The imperfect mobility of labour: Going from theory to 'virtual' reality. Simulations with simple trade models.

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1- Introduction

A recent paper presented by Stiglitz (1999) on the prospects of the world-wide trade negotiations, urges to reflect on the necessity of re-designing the strategies to follow in the multilateral rounds, as the only way to make possible to reap further gains from the process of liberalisation in the far and near future. This controversial speech stresses that a more balanced agenda is needed, based on the recognition of the differences - a growing gap - between the developed and developing countries which explain the diverse of interests and concerns of the trading partners at the negotiation table (differences that range from comparative advantages, to government regulations, to good and factor market rigidities, to access to capital, to vulnerability and volatility of the economies, etc.).

The standard trade policy analysis following the Heckscher-Ohlin tradition states the well-known benefits from liberalisation. However, a closer look to the facts suggests that the welfare effects ultimately depends on the flexibility with which the economy is capable to respond to a changing environment. On this point, it is worthwhile to recall here from Stiglitz's speech the statements on the validity of the standard results when, as it is too often the case in the developing world, the assumption of perfect mobility in factor markets fails. As he states, *"...(S)tandard economic analysis argues that trade liberalization - even unilateral opening of markets - benefits a country. In this view, job loss in one sector will be offset by job creation in another, and the new jobs will be higher-productivity than the old. It is this movement from low- to high-productivity jobs that represents the gain from the national perspective, and explains why, in principle, everyone can be made better off as a result of liberalization. This economic logic requires markets to be working well, however, and in many countries, underdevelopment is an inherent reflection of poorly functioning markets. Thus new jobs are not created, or not automatically. Moving workers from a low-productivity sector to unemployment does not - let me repeat, does not - increase output."*

The point is not new but brings to the front again the concerns on the cost of the adjustment, mainly for the developing world, on the verge of the upcoming trade negotiations. The same motivation has re-opened the discussion on gainers and losers from freer trade, where the difference between developed and developing countries seems to be also relevant for being the latter more likely to lack of social security networks and other compensation policies to safely guard the fate of the losers in the adjustment process.

From a narrower perspective, the above mentioned considerations are also valid with a view to analyse the ongoing process of regional integration agreements. In fact, they seem to justify a bit of concern on some long term trade policy predictions in integrating schemes in developing countries, which may not be accurate, or even correct, when the cost of the adjustment process is ignored, giving rise sometimes to an exaggerated optimism. In particular, it is worthwhile mentioning that in the case of MERCOSUR it has been a common feature in the applied work to point out one of the smallest members, Uruguay, as the biggest winner (Behar (1995), Flores (1997), etc.), where the major reallocations in this country would play an important role in the explanation of the great welfare gains. This common place in the applied literature on MERCOSUR has been a "red light" that necessarily has drawn the attention to the adjustment costs issue at the moment of thinking in a proper assessment of the impact of these agreements.

In general, the costs associated to the adjustment - caused by changes in trade policy or by shocks in terms of trade or any other external shock - have been the focus of an extensive, theoretical and applied, literature. These adjustment costs are economic losses incurred when a factor that is imperfectly mobile is reallocated, implying a loss in output and thus affecting welfare adversely.

More specifically, and paying a special attention to the methodological aspects, Clarete, Trela and Whalley (1994) have claimed that the assessment of trade policy impacts requires a general equilibrium framework in which intersectoral reallocations and adjustment costs are endogenously determined; also, that the estimates ignoring the adjustment costs tend to overstate the amount of factor reallocated.

Taking into account all the above mentioned considerations as the motivation, this work is a very first step in analysing the static effects of trade policy in absence of perfect mobility in factor markets. Thus this work will develop a discussion on the presence of imperfect mobility of factors in the economy- focusing on the labour market; later some of the features found in the literature will be introduced in a simple Computable General Equilibrium (CGE) trade model, and some simulation for selected scenarios are performed.

The work is organised as follows. Section 2 analyses theoretical aspects concerning to the presence of imperfect mobility of labour. Section 3 develops a CGE static model of trade close to the standard tradition but introducing imperfect mobility in the labour market, along some of the lines the suggested by the literature in particular related with unemployment. The Section 4 contains the results from the simulations. The final section includes some concluding remarks.

2- Imperfect mobility of labour

This section aims to set the theoretical framework for this topic, and to summarise the main lines of explanations given in the literature for the phenomenon. The farther purpose will be to select some features of imperfect mobility of labour to be introduce into a simple trade model close to the standard tradition to be able to analyse how the expected results from the traditional theory are modified by the presence of the mobility costs of labour.

2.1 Theoretical background

The well known predictions from the standard trade models in the Heckscher-Ohlin (henceforth HO) tradition state that, for instance, a reduction in the level of protection in the economy will induce to a reallocation of factors, to be deployed in its best alternative use, with the expansion of the sectors with comparative advantage - while the others decline. This implies a rise in the productivity of the use of factors, thus in output and overall welfare. Though there are winners and losers in the new situation (workers *versus* capitalists), as the Stolper-Samuelson theorem tells us, the overall welfare gains ensure at least the chance to compensate losers yielding to a Pareto superior situation.

