

Step-by-step integration and activity location: the role of factor endowment and industrial linkages

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Introduction.

During the last decade, European integration was essentially seen from a monetary point of view, the main challenge being the introduction of the Euro. It corresponds to the ultimate stage of a sequential process of integration, proceeding through enlargement and deepening and through progresses alternatively realised on the real side or the monetary one. But, beyond its purely monetary logic, the single currency is also viewed as a powerful integrative tool as it is supposed to be able to foster the real convergences across countries (One market, one money, 1991). Then, the effects of the constitution of a single market are commonly studied by the joined contributions of the international economics and geographical economics, dealing with the question of the location of economic activities. Even if this question is not new, the 1990s were marked by the resurgence of academic interest for the spatial dimension of economy. This is due partly to theoretical developments- international trade theory has been combined with insights from industrial economics - by the improvement of analytical tool kit available to economists through the “new” theories of trade and economic geography- monopolistic competition *à la Dixit and Stiglitz [1977]*, transportation costs like Samuelson’s “iceberg”... Moreover the deepening of European economic integration provided a real benchmark for testing analytical patterns.

Therefore, international trade theory predicts that the constitution of a free-trade area would define specialisation patterns according to economies’ comparative advantages. Under the assumption of unchanged technology and endowments, the specialisation process would be reinforced after further economic integration.

Geographical economics aims at explaining the dynamics of industrial location, submitted to centrifugal and centripetal forces leading to cumulative processes. It views the ongoing European integration as a process of reduction of costs involved in international transaction.

At a first sight, both fields seem to be complement; the conjunction of their results would provide a comprehensive picture of the structuring of an economic area. Nevertheless, throughout the 1990’s, both theoretical bodies were considered as mutually incompatible. A reason for this split could be that international economics focuses on international differences, as a source of comparative advantage, whereas geographical economics pays little attention to the existence of such a type of specialisation. Moreover, with respect to location decisions, many contributions based on *Venables [1996]* highlight cost and demand linkages between firms as a source of agglomeration under the strong assumption of a perfect symmetry across countries.

However, recent empirical evidence seems to support the relevance of both agglomeration effect and traditional effect through comparative advantage in shaping the industrial structure of countries involved in the process of European Union. As far as the enlargement and the deepening of European Union are concerned, many empirical studies seem to confirm the need to take into account not only the “new” forces but also to combine them with the traditional forces of specialisation

Now, the future of Europe, a new enlargement stage, characterised by the entry of several new countries and extending European territory towards the East could be a good pretext to check the relevance of such a reconciliation. From an economic point of view, these countries are heterogeneous with respect to their relative endowment; they are more or less far

from the “core countries” and they have to join an already existing union, a pre-established “core-periphery”.

We have now to build the economics of the integration of the core countries of Europe with heterogeneous newcomers, through several stages. This paper addresses the question of what determines the location of different industries across countries when endowments are unequally distributed in the precise case of a sequential integration process.

The model is related to recent work analysing the tension between Heckscher-Ohlin specialisation and NEG agglomeration forces. The general features of this contributions are the following: they take into account the countries endowment, and they deal with input output links between firms. *Amiti [2001]* using a framework of fragmentation shows that agglomeration forces could lead to the agglomeration of the downstream industry into the capital abundant country. This situation in *Epifani [2001]*'s words “*a perverse agglomeration*” could only be temporary. *Epifani [2001]*, augments a *Krugman and Venables [1996]*'s model abstracting from inter-industry linkage but considering differences in relative endowments across countries. He shows that the non-monotonicity arises as the most current outcome. For intermediate values of trade cost the NEG forces strengthen the traditional forces. We extend this model first by accounting for inter-industrial linkages. Second we introduce a third country. For which we make different assumptions relative to its endowment and/or the level of trade cost. This cost may differ between each pair of countries.

The remainder of the paper is organised as follows: section 2 presents the related literature. In section 3 we present the model and make the stability study. Section 4 deals with specialisation. Elements of conclusion are gathered in section 5.

Related literature.

We start by considering the characteristics and results of main bodies of theory dealing with space and agglomeration: Traditional Trade theory and new analyses that include New Trade Theory and New Economic Geography. We treat these two last fields simultaneously, using usually as a frontier the acceptance of the hypothesis of intrinsic differences or cumulative processes as a source of specialisation. Then we introduce papers that consider the two kinds of forces simultaneously; they allow supporting evidence about some case of industrial dynamics or about particular aspects of the current state of European integration. Finally we refer to other contributions related to apprehension of differentiated geographical areas, corresponding to different levels of integration. They focus on the effect of international integration on regional agglomeration. As we are interested in explaining the effect of integration between countries having a more or less important degree of physical or economical proximity. We will have a necessarily to borrow argument from all these theoretical references taken together.

Traditional trade theory uses assumptions such as perfect competition, homogeneous goods, production with constant return to scale, mobility of factor of production between sectors but not between countries.

In Traditional trade theory, intrinsic differences between countries are necessary and sufficient to explain specialisation patterns. While the Ricardian model resorts to differences in technology, Heckscher-Ohlin's model focuses on differences across countries in their relative factor endowment with respect to both their relative abundance and intensity of use. Whatever the origin, these differences give rise to differences in cost of production between locations. Then a reduction in trade cost drains firms in the country with a cost advantage. In so far, trade liberalisation between countries implies a greater specialisation; leading to Inter industry trade.

But a large part of international trade takes place between countries with very similar factor endowment. This trade is not, as the traditional trade theory would predict, inter-industry trade but intra-industry trade. One can see the need for rethinking trade theory to be triggered by this stylised fact; and the impossibility of traditional theory to explain it.

This is the starting point of The New Trade Theory, which stresses scale economies, product differentiation and imperfect competition, paying attention to the role of the market access as a determinant of industrial structure. The latter constitutes the "*home market effect*".

The presence of economies of scale encourages firms to choose only one location, and the presence of trade costs encourage them to locate in the country that has the larger market for their goods *Krugman [1980], Helpman and Krugman [1985]*. As a result, a deeper integration leads to a greater concentration of activities, the core country becoming more specialised in manufactured goods -which are produced under increasing returns to scale- and so a net exporter of this kind of goods.

In this framework it is not comparative advantages that determine specialisation, but rather differences in market size and the concentration of demand. In fact market size depends on the amount of labour force in a country, then the difference in size is magnified by economic process. The next step is to render endogenous the market size.

