symmetric case in figure ?? in which even when the country 2 is fully home bias, Heckscher-Ohlin type specialisation still holds here, because of the asymmetry, this no longer the case.

2) Relative Factor Prices

Figure 5 graphs the relative factor prices as a function of the degree of public market liberalisation (with free trade in the manufacturing sector). For positive values of the degree of home bias (i.e. for $1 - \phi_x \in [0, 1]$), factor price differ. This is so because as we have seen for the figure ??, as the degree of home bias increase, each country tends to be relatively more specialised in the production of the good
Public procurement market liberalisation when \( \Phi \) is in \([0,1]\) and \( \kappa_i = 1 \).

Relative factor price

\[
\rho_1, \rho_2
\]

for which it have a relatively comparative disadvantage. This specialisation implies that the demand for the scarce factor increase in both country which leads factor prices to adjust in order to compensate for the new equilibrium. Therefore, as the degree of home bias increase, the relative factor price of capital increase in country 2 but decrease in country 1. This is the inverse of the result of the Heckscher-Ohlin model in which the abundant factor gains in each country. As for the figure, \( \Phi \), since an increase in the degree of home bias benefit the scarce factor in each country, we may want to know which scarce factor is the most favorised by this process. Figure 6 gives an answer to this question.

Figure 6 plots the relative factor price of the scarce factor in each country as a function of the parameter \( \phi_x \). It shows that, the relative factor price of the scarce factor in country 2 (i.e. the capital) is the most favorised by an increase in the degree of home bias compared to the relative price of labour in country 1. Indeed, for any positive value of the degree of home bias, the line representing the relative factor price of the scarce factor in the country 2 is above the line for the country 1. We have seen in figure \( \Phi \) that an increase in the symmetric degree of home bias leads to an increase in the relative specialisation of a country in the good intensive in the scarce factor. Given it relative scarcity in the endowment of capital, and the fact that the home bias in governement purchase is directed only towards manufacturing goods,
Home bias deepening when \( \Phi \) is equal to \( \frac{1}{\epsilon} \). Element \( \sum_{i} \epsilon_{x} \) and \( \sum_{j} \epsilon_{x} \) is the total domestic demand for the good intensive in the scarce factor increase more in country 2 than in country 1 (as seen in figure ??). As a consequence, an increase in the symmetric degree of home bias leads to an increase in the demand for the scarce factor that is higher in country 2 than it is in country 1. Given the fact that factor prices need to be adjusted following a change in the demand, we obtain the pattern that we see in figure 6.

Figure 7 plots the relative factor prices as a function of the degree of home bias for the asymmetric case for which \( 1 - \phi_{1x} = \phi_{2x} \). As seen for the figure 4, when purchases of country 2 become home biased, domestic demand for the domestic good increase which leads to an agglomeration of firms in this country. In order to match the new demand domestic output need to rise, therefore their is an increase in the demand for capital in country 2 and a decrease in country 1 (since the reverse mechanism is at works in this country). Again, given the relative scarcity of the factor whose demand increase, it relative price need to increase to equilibrate the factor market.
4.1.3 Economic Integration

1) Relative Specialisation

Figure 8 plots the relative specialisation in the manufacturing sector as a function of the parameter $\kappa$ without home bias procurement $\phi_{ix} = 0$ for all $i$. This figure allow us to illustrate the interplay between autarky and increase in trade integration. In autarky, $\kappa = 0$, the two country produce the two goods, there is no trade, competition is entirely local and Heckscher-Ohlin type comparative advantages are not exploited. In this latter case, the dispersion forces are maximum. Trade allow each country to fully employ it abundant factor to increase the production and export the good in which it have a comparative advantage. Indeed, when the trade costs start to decline to permit trade, competition remains mainly local but a country can exploits it comparative advantage and export the good whose production is intensive in it abundant factor. Both the agglomeration forces and the intensity of trade increases with lower trade costs until we reach a point where countries are highly specialised. In a situation of free trade, competition is global, there is both intra and inter industry trade as the capital abundant country
is a net exporter of the capital abundant good and an importer of the labour abundant good and vice versa. For this figure we have considered the case where there is no home bias, but a decline of the trade costs. One may wonder what is the impact of the degree of home bias on the forces at play when there is a decline in trade costs. In this setting, Trionfetti (1997) has demonstrated that the effect of home bias is to counter agglomeration forces. The reason is simple, a decline of trade costs allow each country to exploit its comparative advantage which is given by its factor endowment. However, the presence of a bias in the demand for domestic goods forces firms to increase their production in order to match the demand whatever what is the comparative advantage.