Notwithstanding that the standard trade policy welfare analysis assumes the perfect mobility of factors, in fact the welfare effects depend on the flexibility with which the economy is capable of responding to a changing environment. For instance, some factors may not be able to reallocate in the short run, while some others are likely to be able to move in the short run but at a positive cost; these cases, that are discussed below, show a restricted reallocation, a reduced output response and lower welfare gains than expected in the standard paradigm.

In the short run, some factors are likely to be fixed which is the distinctive feature of Jones's (1971) model of specific factors (henceforth SF): the mobile factor (labour) can be allocated in any sector straight away while the specific factors cannot be reallocated in the short run. The short-term fixity of some factors leads to an interior production possibilities frontier - except at the initial equilibrium; thus, there is a restricted reallocation and lower welfare gains in comparison with the

HO paradigm. There are also differences in the distributional implications, where the owners of the mobile factor (workers) and the specific factor (capitalists) can become allies in some circumstances; distributional implications are discussed in detail in Mussa (1974) and Mayer (1974).

The other case mentioned before is that sometimes the imperfect mobility is caused by the fact that the factor can move in the short run but only at a positive cost - giving rise to the so-called quasi-fixed factors. The costs associated to the adjustment process have been the focus of an extensive literature both theoretical and applied. In general, these adjustment costs are understood as losses incurred when a factor that is imperfectly mobile is reallocated, thus implying a loss in output and affecting welfare negatively. This work will focus henceforth in imperfect mobility in the labour market exclusively.

The imperfect mobility or the friction to the movement of labour across sectors can be caused for example by differences in workers' qualification, that require some retraining, or by a time of searching and/or unemployment before finding a new job. The practical importance of the point has been stressed by Clarete, Trela and Whalley (1994) showing that the estimates when the adjustment costs are ignored tend to overstate the amount of labour reallocated; a central message from their work is that the larger the mobility costs the more likely a shock will produce distributional effects rather than factor reallocation.

The next section will summarise the main explanations found in the literature on the imperfect mobility in the labour market mainly oriented to trade models. Notwithstanding, there are many occasions in which the imperfect mobility is assumed without paying special attention to the underlying economic structure, as for instance in Hill and Mendez (1983). This very flexible model - suitable for any possible configuration of mobility of both factors - shows that the difference in mobility between factors is the determinant of the price effect on their returns. Two important conclusions are drawn here: firstly, that the Stolper-Samuelson result remain to hold provided the two factors are equally mobile; secondly, that the magnification effect obtained by Jones (1971) is analogously replicated for the factor more mobile - playing the role of *the* mobile factor in the SF model; the latter result assumes equal input ratios across sectors.

2.2 A brief survey

The labour mobility costs have been explained in several ways, being the aim of this section to focus on the trade oriented literature. Along the main lines, that will be briefly summarised below, are the following: a) a first one assumes some degree of factor specificity that impedes easy mobility (Grossman and Shapiro (1982), Mussa (1982), Leamer (1980), etc.); b) a second possibility considers that the transfer across sectors causes a waste of resources for example in the form of transitory unemployment (as for instance in Neary (1982) and Leamer (1980)); c) an alternative explanation considers that the movement of labour is a resource consuming activity, for example training and firing costs (Clarete et al (1994), Oi (1962), Hamermesh (1989, 1993, 1994), etc.). Such costs additionally caused by the presence of market distortions as minimum wages, or other non-clearing market explanation as the incentive wage settings are left aside at this stage.

a) The imperfect mobility of labour can be explained by the presence of some degree of specificity, e.g. labour qualification, that impedes an easy mobility across sectors. There is a friction to the movement that causes an economic loss in the process of reallocation, measured in terms of productivity or efficiency units, as can be found in the following literature:

i- In Mussa's (1982) model the labour units are imperfect substitutes across sectors. The imperfect mobility of labour is caused by the fact that the jobs require different qualifications, and hence the workers posses a sort of specificity - for example some skills specially suitable for one activity. Thus a worker will have a different productivity according to its allocation, or to say it differently, the amount of labour owned by a worker (his/her supply of working hours) is measured in different units in each sector, say in efficiency units. Consequently, this affects the degree of mobility in the sense that a movement across sectors would imply some loss for the worker, in productivity (wages) or efficiency units. In this model the imperfectly substitutable units of labour are modelled by means of an input transformation curve; the degree of mobility is measured by the elasticity of substitution of the transformation function. In an extreme case, for an infinite elasticity of substitution (homogeneous workers, perfect substitutability) this model replicates the SF model. Note that the reallocation of labour in this case implies a loss of productivity in the use of the resources or a loss in efficiency units of the economy's endowment, that affects adversely welfare.

ii- In Leamer's (1980) work the so-called *productivity-augmentation models* the imperfect mobility of labour is also explained by a sort of factor specificity, in this case the industry specific human capital accumulated through on-the job training. When the worker leaves the job there is a loss of these industry specific human capital, and the costs the costs of moving across sectors are understood as the economic loss in productivity (and wages) when starting in a new activity) and that will imply that the worker will have to start to built again his/her industry specific human capital in the new job. Consequently, the experience accumulated makes the workers, insiders and outsiders, differentiated across sectors, where the new entrants to an industry must face a period of reduced productivity.