The New Economic Geography literature extends this line of research by showing that international differences in demand are likely to be endogenous -either because of workers' mobility *Krugman [1991]*, or because of vertically linked firms' mobility *Venables [1996]*. These characteristics generally produce self-reinforcing agglomeration processes. However, if economic activity is already concentrated to a certain extent in one place, a favourable economic environment is created, which in turn supports further concentration. Concentration then becomes a self-reinforcing process.

The NEG is ambiguous in predicting the location of production. When trade cost are reduced. Production first concentrates in locations with good market access (core) and then spreads to more distant markets (periphery).

This is the basic result of NEG: agglomeration relates non-monotonically to economic integration.

Surprisingly enough, NEG has devoted little attention to the analysis of the interaction between these agglomeration forces and the international differences in factor proportions. In fact, accounting for factor differences across countries could have obscured the most striking features of NEG, i.e., that even in the absence of any intrinsic and exogenous differences among countries, centripetal forces are sufficient to explain country specialisation.

Even if the question of the location of economic activities is not new, the last decades were marked by the resurgence of academic interest for the spatial dimension of economy. No matter the technical reason of the emergence of new area in international economy, it has (perhaps too fast) let believe that old theories were obsolete.

Moreover, empirical literature provide evidences of the relevance of both theories in explaining the evolution of the pattern of specialisation of countries involved in a process of integration (*Davis and Weinstein [1996];[1999]*, *Midelfart - Knarvik, Overman, Redding and Venables [2000]*, *Overman, Redding and Venables [2001]* for the regional level...).

A set of papers observe that the specialisation process in Europe in U-shaped. There is a weak tendency towards less specialisation and concentration in manufacturing in the 1970s and a slight reversal of this tendency since the 1980s. More significant results of structural change are for smaller peripheral countries that have undergone a rather fast process of catching-up, in particular Ireland and Portugal *Amiti [1998];[1999];Midelfart - Knarvik, et al. [2000];WIFO [1999]*

From a sector point of view the strongest recent localisation trend emerges in industries tagged as labour intensive, which appear to be concentrating in peripheral EU regions. *Brühlhart [1998]* therefore suggest that factor-cost considerations are likely to dominate increasing returns as the main locational determinant. This conclusion mirrors that of *Kim [1995]*, whereby the recent theoretical emphasis on increasing returns might not capture the main locational forces of our time. He concludes for the relevance of both theories,

Finally even if *Amiti [1999]* finds evidence for increasing returns, and input output linkages effect on geographical concentration but no effect of the factor intensity variable. The author writes

“this is not really surprising, since the five countries¹ in the sample were very similar in term of their relative factor endowments during the period 1976-1989. If the data included earlier periods when these five countries differed in their relative factor endowment or included countries with different relative factor endowment such as Spain or Portugal, then it would be likely that we would see evidence of specialization according to the H-O theory ”

The need to take into account traditional forces as well as new ones seems natural. Models have been developed following this line. For example *Forslid and Wooton [2001]* augment *Krugman [1991]*'s allowing for international differences in technology. In this framework they show that, for sufficiently low trade cost comparative advantages act against agglomeration forces.

Recent works analyse the tension between Heckscher-Ohlin specialisation and NEG agglomeration forces. *Amiti [2001]* splits the manufacturing sector into an upstream capital-intensive industry and a downstream intensive industry. Then she shows that trade integration may lead to the agglomeration of the downstream industry into the capital abundant country. In the same line *Epifani [2001]*, augments a *Krugman, et al. [1996]*'s model abstracting from inter-industry linkage, showing that the non-monotone relationship between specialisation and integration arises as the most current outcome. In fact, adopting a structure more general than *Amiti*'s, *Epifani* shows that an agglomeration incompatible with H-O prediction can be only temporary within the integration process. Once a sufficiently low level of trade cost is reached, specialisation actually follows the prediction of the standard theory – providing intra-industry linkages only matter. For intermediary values of trade costs these linkages result in a greater specialisation than the one induced by the sole comparative advantage mechanism.

Theoretical models concern mainly two countries. This of course implies simultaneity in the integration process. Now we are concerned with the issue of the integration of a third country whenever the two first countries are already opened to trade.

Some lines of analysis have already been defined.

Indeed, *Krugman, et al. [1996]*, in a two-country three-region framework, suggest that a decrease in international transaction cost between two countries may foster the dispersion of economic activity inside the home country. This result is provided to explain the future of economic activity location in Mexico City and along the US border area. After this contribution many papers have been written, all concluding that trade liberalisation is more likely to enhance agglomeration of economic activity inside the country opening to trade. In each case the consideration of a particular assumption about the centrifugals forces leads to different conclusions about the extent of agglomeration. (*Alonso-Villar [2001]*, *Monfort and Nicolini [2000]*, and *Paluzie [2001]*, *Crozet and Koenig-Soubeyran [2002]*).

On this basis our aim is to examine the impact of integration of a third country in a trade area constituted by two countries already integrated. We do not consider regions but countries involved in a two-step integration process. To this end we extend *Epifani [2001]*'s model, allowing inter-industrial linkages to prevail and incorporating a third country. We explore different scenari each of them being characterized by a certain configuration of trade

¹ The study is carried on Belgium, France, Germany, Italy and UK.

cost and factor endowment. Thanks to numerical simulations we will be able to deepen our understanding of how the process of enlargement of a trade area affects the process of specialisation within the trade area.

The model

Model overview

This section exposes a model proposed by *Epifani [2001]* which is an extension of *Krugman, et al. [1996]* model. It takes into account differences in relative endowments between countries but it neglects inter-industrial linkages. We extend this framework to three countries: the Domestic country, the Foreign country and the “Rest of the World” (variable relative to Foreign and RoW are respectively denoted by a $(\tilde{\cdot})$ and a $(\hat{\cdot})$), furthermore we allow inter-industrial linkages between firms to prevail. As usual we suppose that all countries have identical preferences and technology but are differently endowed with capital and labour.

First, Domestic and Foreign experience a process of trade liberalisation, then this will be extended to the Rest of the World. We want to focus on the impact of this enlargement process on the economic geography of the first members. We study this question using the framework an economic geography model proceeding through the following steps: setting out the formal model, solving for different cases of specialisation.

For the sake of simplicity, we present below the equation describing the domestic economy. They hold for the Foreign country and the RoW, only the country denomination changes.

Manufacturing.