Figure 9 plots the relative specialisation in the sector in which each country has a comparative advantage as a function of the parameter $\kappa$ and with a symmetric degree of home bias of 0.5. We can see that economic integration benefit more the comparative advantaged sector of country 1 than the comparative advantaged sector of country 2. Indeed, for any positive values of $\kappa$, the relative output of the manufacturing good in country 1 is greater than the relative output of the agricultural good in country 2.

2) Relative Factor Prices
Economic integration when \( \phi_i = \phi_h = 0.5 \) and \( \kappa \in [0, 1] \). Economic integration is associated with an increase of the return of the relative abundant factor in each country as predicted by the Heckscher-Ohlin model.

Figure 11 plots the relative factor prices in the sector in which each country has a comparative advantage as a function of the parameter \( \kappa \) and with a symmetric degree of home bias of 0.5. As for the figure 9 in this setting, economic integration benefits the country 1 more than the country 2 this time through the relative prices. Indeed, a decrease in trade costs is associated with a rise of the relative prices of the
Figure 10: Economic integration and factor prices

Figure 11: Economic integration and relative factor price of the abundant factor
abundant factor in each country. However, the abundant factor in country 1 is the most favored since for any positive values of $\kappa$, its relative price is above the relative price of the abundant factor in country 2.
5 Empirical Evidence

5.1 Empirical model

We seek to test whether a relation similar to the figure 6 is present in the data. We will work we the following specification:

$$\ln\text{SkillPremium}_i = \alpha + \beta \ln\text{ExpendCap}_i + \delta \ln\left(\frac{H}{L}\right)_i \times \ln\text{ExpendCap}_i + Z_i + \epsilon_i$$ (7)

The left-hand side variable is a measure of a country $i$ skill premium. $\ln\text{ExpendCap}_i$ is a measure of country $i$ government purchases of goods and services per capita and $\ln H/L$ is a measure of human capital per worker for country $i$. The main coefficient of interest is the coefficient $\delta$, we should expect a negative sign, which means that the skill premium is negatively correlated to a government expenditure in a country with a high human capital per worker. $Z_i$ is a vector of controls and $\epsilon_i$ is a noise term.

5.2 Data Description

Data for wages to compute the skill premium comes from the Freeman & Oostendorp (2000) Occupational Wages around the World (OWW) dataset. This base provides wage information on 162 occupations with 137 countries between the year 1983 – 2003. The main drawback with this data comes from the fact that the corresponding panel is very unbalanced as countries most of the time do not report wages for all occupations in all years. Our main year is 2003, the size of our sample is extremely limited for data for only this year, therefore, we report data on others years as proxy for 2003 for the missing observations. Data for the size of government procurement and for population comes from the International Financial Statitics and the Government Finance Statistics Yearbook of the IMF. Data for human capital per worker is calculated following Caselli (2005), specifically as $H/L = exp(\phi(s))$ where $s$ is the average years of schooling in the population over 25 years old from Barro & Lee (2010) and $\phi(.)$ is a piece-wise linear function. Whithout the data on wages we have a panel of 53 countries for the period 2003 – 2005 our sample is composed of 35 countries for the year 2003 (with proxies for the missing observations) when wages are included. Table 2 shows some descriptive statistics for our panel:

The government expenditure as percent of GDP is higher for high-income countries than for low-income countries but it is lower for democratic countries than for autocratic countries. Moreover, the relationship seen in figure 1 is confirm as countries with higher government expenditure per capita tend to be more
Table 2: Descriptive Statistics