iii- Feenstra and Lewis' (1994) work deals with a more general model, in terms of the number of factors and sectors involved. It is assumed that all productive factors as imperfectly mobile, modelling also the mobility costs by means of an input transformation function. The transformation curve is convex (upwards) and constrained by the individual endowment of each factor, where inputs are measured in efficiency units and the efficiency units of each factor differ across sectors (and so returns).

iv- In Grossman and Shapiro's (1982) approach the workers' decisions on training are analysed as investment decisions, in the sense that they can be considered to be an investment in mobility that is specially important in an environment of uncertainty. In this model training decisions are modelled by means of a training possibilities frontier. The acquisition of general skills allows the worker to select the better job once uncertainty is resolved - nonetheless, these topics are beyond the scope of this work.

b) A second possible line of explanation considers that the transfer across sectors can cause some waste of resources, for example a period of transitory unemployment before getting a new job. One case could stream from wages downward rigid or wage stickiness, or by the searching time required to find a new job, as in Neary (1982) and in Leamer(1980) respectively, which is described below:

i- Neary's (1982) model with capital specificity and wage stickiness in the labour market, makes the case to introduce the concept of *immiserising reallocation*, when the costs for the economy induced by the reallocation of factors outweigh the efficiency gains reaped. The results obtained reveal that the time paths of factor prices, allocation and output are not monotonic, showing that national income can fall temporarily during the adjustment process, in contrast to the situation when the full employment mechanism works. As a welfare measure of the adjustment costs, the present value of the stream of all shortfalls of output below the long run level is proposed.

ii- In Leamer's (1980) *lost-labour-time models* the mobility costs are modelled as temporary unemployment during the transfer. In this model a period of unemployment occurs when the workers decide to change job, for example searching time. In this case, skills required across sectors are identical but the worker faces a friction to the movement, in the form of a period of transitory unemployment before finding a new job. This friction - the period of unemployment - is taking into account at the moment of making the decision whether to change job, which explains the differences in wage rates across sectors. The unemployment is voluntary: it occurs when the workers evaluate the movement as convenient, and then decide to change from one sector to another. The economic impact of the mobility costs is suggested to be measured by the reduction effect in the supply side.

c) An alternative explanation, related in a way with these previous ones, considers that the reallocation is a resource consuming activity in the sense that some factors must be devoted to the activity of the movement itself, for example installations costs for capital (among trade oriented models, for instance Mussa (1978, 1982b, 1986)). In the case of labour these additional costs come from the fact that it is usually costly for the firms to modify the payroll, for instance due to the training and firing costs, as can be seen for instance in Hamermesh (1989, 1993, 1994)) and Oi (1962) as it is summarised below:

i- Hamermesh (1989, 1993, 1994)) stresses the distinction between net and gross adjustment costs: the *net adjustment costs* are related to changes in the level of the labour force employed in the firm. They are caused for example by disruptions in the production or by the realignment of tasks required to the new size of the payroll (in analogous ways both for expanding and retracting firms). As workers are identical in skills, and there is no distinction between workers inside and outside the firm (i.e. a same amount of workers could be hired and dismissed at one time without bearing any (net) adjustment cost), the wage rate is equalised across sectors; the *gross adjustment costs* are related to the amount of newcomers and sacked workers, in terms of the hiring and firing costs involved. As it is clear the informational requirements are far more demanding than in the previous case, because now a detailed information on the number and/or identity of the workers hired and sacked in the period is needed to determinate the gross adjustment costs for the firm. There is a definitive distinction between workers in and out the firm, because the insiders have already incorporated some economic value - in terms of the trained received - as well as they have acquired compensation rights for being sacked, hence an insider is not interchangeable for an outsider without cost which justifies that wages fail to equalise across sectors.

ii- Oi's (1962) analysis is more concern in explaining the effect of the additional costs required to expand firms' employment - as hiring and training activities - on the degree of fixity of labour. The presence of these additional costs distorts the firm's response to changes in the market conditions; for instance in the case of an upswing in demand the firm will hire less workers because the firm's total cost of expanding labour employment (in the margin) rises above the wage rate paid to the worker. The extra amount required when a worker is hired drives a wedge between the wage rate and the value of the marginal productivity, which explains the restricted mobility of the factor. In fact, the higher the wedge the lower the expansion in the firm's employment, explaining the variation of degrees of fixity across factors - i.e. higher training costs for one type of labour make it less mobile (more 'fixed') than another type of labour that requires lower training costs or no training at all. In this approach, the firm's labour employment decisions are as investment decisions - in particular, training expenses can be seen as investment in human capital. The extra payments made for the hired workers in previous periods can be seen as sunk costs, which generate the phenomenon known in the literature as the hysteresis effect (that is, an incentive to expand output

followed, after the induced reallocation, by an identical incentive in the opposite direction does not leave the economy in the same starting position [1]).