Manufacturing is composed of *two* different sectors (indexed $i=1, 2$). Each is assumed to be monopolistically competitive *à la Dixit, et al. [1977]*, producing under increasing return to scale a large number of differentiated goods.

Production of a quantity q of any variety in any country requires the same amount fixed F and variable cq quantities of production input. This input, used in sector i , is a Cobb-Douglas composite of both labour and capital, and of an aggregate of the differentiated industrial goods from this sector and from the other sector. Following *Ethier [1982]* all varieties enter symmetrically into the intermediate aggregate with a constant elasticity of substitution ($\sigma > 1$).

The unit cost function for each sector is:

$$(1) \quad \begin{aligned} \psi_1 &= (F + cq_1) (\omega^\alpha r^{1-\alpha})^{(1-\delta)} (G_1^\gamma G_2^{(1-\gamma)})^\delta \\ \psi_2 &= (F + cq_2) (\omega^{(1-\alpha)} r^\alpha)^{(1-\delta)} (G_1^{(1-\gamma)} G_2^\gamma)^\delta \end{aligned}$$

Where all parameters lie into a $(0, 1)$ interval, ω is the nominal wage, r the capital rental and G_i the price index of the aggregate from sector i defined by equation (2).

$\delta (1-\delta)$ is the share of intermediate input (primary factors) in the cost function. Given this share, γ give the origin of this intermediate. So far if $\gamma > 1/2$, intra industrial linkages are stronger than inter industry linkages. For primary factor, in sector 1, $\alpha (1-\alpha)$ is the share of labour (capital) in cost function. Assume afterwards $\alpha > 1/2$, i.e. that industry 1 is labour intensive. Assume furthermore that the domestic country is relatively more abundant in capital the others, that is $\frac{K}{L} > \frac{\tilde{K}}{\tilde{L}} > \frac{\hat{K}}{\hat{L}}$.

$$(2) \quad \begin{aligned} G_1 &= \left[n_1 p_1^{(1-\sigma)} + \tilde{n}_1 (\tilde{p}_1 \tau)^{(1-\sigma)} + \hat{n}_1 (\hat{p}_1 \theta)^{(1-\sigma)} \right]^{1/(1-\sigma)} \\ G_2 &= \left[n_2 p_2^{(1-\sigma)} + \tilde{n}_2 (\tilde{p}_2 \tau)^{(1-\sigma)} + \hat{n}_2 (\hat{p}_2 \theta)^{(1-\sigma)} \right]^{1/(1-\sigma)} \end{aligned}$$

Where p_i is the producer price of a variety i in domestic country. n_i denoting the number of firms operating in domestic country in sector i , it is endogenously determined.

The price index in each country depends on local prices of individual varieties, which in turn are a function of the mill price and trade cost. Shipments of industrial goods are subject to ‘iceberg’ transportation cost — that is, a fraction of any shipment melts away in transit. If we note T this trade cost, when a unit of good is shipped from a location r to another location s , only a fraction $\frac{1}{T_{rs}}$, of the original unit actually arrives; the rest melts away.

In our model, we have three different locations for production and consumption of goods. We follow *Crozet, et al. [2002]* in introducing the spatial framework of the model using variable transaction cost, representing distance between countries. We assume these trade costs to be the same for all industries, but to be different across countries: τ is the transaction cost between Domestic and Foreign, we assume $\tau_{DF} = \tau_{FD} = \tau$. θ_{DR} and θ_{FR} are respectively the transaction cost applying to each country of the trade area with the rest of the world. For the moment we suppose $\theta_{DR} = \theta_{FR} = \theta$

Preferences.

The representative consumer in each economy has a Cobb-Douglas preference over the CES aggregate of industrial goods. For convenience, we assume it is the same CES aggregate that enters firm's technology. Therefore, each firm is both an upstream supplier of intermediate input to firms from his own sector, and to firms from the other sector. It is also a downstream producer for final consumer demand. The indirect utility of the representative consumer in domestic country is

$$(3) \quad Y = G_1^{-\xi_1} G_2^{-\xi_2} Y$$

Where Y is income, and ξ_i the share income devoted to sector i . With two sectors we assume these shares to be a half for each one.

The split of consumers' and producers' expenditure on industrial good between individual varieties can be found by using Roy's identity on the indirect utility function equation (3) and Shephard lemma on the cost function, equation (1)

The demand faced in domestic market by a firm

$$(4) \quad \begin{aligned} q_1 &= (p_1)^{-\sigma} \left[E_1 G_1^{(\sigma-1)} + \tilde{E}_1 \tilde{G}_1^{(\sigma-1)} \tau^{(1-\sigma)} + \hat{E}_1 \hat{G}_1^{(\sigma-1)} \theta^{(1-\sigma)} \right] \\ q_2 &= (p_2)^{-\sigma} \left[E_2 G_2^{(\sigma-1)} + \tilde{E}_2 \tilde{G}_2^{(\sigma-1)} \tau^{(1-\sigma)} + \hat{E}_2 \hat{G}_2^{(\sigma-1)} \theta^{(1-\sigma)} \right] \end{aligned}$$

Where E_i is total expenditure on sector i in domestic country

$$(5) \quad \begin{aligned} E_1 &= \left(\frac{1}{2}\right)(wL + rK) + \delta\gamma n_1 p_1 q_1 + \delta(1-\gamma) n_2 p_2 q_2 \\ E_2 &= \left(\frac{1}{2}\right)(wL + rK) + \delta(1-\gamma) n_1 p_1 q_1 + \delta\gamma n_2 p_2 q_2 \end{aligned}$$

The first term in equation (5) is the value of consumer expenditure, since consumers spend a half of their income on each sector where consumer income is the sum of wages, and capital rental. The final term is intermediate demand, generated as firms from sector 1 spend a fraction $\delta\gamma$ of their cost on their own sector and a fraction $\delta(1-\gamma)$ on the other sector. we have to come on the zero profit condition, and since this condition holds the share of total cost that a sector allocates to another sector corresponds to the same share of value of total output of the sector.