<table>
<thead>
<tr>
<th>Countries</th>
<th>All countries</th>
<th>High-income countries</th>
<th>Low-income countries</th>
<th>Democratic countries</th>
<th>Autocratic countries</th>
<th>Euro-area countries</th>
<th>Other high-income countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government expenditure (% of GDP)</td>
<td>6.28</td>
<td>6.629</td>
<td>5.929</td>
<td>6.23</td>
<td>6.66</td>
<td>5.29</td>
<td>7.54</td>
</tr>
<tr>
<td>Log Government expenditure per capita</td>
<td>6.36</td>
<td>7.68</td>
<td>4.91</td>
<td>6.45</td>
<td>5.69</td>
<td>7.32</td>
<td>7.92</td>
</tr>
<tr>
<td>Log GDP per capita</td>
<td>9.20</td>
<td>10.45</td>
<td>7.90</td>
<td>9.30</td>
<td>8.44</td>
<td>10.30</td>
<td>10.568</td>
</tr>
<tr>
<td>Log Population</td>
<td>2.34</td>
<td>2.53</td>
<td>2.14</td>
<td>2.38</td>
<td>2.002</td>
<td>2.85</td>
<td>2.314</td>
</tr>
<tr>
<td>Polity measure of democracy</td>
<td>0.87</td>
<td>0.94</td>
<td>0.80</td>
<td>0.959</td>
<td>0.23</td>
<td>0.905</td>
<td>0.909</td>
</tr>
</tbody>
</table>
Figure 12: Democracy and Government expenditure.  *Source: International Financial Statistics and Polity IV database*

democratic.

5.3 Results

Table 3 presents the estimation of equation (7). There exist a positive correlation between democracy and government expenditure as already shown by figure (??). Countries with a higher human capital per workers have also a higher government expenditure per capita but a lower skill premia. Our main result is in column (6), it appear that countries with high human capital per workers have a lower skill premia. The sign is negative and highly significant at the 1% level. Table 3 presents the results with some controls. We add to the regression, the average year of schooling as well as a measure of openness i.e., exports plus imports as a share of GDP from the Penn World Table. Table 3 present the results of the instrumental variables with democracy as an instrument for the produit of the logarithm of government expenditure par capita and the logarithme of the human capital intensity.
Table 3: Main Estimation Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log (H/L)</td>
<td>-1.058***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.363)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log (Exp/L)</td>
<td>-0.123**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0533)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log (H/L) * Log (Exp/L)</td>
<td>-0.123***</td>
<td>-0.128**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0370)</td>
<td>(0.0606)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average year of schooling</td>
<td></td>
<td></td>
<td>0.00483</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0528)</td>
<td></td>
</tr>
<tr>
<td>Openness</td>
<td></td>
<td></td>
<td>-0.000596</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.000848)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.098***</td>
<td>1.774***</td>
<td>1.838***</td>
<td>1.881***</td>
</tr>
<tr>
<td></td>
<td>(0.383)</td>
<td>(0.333)</td>
<td>(0.245)</td>
<td>(0.304)</td>
</tr>
<tr>
<td>Observations</td>
<td>33</td>
<td>35</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.133</td>
<td>0.295</td>
<td>0.406</td>
<td>0.417</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 4: IV regressions

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(H/L)*Log(Exp/L)</td>
<td>-0.317***</td>
<td>-0.413***</td>
</tr>
<tr>
<td></td>
<td>(0.0714)</td>
<td>(0.126)</td>
</tr>
<tr>
<td>Average year of schooling</td>
<td>0.206*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.111)</td>
<td></td>
</tr>
<tr>
<td>Openness</td>
<td>-0.000427</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00128)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.154***</td>
<td>1.878***</td>
</tr>
<tr>
<td></td>
<td>(0.430)</td>
<td>(0.436)</td>
</tr>
<tr>
<td>Observations</td>
<td>33</td>
<td>33</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Figure 13: Democracy and Government expenditure (% of GDP)

References