3- Modelling

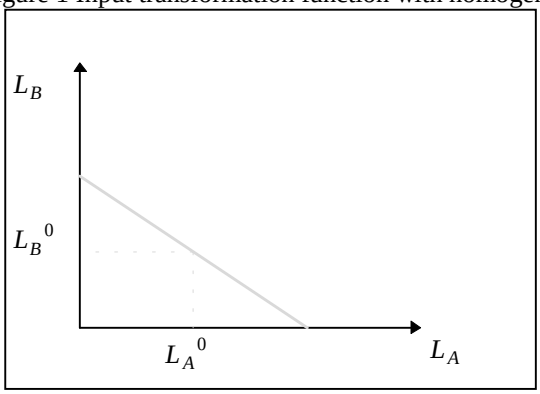
This section develops a trade model following the standard tradition - perfect competition, constant returns to scale and homogeneous products - but where adjustment costs for labour are incorporated. In spite of this, the models remain as close as possible to the HO paradigm with the purpose of analysing how the expected results from the traditional theory are modified by the presence of mobility costs.

To this purpose, some features from the literature on modelling imperfect mobility of labour will be introduced into a simple static computable general equilibrium framework close to the standard trade models, which will enable to make computable applications for selected scenarios. Firstly, the general settings typical in the general equilibrium trade model will b2cat2 29.2(od.lk)13(C.9(2s)-p6.96s)-p3.00

workers will continue up to the point where wages are equalised across sectors - when there is no longer incentive to move.

A way to represent the allocation of labour is using the L_A, L_B plane - *the input transformation function* - as it is shown in the Figure 1. This locus shows all the possible allocations of labour with full employment, and as the units of labour are homogeneous the elasticity of substitution across sectors is infinite - its shape is a straight line. In the figure the point L_A^0, L_B^0 represents the initial equilibrium.

Figure 1 Input transformation function with homogeneous units of labour and full employment



However, the imperfectly mobility of labour is the distinctive feature of the trade models to be analysed in this work. In what follows the units of labour are homogeneous but when reallocation is taking place there is a friction to the movement that generates a period of temporary unemployment, thus distorting the input transformation function shown in the Figure 1.

3.1 Model set up

The model introduces a feature from Leamer's (1980) lost-labour-time models, considering that the adjustment implies a loss of units of labour during the transfer across sectors. This loss is proportional to the total amount to be transferred and only a fraction of the labour that leaves one sector is finally incorporated into the new allocation. It is important to note that in this case, labour units are homogeneous and the skills required in both sectors are identical, nevertheless there is a friction to the movement that generates a period of transitory unemployment. The unemployment in this model is voluntary: it occurs when the workers evaluate positively the convenience of the movement, and then decide to change from one sector to another.

To express this in a more formal way, only a fraction λ of the labour units leaving one sector is effectively incorporated into the activity of destination, while the remaining $(1 - \lambda)$ is lost in transit - for example in searching time. Note that $0 \leq \lambda \leq 1$, the lower is the value of λ the higher the adjustment cost; for the extreme cases, when $\lambda = 1$ there is no loss at all, returning to the SF model (capital specific), when $\lambda = 0$ the cost is prohibitively high and no reallocation at all takes place.

Returning now to Figure 1, the straight line - showing perfect substitutability of labour units with full employment - is not longer valid when there is unemployment during the adjustment. The new shape for the locus of feasible allocations of labour after the transfer is a line kinked at the initial allocation. Consequently, the production possibilities frontier of the economy shrinks to a strictly

interior position - except at the initial equilibrium point - when considering the prospective of a costly reallocation. Then, as in the SF model, the price-output responsiveness is reduced.

Note that, as the worker bears in mind at the moment of taking the decision of moving the prospective of a period of temporary unemployment before finding a new job, the market mechanism will lead to an equilibrium where wage rates fail to equalise across sectors. For example, those people working in a declining sector have to decide whether to move, taking into consideration that if they remain in the current job they will receive a lower wage (than that they would otherwise in the expanding sector) without any loss of (paid) working hours, but if they move they will have to face a period of transitory unemployment before getting the new better job.

As mentioned before, under perfect competition the firms will hire up workers up to the point where the value of the marginal productivity and wages are equalised. In presence of imperfect mobility the full employment of labour is not ensured and the market mechanism does not lead to wages equalised across sectors (as in the expression (2)), instead, there is a gap in the wage rates in the new equilibrium. In this case then, during the adjustment the workers' decisions to move, for example from sector B to A, will be based on expression (3) or the equivalent (3'):

$$w_B \leq \lambda \; w_A \qquad 0 \leq \lambda \leq 1 \qquad (3)$$

$$P_B MP_{LB} \leq \lambda \, P_A MP_{LA} \qquad (3')$$

Only if the inequality contained in the expression (3) (or 3') strictly holds the workers will decide to move from the sector B (low salaries) to A (high salaries). This expression shows that the worker will be willing to change sectors even though the perspective of temporary unemployment if the remaining return received in the sector of higher salaries - deducting the wages lost during the unemployment period- is higher that the wage that they would receive if he/she remains in the original position. For simplification, it is assumed that at the moment of taking decisions, the workers behave identically, and in an orderly way - everyone knows the updated information about the marginal values of the relevant variables.