The form of cost function being given, the profit of a representative firm of each sector located in the domestic country is

$$(6) \quad \begin{aligned} \pi_1 &= p_1 q_1 - \left[(F + cq_1) (\omega^\alpha r^{(1-\alpha)})^{(1-\delta)} (G_1^\gamma G_2^{(1-\gamma)})^\delta \right] \\ \pi_2 &= p_2 q_2 - \left[(F + cq_2) (\omega^{(1-\alpha)} r^\alpha)^{(1-\delta)} (G_1^{(1-\gamma)} G_2^\gamma)^\delta \right] \end{aligned}$$

Each firm is supposed to set its price taking the price index as granted. Profit maximisation results in, a constant mark-up pricing over marginal cost:

$$(7) \quad \begin{aligned} p_1 &= \left(\frac{\sigma}{\sigma-1} \right) c \left[\left(\omega^\alpha r^{(1-\alpha)} \right)^{(1-\delta)} \left(G_1^\gamma G_2^{(1-\gamma)} \right)^\delta \right] \\ p_2 &= \left(\frac{\sigma}{\sigma-1} \right) c \left[\left(\omega^{(1-\alpha)} r^\alpha \right)^{(1-\delta)} \left(G_1^{(1-\gamma)} G_2^\gamma \right)^\delta \right] \end{aligned}$$

If firms enter and exit in response to positive and negative profit, at equilibrium industrial sectors profits are exhausted in each country. There is a unique level of output that gives firms Zero profit

$$(8) \quad q^* = \frac{(\sigma-1)F}{c}$$

We choose unit of measurement such as $c = \left(\frac{\sigma-1}{\sigma} \right)$ and $F = \frac{1}{\sigma}$, so the zero profit condition implies

$$(9) \quad \begin{aligned} p_1 &= \left(\omega^\alpha r^{(1-\alpha)} \right)^{(1-\delta)} \left(G_1^\gamma G_2^{(1-\gamma)} \right)^\delta \\ p_2 &= \left(\omega^{(1-\alpha)} r^\alpha \right)^{(1-\delta)} \left(G_1^{(1-\gamma)} G_2^\gamma \right)^\delta \end{aligned}$$

and

$$(10) \quad q^* = 1$$

Note that equilibrium output is the same across firms and sector.

We supposed full employment of labour and capital.

Furthermore we have supposed the Domestic country to be endowed with a quantity L of labour and K of capital. Denoting L_1 and L_2 the quantity of labour allocated to sector 1 and 2. From equation (1) a firm spend a proportion $\alpha(1-\delta)$ of its cost on labour, from zero profit conditions this is also a share $\alpha(1-\delta)$ of the total value of output. Using analogous notation for capital, market clearing condition gives:

$$(11) \quad \begin{aligned} L &= \alpha(1-\delta)n_1 p_1 w^{-1} + (1-\alpha)(1-\delta)n_2 p_2 w^{-1} \\ K &= (1-\alpha)(1-\delta)n_1 p_1 r^{-1} + \alpha(1-\delta)n_2 p_2 r^{-1} \end{aligned}$$

Equilibrium of the model.

Equilibrium of the model is given by zero profit condition which implies that an active firm just breaks even when it reaches a quantity $q^*=1$. It sets to this quantity a price given by equation §§. Equilibrium is then given by the simultaneous solution of equation§§§ and their analogous for the other countries.

In order to study the forces at work, we suppose that the trade costs with respect to the Rest of the World are prohibitive. We go back to a two country case which will allow us to emphasise the role of industrial linkages. Then we reintroduce the third country through a trade cost reduction.

The model shows different equilibria, and particularly a diversified one, and two cases of complete specialisation. In the diversified equilibrium each sector is active in each country; two configurations are possible for the specialised equilibria. Following again *Epifani*, a “*normal specialisation*” is characterised by a complete specialisation of Domestic country in the sector capital intensive, while the Foreign country is completely specialised in the labour intensive sector. The opposite of this situation is also possible and it is called a “*perverse agglomeration*”.

In next section we are looking for the relationship between “normal specialisation” and the nature of industrial linkages.

Industrial linkages and complete specialisation.

We have supposed that the domestic country is relatively endowed with capital, furthermore we have supposed $\alpha > 0.5$, that is the sector one is labour intensive. We suppose that this sector one is only active in foreign country, and following *Epifani* we call this situation a “*normal specialisation*”. To determine whether this is equilibrium, we have to check if the sales of a (potential) deviant from sector one relocating in domestic country are less than the level required to break even, i.e. if $q_1 < 1$. Using similar condition we have to check if a firm in sector 2 could be active in foreign country.

With all firm from sector 2 producing in domestic country and all firms from sector 1 producing in foreign country the precedent model could be rewritten:

Price index reduces to

$$(12) \quad \begin{aligned} G_1 &= (\tilde{n}_1)^{\frac{1}{(1-\sigma)}} \tilde{p}_1 \tau = \tilde{G}_1 \tau; & \tilde{G}_1 &= (\tilde{n}_1)^{\frac{1}{(1-\sigma)}} \tilde{p}_1 \\ G_2 &= (n_2)^{\frac{1}{(1-\sigma)}} p_2; & \tilde{G}_2 &= (n_2)^{\frac{1}{(1-\sigma)}} p_2 \tau = G_2 \tau \end{aligned}$$

Demand for the output of each firm from sector 1 and 2 respectively in foreign and domestic country are respectively

$$(13) \quad \tilde{q}_1 = \frac{E_1 + \tilde{E}_1}{\tilde{n}_1 \tilde{p}_1} = 1; \quad q_2 = \frac{E_2 + \tilde{E}_2}{n_2 p_2} = 1$$

Where

$$(14) \quad \begin{aligned} E_1 &= \left(\frac{1}{2}\right)(wL + rK) + \delta(1 - \gamma)n_2 p_2 \\ E_2 &= \left(\frac{1}{2}\right)(wL + rK) + \delta\gamma n_2 p_2 \\ \tilde{E}_1 &= \left(\frac{1}{2}\right)(\tilde{w}\tilde{L} + \tilde{r}\tilde{K}) + \delta\gamma\tilde{n}_1\tilde{p}_1 \\ \tilde{E}_2 &= \left(\frac{1}{2}\right)(\tilde{w}\tilde{L} + \tilde{r}\tilde{K}) + \delta(1 - \gamma)\tilde{n}_1\tilde{p}_1 \end{aligned}$$

The factor rewards in each country are

$$(15) \quad \begin{aligned} w &= \frac{(1 - \delta)(1 - \alpha)n_2 p_2}{L}; & r &= \frac{(1 - \delta)\alpha n_2 p_2}{K} \\ \tilde{w} &= \frac{(1 - \delta)\alpha\tilde{n}_1\tilde{p}_1}{\tilde{L}}; & \tilde{r} &= \frac{(1 - \delta)(1 - \alpha)\tilde{n}_1\tilde{p}_1}{\tilde{K}} \end{aligned}$$

Solving the system of equation(13)-(15) gives the following solution

$$(16) \quad \begin{aligned} w &= \frac{\tilde{K}}{L} & \tilde{w} &= \frac{\alpha}{(1 - \alpha)} \frac{\tilde{K}}{\tilde{L}} \\ r &= \frac{\alpha}{(1 - \alpha)} \frac{\tilde{K}}{K} & \tilde{r} &= 1 \end{aligned}$$

$$(17) \quad \begin{aligned} E_1 = \tilde{E}_2 &= \frac{\tilde{K}(1 + \delta - 2\gamma\delta)}{2(\alpha - 1)(\delta - 1)} \\ E_2 = \tilde{E}_1 &= \frac{\tilde{K}(1 - \delta + 2\gamma\delta)}{2(\alpha - 1)(\delta - 1)} \end{aligned}$$

Factor rewards and demand for each sector in each country only depend on technological parameters of the model. We will return after on the influence of these parameters and particularly on the nature of the linkages via the level of γ . Before, the next two equations giving the output of a deviant firm from sector 1 and 2 in Domestic and Foreign summarize the condition under which the situation of complete specialisation is an equilibrium.

$$(18) \quad q_1 = \left(\frac{p_1}{\widetilde{p}_1} \right)^{-\sigma} \left[\frac{E_1}{E_1 + \widetilde{E}_1} \tau^{\sigma-1} + \frac{\widetilde{E}_1}{E_1 + \widetilde{E}_1} \tau^{1-\sigma} \right]$$

$$(19) \quad \widetilde{q}_2 = \left(\frac{\widetilde{p}_2}{p_2} \right)^{-\sigma} \left[\frac{\widetilde{E}_2}{E_2 + \widetilde{E}_2} \tau^{\sigma-1} + \frac{E_2}{E_2 + \widetilde{E}_2} \tau^{1-\sigma} \right]$$

The term in square brackets of equations (18) represents the backward linkages. The term $\tau^{1-\sigma}$ captures the trade cost disadvantage that a (potential) firm locating in foreign country will have in catching domestic demand. Conversely the term $\tau^{\sigma-1}$ gives the advantage that the deviant matches to serve the demand from the foreign country.

For a given value of transport cost, one can see that the sales of a potential deviant are greater the greater the share of world expenditure for this industry that is localised in home country. Using equation (17) we can give an expression for this relative demand, being a function of the technological parameters of the model.

$$(20) \quad \frac{E_1}{E_1 + \widetilde{E}_1} = \frac{\widetilde{E}_2}{E_2 + \widetilde{E}_2} = \frac{1}{2}(1 + \delta - 2\gamma\delta)$$

$$(21) \quad \frac{\widetilde{E}_1}{E_1 + \widetilde{E}_1} = \frac{E_2}{E_2 + \widetilde{E}_2} = \frac{1}{2}(1 - \delta + 2\gamma\delta)$$

Equation (20) provides an expression of demand faced by a deviant firm in the host country. This is, *ceteris paribus*, all the weaker that the value of γ is large. This can be easily understood as a large value of γ corresponds to strong intra-industrial linkages. In this case a deviant firm would depart from the suppliers belonging to the same sector. This effect is all the more important that a large share of cost consists in the purchase of industrial products.

Finally one can rewrite the equation (18) and (19) using (16), (20) and (21). By the way, we can rewrite the quantity produced by deviant firms as a function of endowments parameters and technology parameters of the model. The term in the first brackets expresses the influence of a discrepancy in endowment on the stability of complete specialisation. We do not develop this point as the results are the same as the ones obtained by Epifani.

$$(22)$$

$$q_1 = \left[\left(\frac{\alpha}{1-\alpha} \right)^{(1-2\alpha)} \left(\frac{\tilde{K}}{K} \right) \left(\frac{\tilde{K}/\tilde{L}}{K/L} \right)^{-\alpha} \right]^{-\sigma(1-\delta)} \tau^{-\sigma(2\gamma-1)\delta} \left[\frac{1}{2}(1+\delta(1-2\gamma))\tau^{\sigma-1} + \frac{1}{2}(1-\delta(1-2\gamma))\tau^{1-\sigma} \right] < 1$$

$$\tilde{q}_2 = \left[\left(\frac{\alpha}{1-\alpha} \right)^{(1-2\alpha)} \left(\frac{\tilde{L}}{L} \right) \left(\frac{\tilde{K}/\tilde{L}}{K/L} \right)^{-\alpha} \right]^{-\sigma(1-\delta)} \tau^{-\sigma(2\gamma-1)\delta} \left[\frac{1}{2}(1+\delta(1-2\gamma))\tau^{\sigma-1} + \frac{1}{2}(1-\delta(1-2\gamma))\tau^{1-\sigma} \right] < 1$$

we now turn to New Geographical parameters, and more specifically to the impact of a reduction of trade cost on the sustainability of a complete specialisation. For simplicity we rewrite equation(22) bringing together all the variables relative to factor endowment. All the terms in first brackets are grouped. No matter the sector, there is a unique equation:

$$(23) \quad q = \Lambda^{-\sigma(1-\delta)} \frac{1}{2} \left[(1+\delta(1-2\gamma))\tau^{\sigma-1-\sigma(2\gamma-1)\delta} + (1-\delta(1-2\gamma))\tau^{1-\sigma-\sigma(2\gamma-1)\delta} \right]$$

As usually, to understand the impact of trade cost we begin with a situation of free trade that is $\tau=1$, and we look what happens from this point when trade cost increases. For free trade the quantity produced by a deviant firm reduces to

$$(24) \quad q = \Lambda^{-\sigma(1-\delta)}$$

once again we follow Epifani who ensures this is greater than one if the endowment parameters are in the “*cone of diversification*”. In such a configuration a complete specialisation is never stable.