In the expression (3) (or 3') when the equality holds the worker is indifferent between to move or not, thus the wage gap across sectors rests upon this expression as an equality. Note that, in this case, even though the required skills are identical for any activity the workers receive different wages across sectors, but anyway the labour market is in equilibrium in the sense that workers do not have incentives to move due to the mobility costs; hence the expression (3) as an equality will be taken as an equilibrium condition.

Finally, note that for a set of configurations of λ and prices the expression (3) (or 3') does not hold, and thus the worker will be unwilling to move and will remain in his/her current position. In this case the workers will not have incentives to move even when the wage rate in other sector is higher if the difference is not big enough to afford the cost of the mobility. In this case there is no reallocation at all, and any change in prices will be reflected on the return to labour, that remains fixed in the sector (resembling the results from a SF model with labour specific).

To sum up, in this model the labour units are homogeneous but imperfectly mobile across sectors due to the fact that workers must face a period of unemployment during the transfer - for instance in the way of searching time - which is taking into account by the worker at the moment of making the decision of moving. The presence of transitory unemployment in the process of adjustment

drives a wedge between salaries in expanding and contracting sectors, and places a limit to the reallocation of labour. Thus when it is costly for the worker to move wage rates will fail to equalise across sectors - and the costlier the adjustment the bigger the gap - with clear distributional implications.

3.2 The formal model

The exercises of comparative static to be performed simulate a shock in terms of trade, favourable to the exporting sector (sector A). The general equilibrium effects of an increase of the international price of good A (P_A^W) will be analysed in the following section, reason by which in the direction of the reallocation of labour is set up from B to A. However, for an opposite shock the model could be written analogously, reversing the direction of the movement.

(1) $C_A = \theta \frac{Y}{P_A}$

(2) $C_B = (1-\theta)\frac{Y}{P_B}$

(3) $P_A = w_A\, l_A + r_A\, k_A$

(4) $P_B = w_B\, l_B + r_B\, k_B$

(5) $C_A = Q_A - E$

(6) $C_B = Q_B + M$

(7) $k_A = \frac{1}{H_A}\left(\frac{w_A}{r_A}\frac{\alpha}{1-\alpha}\right)^{1-\alpha}$

(8) $\overline{K}_A = k_A\, Q_A$

(9) $l_A = \frac{1}{H_A}\left(\frac{r_A}{w_A}\frac{1-\alpha}{\alpha}\right)^{\alpha}$

(10) $L_A = l_A\, Q_A$

(11) $k_B = \frac{1}{H_B}\left(\frac{w_B}{r_B}\frac{\beta}{1-\beta}\right)^{1-\beta}$

(12) $\overline{K}_B = k_B\, Q_B$

(13) $l_B = \frac{1}{H_B}\left(\frac{r_B}{w_B}\frac{1-\beta}{\beta}\right)^{\beta}$

(14) $L_B = l_B Q_B$

(15) $L_A = L_A^{\,0} + \lambda T$

(16) $T = L_B^{\,0} - L_B$

(17) $w_A = \lambda w_B$

(18) $Y = w_A L_A + w_B L_B + r_A \overline{K}_A + r_B \overline{K}_B$

(19) $P_A = P_A^{\,W} F$

(20) $P_B = P_B^{\,W} F$

(21) $P_A^{\,W} E - P_B^{\,W} M = 0$

where the endogenous variables are (subscripts denote the sectors): C_A, C_B consumption, Y national income, Q_A, Q_B output, P_A, P_B domestic prices, L_A, L_B labour allocation, w_A, w_B labour return, r_A, r_B capital return, E exports, M imports, l_A, l_B unit labour demand, k_A, k_B unit capital demand, F the foreign exchange rate, T total labour leaving the sector B. The foreign exchange rate is taken as the numeraire (setting it equal to one) and the last equation is eliminated (s the system includes one redundant equation).

The exogenous variables are $P_A^{\,W}, P_B^{\,W}$ the international prices. $L_A^{\,0}$, $L_B^{\,0}$ are the allocation values in the benchmark dataset. H_A, H_B are the scale parameters in the Cobb Douglas function, and α, β the share of capital in total income in the sectors A and B respectively. $\overline{K}_A$, $\overline{K}_B$ are the economy's endowment of specific capital. The parameter θ represents the share of the consumer's expenditure in the good A.

The system of equations is obtained as follows: 1 and 2 from consumer's utility maximisation; 3 and 4 are the unit price equations from the zero profit conditions; 5 and 6 are the goods market clearing conditions; 7 to 14 are unit factor demands from the firm's costs minimisation program, sector allocation of labour is determined, sector allocation of capital is fixed; 15 and 16 shows the loss in transit of the transferred labour units (assumed from B to A); 17 is the labour market equilibrium condition (taking into account 15 and 16, analysed in the section 3.1 expression 3); 18 is the national income; 19 and 20 price equations for a price taker economy (no trade barriers); 21 balance of payment equation.

4.- Simulation results

In order to assess the impact of the mobility costs on the economy's adjustment to an external disturbance some simulations are performed by means of an application of a static computable general equilibrium trade model. The exercises of comparative static simulate a shock in the terms of trade - an improvement in the terms of trade will be the scenario (for example, an increase in the international price of the exporting good).