We have seen that for $\tau = 1$, complete specialisation is not a stable equilibrium, from this point we suppose a small transport cost increase. We obtain by totally differentiating equation (23) and evaluating the derivative at $\tau=1$.

$$(25) \quad \frac{\partial q}{\partial \tau} = \frac{1}{2} \Lambda^{-\sigma(1-\delta)} \left[\delta(-1+\gamma(2-4\sigma)) + 2\sigma \right]$$

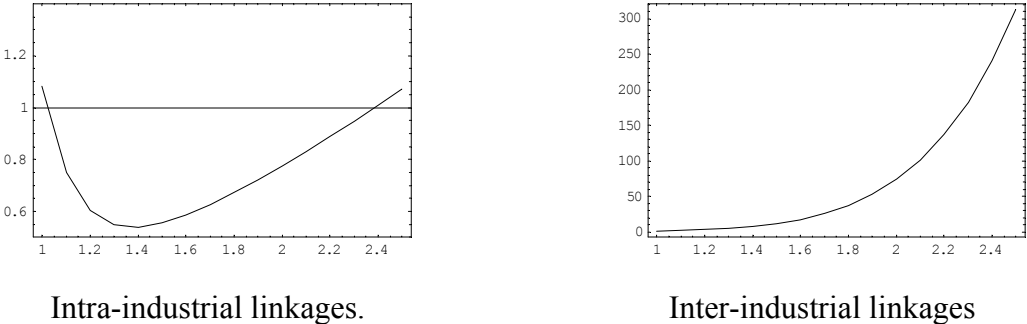
The sign of derivative is given by the sign of expression $\left[\delta(-1+\gamma(2-4\sigma)) + 2\sigma \right]$. With inter-industry linkages that is $\gamma=0$, this expression reduces to $-\delta+2\sigma$ that for $\delta \in [0,1]$ and $\sigma > 1$ is positive. This means that from a point of departure

where a quantity produced by a deviant firm is greater than unity, this quantity increases when trade costs increase.

Supposing now that transport costs are arbitrarily high. The first term of expression (23) becomes arbitrarily high. There are two issues for the second one. The respect of the “no black hole condition” *Fujita, Krugman and Venables [1999]* ensures that this term is also very high. So from a point where the quantity produced by a deviant firm is given by comparative advantages consideration, an increase in trade cost will reinforce the incentive to deviate.

Only interested in intra-industry linkages, Epifani obtains a U-shaped relation between integration process and the quantity produced by a deviant firm. We saw that this reversal disappears when allowing inter-industry linkages to be stronger than the intra-industry. We plot on the figure the two cases

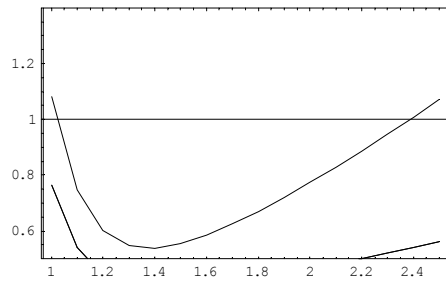
Figure 1 Complete specialisation



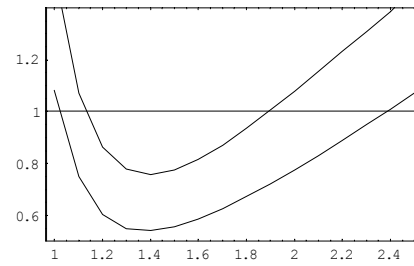
Before that, we go back to our concern of the entry of a third country in such a framework. We want to analyse how the threshold value of τ at a sustain point of the economy varies with θ . We do that as well in our situation of inter industrial linkages as well in those where intra linkages prevail, that is in *Epifani’s* case.

Unfortunately, the three-country framework introduces analytical difficulties, and we are not able to give analytical proof. We will instead use numerical simulations to investigate how the sustain point varies with the reduction of the external value of trade cost. We have seen that according to the trade cost level a country has a complete specialisation and before a certain threshold it can maintain it, in the case of intra-industrial linkages. What happens when trade cost are reduced with a third country? To illustrate the different possibilities we drawn in figure 2 the same graph than figure one but for different value of θ . Remember that for figure one, we have supposed $\theta = \infty$.

Figure 2...



q_1



\tilde{q}_2

The curved from the bottom to the top are plot for value of $\theta = 10, 5, 2$, for q_1 . Reversed for \tilde{q}_2 . One can see that integrating a labour intensive country in the trade area act agains complete specialisation

Conversely this enlargement act for

To be completed with other configuration of trade cost.

Common to each scenario, we suppose that the countries in trade area are completely specialised according to their comparative advantages. That is, in domestic country the only active sector is the one which uses intensively capital. Conversely in Foreign only goods from labour intensive sector are produced. On the other hand we have supposed trade costs between the RoW and the two others countries are prohibitive, so it seems natural to suppose the two sectors active in RoW.

Specialisation.

In this section our interest is twofold; first we are concerned in the effect of industrial linkages on the economic specialisation. Secondly how the entry of a third country change the specialisation patterns.

We treat these questions in two steps. First going back to our assumption of infinite trade cost with respect of the RoW we compare the pattern of specialisation in the case of inter and intra industrial linkages. Second we reintroduce the third country to check the impact of enlargement on the degree of specialisation of countries.

To determine the influence of industrial linkages on specialisation pattern we use the same measure of specialisation as Epifani. We plot $S_2 = \frac{n_2 p_2}{n_1 p_1 + n_2 p_2}$; the share of capital intensive sector in the domestic country.

One can see that taking into account inter-industrial linkages change the relation between the integration process and nation's specialisation. Clearly in this case the relation between the two processes is monotonous. Furthermore the degree of specialisation of nation with respect to there comparative advantage is always weaker. This last point seems confirm accounting for inter-industry linkages is not as a simple abstraction of specialisation forces.

To illustrate the differences of specialisation pattern according to the nature of linkages we compare our result with Epifani's ones

Figure 1-a report the evolution of S_2 when abstracting industrial linkages. That is for $\delta=0$. Relationship between integration and specialisation is monotonous and only induced by comparative advantage forces.

For the same value of parameters figure 1-b report \tilde{r}/\tilde{W} and r/W (respectively the higher and the lower curve for $\tau=2.5$).