In these exercises, firstly different magnitudes for the price shock are simulated for some values of the parameter λ. Secondly, the same price disturbance is analysed for alternative values of λ in order to compare the variation in the economic impact with the level of mobility costs . The whole set of simulation results as well as the resulting SAMs (Social Accounting Matrix) are presented in the Appendix.

Before in the section 3.1, it has been discussed that worker's decision to change from one sector to another is made bearing in mind the expression (3). Here, in the Table 1 the expression (3) is calculated for alternative λ and prices - placing both terms in the left hand side of the inequality. It is assumed that all the workers know what wages would prevail in absence of reallocation (SF model's type results), then for the construction of the table a model with labour as a fixed factor was running.

The workers in the adversely impacted sector (with lower wages) will have to decide whether to move taking into account that there is a friction for the movement, which takes the form of a period of unemployment equal to a fraction $(1-\lambda)$ of the amount of labour transferred. It has been mentioned that in this model not any price shock will induce workers to move. The decisions are based on considerations (results) of the type of those presented in the Table 1: only if the value (in the cells) is negative the workers will decide to move.

The Table 1 reveals that for low increases in P_A (for example 10%) workers in the sector B will not have enough incentives to move due to the loss of units of labour in transit (except for very low values or no loss at all, not shown in the table). However, for a higher rise in the price (say 20%) the worker will be willing to move provided the loss in transit is not very high (say roughly, not more that 10%). In analogous way for higher increases in prices; the table shows up to a 50% of increase, case in which workers from sector B will have incentives to move to sector A provided the loss is not more than 30%.

Table 1: Worker's decisions to move *

λ	P_A=1.1	P_A=1.2	P_A=1.3	P_A=1.4	P_A=1.5
0.9	0.01	-0.08	-0.17	-0.26	-0.35
0.8	0.12	0.04	-0.04	-0.12	-0.20
0.7	0.23	0.16	0.09	0.02	-0.05
0.6	0.34	0.28	0.22	0.16	0.10
0.5	0.45	0.40	0.35	0.30	0.25

Note: P_A is the international price of good A, w_A, w_B, are the return to labour in each sector without any reallocation, λ is the fraction of labour units in transfer that are incorporated to the destination.
* The values shown in the cells correspond to $w_B - \lambda\ w_A$, see text for explanations.

In the section 3.2 it has been said that when the equality in the expression (3) holds the worker is indifferent between to move or not, then this expression as an equality sets the wage gap across sectors. Also, the expression (3) as an equality is taken as the equilibrium condition in the labour market, and consequently it has been incorporated as the equation (17) in the section 3.2. The effects of the shock on the induced reallocation and on the factor returns will be analysed next.

Taking the case of 50% of increase in prices as an example, in the Table 2 the effects on labour allocation and factor returns are analysed; an interesting practical point is to compare how differently an economy is affected for a given shock when the mobility costs vary, then a same disturbance is considered for different values of λ. The whole set of results for all variables are presented in the Appendix.

The table 2 shows that the costlier is the movement (lower λ) the amount of labour reallocated is restricted, and thus the more the effects of the shock are reflected in differences on wages across sectors. Note also, that the wage gap is increasing for lower degrees of labour mobility; in the limit, for $\lambda = 0$ no reallocation at all takes place and a model with specific labour (fixed) results (not shown in the table).

Table 2: Effects of a price shock for different mobility costs*

	Benchmark	$\lambda = 0.9$	$\lambda = 0.8$	$\lambda = 0.7$
L_A	900	1046.95	987.25	922.83
L_B	400	236.72	290.93	367.38
w_A	1	1.44	1.47	1.49
w_B	1	1.30	1.17	1.04
r_A	1	1.68	1.61	1.53
r_B	1	0.77	0.85	0.96
T	0	163.28	109.07	32.62

Note: L_A, L_B represent labour allocation, w_A, w_B, r_A, r_B the factor returns, and T the total amount of labour transferred from sector B to A after the shock, λ is the fraction of labour units in transfer that are incorporated to the destination.
* for selected variables, see Appendix for the whole set of results.

The Table 2 shows that even though the required skills are identical for any activity the workers receive different wages in the new equilibrium. Then, the workers allocated in different sectors are not equally affected by the shock: workers in the expanding sector are relatively favoured receiving higher salaries. Moreover, as wages fail to equalise due to the imperfect mobility of labour, the increasing degree of friction exacerbates the differences between workers' fate, only differentiated by its initial allocation (Clarete, Trela and Whalley's (1994) type result).

Note that as labour is imperfectly mobile and capital is fixed, the results resemble the SF model results, where the effects from a shock in prices for the return of the mobile factor lie in between the returns of the specific factors. In this case being labour imperfectly mobile presents a higher degree of mobility than specific capital, explaining the results that always the wage rates, even differing across sectors, lay in between the changes in the capital return (Hill and Mendez's (1983) type results).

For the economy as a whole, the lower is the value of the parameter λ the more units of labour are lost in transit, thus it implies a greater loss of resources for productive uses, causing the corresponding contraction in the production possibilities frontier. That is to say, part of the welfare gains obtained by a favourable terms of trade shock are lost in the way of a 'contraction' in the endowment of labour caused by the reallocation induced by it.

As Leamer states; the aggregate effects from the presence of adjustment costs can be measured by the reduction effect in the supply side. Near this approach, and leaving aside distributional considerations, the welfare effects for increasing levels of mobility costs will be measured by the variations in the impact on the GDP (in Table 3). The table shows that a high degree of labour mobility increases the output-price responsiveness of the economy - due to a frictionless reallocation, and that the costlier the adjustment the less able is the economy to reap the full gains from a favourable terms of trade shock.

Table 3 Impact on GDP from a favourable shock *

	Benchmark	$\lambda = 0.9$	$\lambda = 0.8$	$\lambda = 0.7$
Sector A	1200	2016.21	1929.36	1834.14
Sector B	800	615.43	682.27	766.69
GDP	2000	2631.64	2611.63	2600.83

Note: 50% of increase in the international price of the exportable good

5- Final comments

The aim of this work is to investigate the general equilibrium effects of the remotion of the assumption of perfect mobility of labour, by using a simple static CGE model of trade. A brief survey on the literature on imperfect mobility of labour is presented, from where some features are introduced into a model close to those traditional in trade.

Some features from Leamer's (1980) lost-labour-time models are selected and incorporated into a the trade model. The presence of imperfect mobility of labour - modelled here as temporary unemployment when a worker decides to change job - explains that wages fail to equalise across sectors, thus the mobility costs also affect the distribution of income, even among identical workers.

The model was applied for some selected scenarios, simulating a favourable terms of trade shock to the economy. The results show that a costly movement of labour implies a reduced output-price responsiveness of the economy. Moreover, the costlier the movement the more restricted is the reallocation, and thus the effects from the shock are more pronounced on factor returns - widening the gap across sectors. In an extreme case with a prohibitively high cost of movement no reallocation at all takes places and the results from a SF model with labour specific are obtained.

As expected, the welfare gains for the economy facing a favourable shock depends on the costs of the reallocation induced by it. The temporary unemployment implies that the economy is unable to reap - at least in the short run - the full welfare gains predicted by the traditional trade models, assuming perfect mobility of labour.

Bibliography

Behar, J. (1995): "Measuring the Effects of Economic Integration for the Southern Cone Countries: Industry Simulations of Trade Liberalisation". The Developing Economies, Vol. 33, 1, pg. 3-31

Brander, J. and Spencer, B. (1994): "Trade adjustment assistance. Welfare and incentive effects of payments to displaced workers". Journal of International Economics 36.

Brecher, R. and Choudhri, E. (1994): "Pareto gains from trade, reconsidered. Compensating for jobs lost". Journal of International Economics 36.

Burfisher, M., Robinson, S. and Thierfelder, K. (1994): "Wage changes in a U.S.-Mexico Free Trade Area: Migration Versus Stolper-Samuelson effects". In J. F. Francois and C.R. Shiells (eds.), "Modeling Trade Policy. Applied General Equilibrium Assessments of North American Free Trade", Cambridge University Press.

Clarete, R., Trela, I. and Whalley, J. (1994): "Evaluating labour adjustment costs from trade shocks: illustrations for the U.S. economy using an applied general equilibrium model with transactions costs". NBER Working Paper No. 4628.

Diaz Cafferata, Alberto (1996): "Ajuste estructural y desocupacion de mano de obra. Restricciones de corto plazo". Paper for the XI Jornadas Anuales de Economia, Uruguayan Central Bank, November.

Faini, R. (1996): "Increasing returns, migrations and convergence". Journal of Development Economics, vol. 49.

Feenstra, R. and Lewis, T. (1994): "Trade adjustment assistance and Pareto gains from trade" Journal of International Economics 36.

Flores, R. (1997): "The Gains From MERCOSUL: A General Equilibrium, Imperfect Competition Evaluation. In Journal of Policy Modeling 19(1).

Gaston, N. and Trefler, D. (1997): "The labour market consequences of the Canada-U.S. Free Trade Agreement". Canadian Journal of Economics XXX, No. 1.

Greenaway, D. (1993): "A Note on Structural Change, Adjustment and Specialisation". Paper for discussion at the "Trade, Specialisation and Market Structure" SPES Workshop, 23rd-24th April.

Grossman, G. and Shapiro, C. (1982): "A Theory of Factor Mobility". Journal of Political Economy vol. 90, no. 5.

Hamermesh, D. (1993): "Labor demand and the source of adjustment costs". NBER Working Paper No. 4394.

Hamermesh, D. (1989): "Labour demand and the structure of adjustment costs". American Economic Review 79.

Hamermesh, D., Hassink, W. and van Ours, J. (1994): "New facts about factor-demand dynamics: employment, jobs and workers". NBER Working Paper Series, No. 4625.

Hill, J. and Mendez, J. (1983): “Factor mobility and the general equilibrium model of production”. Journal of International Economics 15.

Jones, R. W. (1971): “A three factor model in theory, trade and history”. In Bhagwati et al. (eds.) “Trade, the balance of payments, and growth”, North-Holland, Amsterdam.

Leamer, E. (1980): “Welfare computations and the optimal staging of tariff reductions in models with adjustment costs”. Journal of International Economics 10, 21-36.