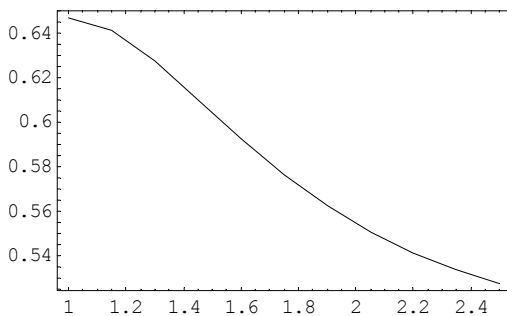


Figure 1-a

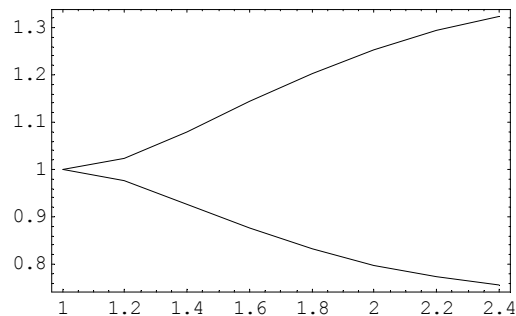


Figure 1-b

Figures 2-a, 2-b² are the analogous of precedents figures, reporting Epifani's results. One can see that for intermediate trade cost the specialisation of Domestic country exceed the level achieved in free trade $(\tau=1)$. This mean that for intermediate level of trade cost the economic geographical forces strengthen the traditional forces.

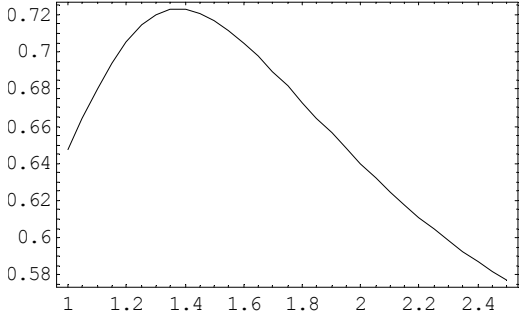


Figure 2-a.

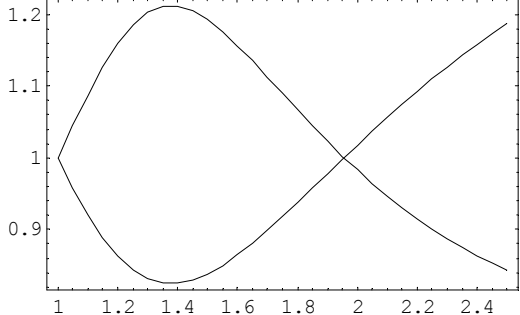


Figure 2-b

Finally Figures 3-a et 3-b are drawn for inter-industrial linkages. One can see that in this case first the non-monotonic relationship between the integration process and the degree of specialisation disappears. Furthermore comparing the result, with this obtained in precedent cases show lower level of specialisation.

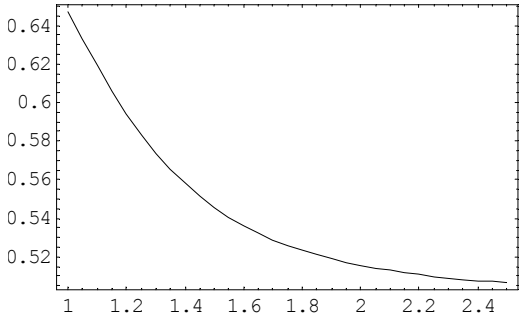


figure 3-a

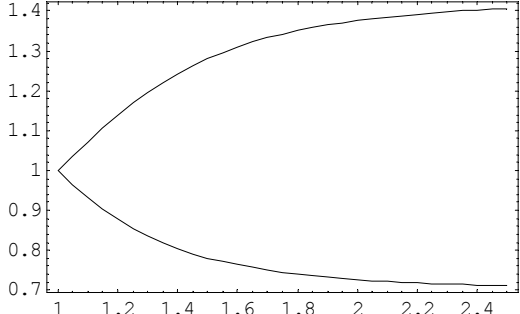
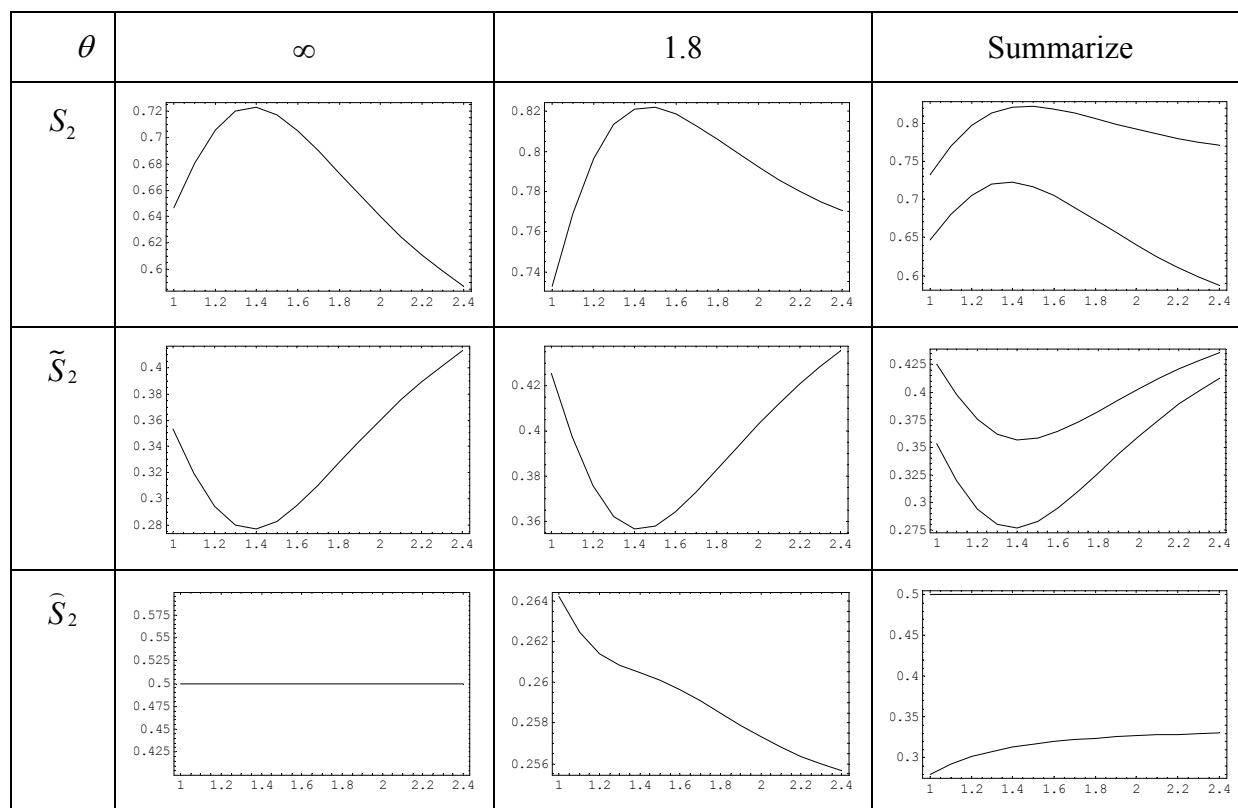


figure 3-b

The result of a lower level of specialisation in absence of intra-industrial linkages is not surprising, since in KV96 the process of specialisation takes place through these linkages. FKV underline the necessity of having intra linkages stronger than inter linkages in order to obtain clustering. But in the context of differences in endowment we think it is useful to see the possible opposition between the new and the traditional forces. Second it seems possible by this way to extend the model taking into account a traditional sector to explain; on one

² Now the report \tilde{r}/\tilde{w} and r/w (respectively the lower and higher curve for $\tau=2.5$).