Levy, S. and Wijnbergen S. van (1994): “Transition problems in economic reform: agriculture in the U.S.-Mexico free trade agreement”. In J. F. Francois and C. R. (eds.), “Modeling Trade Policy. Applied General Equilibrium Assessments of North American Free Trade”, Cambridge University Press.

Markusen, J. and Manning R. (1993): “Long-run production frontiers for the Jones specific-factors model with optima capital”. In W. Ethier, E. Helpman and P. Neary (eds.) “Theory, policy and dynamics in international trade”, Cambridge University Press.

Mercenier, J. and Schmitt, N. (1996): “On sunk costs and trade liberalization in applied general equilibrium”. International Economic Review 37 (3), 553-571.

Milner, C. and Wright, P. (1996): “Modelling Labour Market Adjustment to Trade Liberalisation in an Industrialising Economy”. Paper presented at the Australian Society of Economists Annual Conference held at the Australian National University, Canberra, September.

Mayer, W. (1974): “Short-run and Long-run Equilibrium for a Small Open Economy”. Journal of Political Economy, vol. 82, 955-68.

Mussa, M. (1974): “Tariffs and the Distribution of Income: the Importance of Factor Specificity, Substitutability, and Intensity in the Short and the Long Run”. Journal of Political Economy, vol. 82, 1191-204.

Mussa, M. (1978): “Dynamic Adjustment in the Heckscher-Ohlin-Samuelson Model”. Journal of Political Economy, vol. 86 No. 5, 775-79.

Mussa, M. (1982): “Imperfect factor mobility and the distribution of income”. Journal of International Economics 12, 124-141.

Mussa, M. (1986): “The Adjustment Process and the Timing of Trade Liberalization”. In A. Choksi and D. Papageorgiou (eds.) “Economic Liberalization in Developing Countries”, 68-124, Basil Blackwell, UK.

Neary, P. (1978): “Short-run capital specificity and the pure theory of international trade”. The Economic Journal, 488-510

Oi, W. (1962): “Labour as a quasi-fixed factor”. Journal of Political Economy 70 No. 6, 538-55.

Rothschild, M. (1971): “On the cost of adjustment”. Quarterly Journal of Economics 85, 605-622.

Stiglitz, J. (1999): “Two Principles for the Next Round. Or, How to Bring Developing Countries in from the Cold”. World Bank mimeo, Geneva, September.

APPENDIX

Table 1: SAM for benchmark and after the terms of trade shock

BENCHMARK

	Household	Sector A	Sector B	External	
Sector A	-1000	1200	0	-200	0
Sector B	-1000	0	800	200	0
Capital	700	-300	-400		0
Labour	1300	-900	-400		0
	0	0	0	0	0

Effects of an increase in the price of A (50%)

λ = 0.9

	Household	Sector A	Sector B	External	
Sector A	-1315.82	2016.21	0.00	-700.39	0
Sector B	-1315.82	0.00	615.43	700.39	0
Capital	811.77	-504.05	-307.71		0
Labour	1819.87	-1512.16	-307.71		0
	0	0	0	0	0

λ = 0.8

	Household	Sector A	Sector B	External	
Sector A	-1305.81	1929.36	0.00	-623.54	0
Sector B	-1305.81	0.00	682.27	623.54	0
Capital	823.47	-482.34	-341.13		0
Labour	1788.15	-1447.02	-341.13		0
	0	0	0	0	0

λ = 0.7

	Household	Sector A	Sector B	External	
Sector A	-1300.41	1834.14	0.00	-533.72	0
Sector B	-1300.41	0.00	766.69	533.72	0
Capital	841.88	-458.53	-383.35		0
Labour	1758.95	-1375.60	-383.35		0
	0	0	0	0	0

Table 2: Effects on all the variables in the model from an increase in prices (increase in P_A 50%)

	Benchmark	λ = 0.9	λ = 0.8	λ = 0.7
C_A	1000	877.21	870.54	866.94
C_B	1000	1315.82	1305.81	1300.41
Q_A	1200	1344.14	1286.24	1222.76
Q_B	800	615.43	682.27	766.69
P_A	1	1.50	1.50	1.50
P_B	1	1.00	1.00	1.00
L_A	900	1046.95	987.25	922.83
L_B	400	236.72	290.93	367.38
w_A	1	1.44	1.47	1.49
w_B	1	1.30	1.17	1.04
r_A	1	1.68	1.61	1.53
r_B	1	0.77	0.85	0.96
Y	2000	2631.64	2611.63	2600.83
k_A	0.25	0.22	0.23	0.25
k_B	0.5	0.65	0.59	0.52
l_A	0.75	0.78	0.77	0.75
l_B	0.5	0.38	0.43	0.48
E	200	466.93	415.70	355.82
I	200	700.39	623.54	533.72
F	1	1	1	1
T		163.28	109.07	32.62

Note: C_A, C_B represent consumption, Q_A, Q_B production, P_A, P_B domestic prices, L_A, L_B labour allocation, w_A, w_B, r_A, r_B the factor returns, k_A, k_B, l_A , l_B, the unit requirement of factors, E, I, F foreign trade and exchange rate, and T the total amount of labour transferred from sector B to A after the shock.