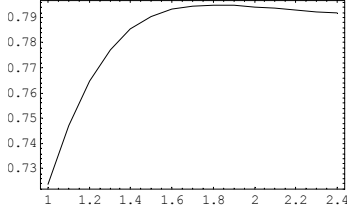
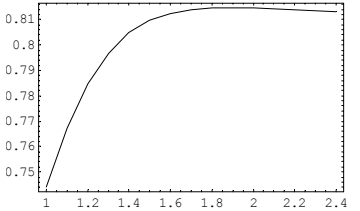
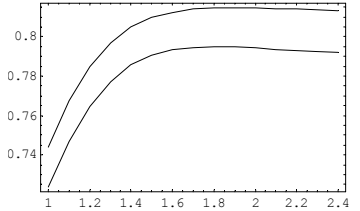
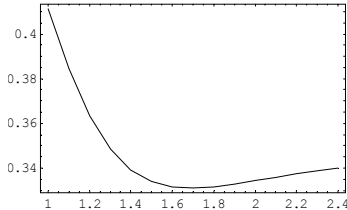
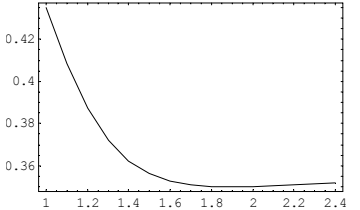
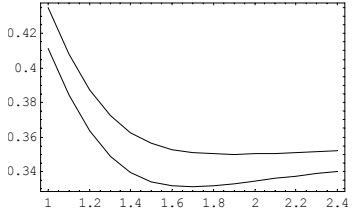
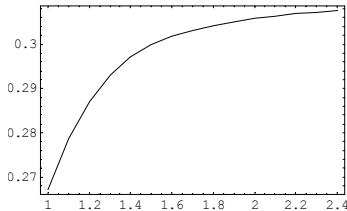
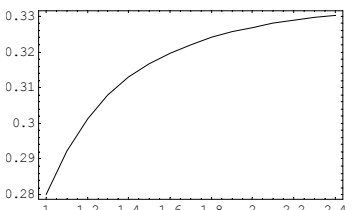
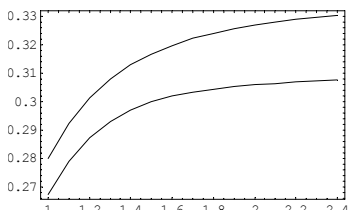
hand the opposition between specialisation in “agriculture” versus in manufacture. On the other hand to distinguish between agglomeration and specialisation.

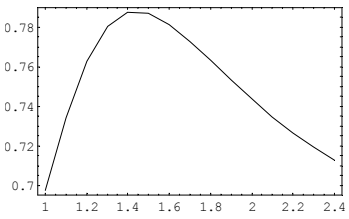
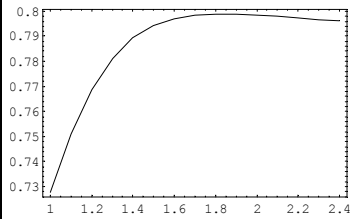
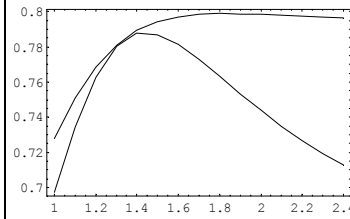
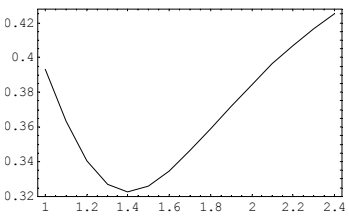
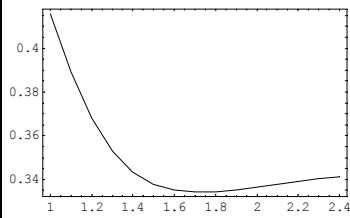
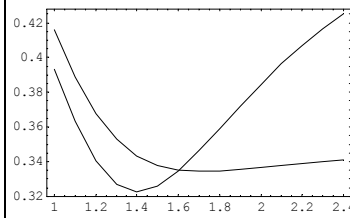
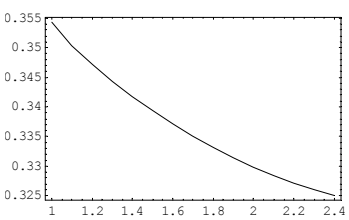
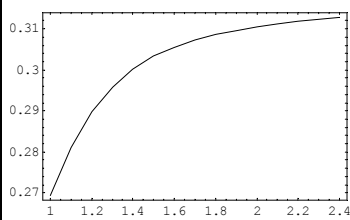
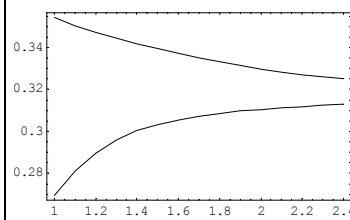


We now have to go back to our concern of specialisation in the case of three countries;

This part have **to be completed**; we only provide a set of figures plot for different values of parameters.

The set of figure plot the level of country specialisation against the level of trade cost between the domestic country for two value of trade cost with respect to RoW.

θ		1.8	summarize
S_2			
\tilde{S}_2			
\hat{S}_2			

	$\theta_{FS} = \theta_{DS} + 0.2$ $\theta_{DS} = 2.2$	$\theta_{FS} = \theta_{DS} + 0.2$ $\theta_{DS} = 2.2$	summarize
S2			
Sf2			
Ss2			

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