The Effect of International Competition on Labour-Demand Elasticities

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Abstract: This paper studies the impact of trade on the price-elasticity of aggregate labour demand, based on the idea that a variation in the cost of (a given type of) labour has an effect on the sectoral trade specialisation of an economy, at the expense of the domestic productions using this factor intensively, even when the trade balance is kept unchanged. As this effect is more important the more open the economy, trade openness induces an increase in the associated labour-demand elasticity, through an "international competitiveness effect". This argument is illustrated by a simple model, based on an Armington hypothesis, with an empirical assessment for France.

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Introduction

The impact of international trade on the labour market is not only a problem of level: it is also worth evaluating modifications induced in the very functioning of the labour market. In particular, the strengthening of competition in goods markets may influence the sensitivity of factor demands. A first illustration is provided by the factor proportions theory, which concludes that the price-elasticity of labour demand turns to be infinite for a non-specialised, small economy in a situation of free trade. By the weakening of mark-ups, new trade theories also show that this elasticity might rise.

Whereas potential consequences are considerable, this topic has received relatively little attention in the recent literature. The result of the traditional approach appears somewhat caricatured, and the only available assessment of the impact linked to the lowering of mark-ups (Slaughter, 1997) provides "mixed support, at best", as the effects highlighted are not robust. Once this points has been detailed in Section 1, we will try to re-define the framework of analysis of the effect of international trade on the price-elasticity of labour demand (Section 2). This will lead us to propose an intermediate approach, in a third section. This approach will be illustrated by a simple model aimed at showing how the strengthening of competition between national producers and foreigners induces a higher sensitivity of trade specialisations and hence of factor demands.

I.   Potential consequences and preliminary analysis.

The effect of international trade on the price-elasticity of labour demand could appear, at first glance, to be a secondary question. A rapid analysis highlights, on the contrary, the importance of its potential consequences. It is therefore useful to return in detail to the analysis provided on this topic by international trade theories.

A.   What is at stake?

Rodrik (1997, pp. 16-27) describes three important consequences of an increase in the absolute value of the price-elasticity of labour demand. Firstly, it modifies the sharing of non-wage cost. The fact of imposing a social protection and/or an improvement in working conditions, which increase labour cost, would induce a stronger decrease in firms' labour demand in an open economy. Be it through their employment levels or through their wages, employees would then be constrained to bear a larger part of the adjustment. As it is presented by Rodrik, this argument is questionable, because it relies largely on the hypothesis that labour supply only depends on wages, and not on non-wage advantages.[1] Nonetheless, it does highlight a first channel through which the position of employers may be weakened.

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[1]   This hypothesis enables Rodrik to consider that imposing supplementary, non-wage benefits corresponds to an upward movement of the labour supply curve. In contrast, if we assume that employers are neutral to the sharing between wages and non-wage benefits, then a shift in this type of advantages has no effect on the labour supply curve.

More generally, Rodrik argues that more elastic labour demand weakens the bargaining power of unions vis-à-vis employers. Rent sharing is consequently distorted at the expense of workers, while the influence of unions is weakened. Thus, the functioning of the regulations of the labour market may be altered.

A more elastic labour demand would also imply increased volatility in the labour market. Indeed, an exogenous shock on labour demand has a stronger effect on wages when the elasticity of demand is higher. Let us add, from a more "European" perspective of wages stickiness, that the sensitivity of employment to exogenous shifts in labour costs is higher when the elasticity of demand is higher. The elasticity of labour demand thus acts as a leverage, which determines the magnitude of labour market effects of exogenous shocks from different origins (technological, demographic, institutional or fiscal). As a consequence, the success of various reforms, planned and/or carried out in various European countries, depends partly on this elasticity. Between other things, this is the case of reducing working hours with wage compensation, or of lowering social charges or low wages.

Far from being unimportant, the question of the impact of international trade on the price-elasticity of labour demand is thus central in order to understand better the past effects of globalisation on labour markets, but also to deepen the analysis of future trends. Among these is the creation of the Monetary Union in Europe, which will probably increase the interdependencies between member states.

Whereas he describes convincingly the consequences of a more elastic labour demand, Rodrik is rather quick to justify the impact of trade. His analysis is closer to that of intuition than demonstration, when he explains that "the reason is that employers and the final consumers can substitute foreign workers for domestic workers more easily -either by investing abroad or by importing the products made by foreign workers"(p. 16). A more complete and rigorous analysis seems useful. Let us specify, however, that we will focus in what follows on the influence of international trade, without dealing with the influence of FDIs.

B. *Learnings from the neo-classical theory of international trade*

In the HOS neo-classical framework, the price-elasticity of labour demand is infinite for a non-specialised small economy in a context of free trade: the FPE theorem stipulates that real and relative factor rewards are determined by international goods prices. However, this extreme result does not apply to the case of a large country. Its influence on international terms of trade smooths the price sensitivity of its labour demand, but this sensitivity remains higher than under autarky. Davis (1996) illustrates this by studying the case of free-trade between two economies identical in their consumer preferences, their production functions, and their endowments in skilled and unskilled labour. One (assimilated to the US) is supposed to have a perfectly competitive labour market, while the other (Europe) sets a minimum wage for unskilled labour, superior the full-employment equilibrium level. Davis shows that under these conditions,[2] the unemployment caused by the minimum wage doubles under free-trade, with respect to autarky.

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[2] However, this result is valid only if the free-trade equilibrium leads to an incomplete specialisation of both economies.

Indeed, in a perfect competition framework with two goods and two production factors and with a given production function, a given minimum wage is only compatible with one level of goods relative price (the one-to-one correspondence between relative prices and relative factor rewards is a corollary of the Stolper-Samuelson theorem). In turn, for given preferences, this level of relative prices is only compatible with one level of the relative employment of production factors. And this level is reached, in autarky, by the unemployment of a part of the unskilled workforce. Under free-trade, the same causal relationship prevails for the integrated economy constituted by both countries. The country which wants to maintain its minimum wage is then constrained to "manipulate" international terms of trade in order to set back the relative goods price to its autarkic level. But this requires the relative employment level of production factors to be identical to the one prevailing in Europe, under autarky. As the minimum-wage economy is the only one likely to carry out the adjustment, it experiences a doubling of its unemployment. In other words, free-trade doubles the employment effect of a given gap between the actual level of unskilled wage and its full-employment level.

If, in addition, the opening to trade with low-wage countries reduces the demand for unskilled labour, Davis shows that the minimum-wage economy has to bear the whole of the adjustment,[3] at least as long as it is not completely specialised in the production of skill-intensive goods. More generally, the same conclusion would apply to any exogenous shock involving a lowering of unskilled labour demand. For the minimum wage economy, openness then magnifies the consequences of the shock, with respect to autarky. In order to maintain its minimum wage, the "European" area has to modify accordingly (through its unemployment rate) the relative employment of production factors in the integrated economy, and not only in its own territory. This implies a doubling of the unemployment consequences of an exogenous shock.

Through the constraint introduced over goods relative prices, trade openness thus appears, in the traditional trade theory, to be likely to modify the price-elasticity of labour demand. However, this analysis remains somewhat schematic. In particular, the notion of an infinite elasticity of labour demand under free-trade seems unrealistic. As a matter of fact, recent studies focused more on the analysis through new trade theories. These relax the hypotheses of homogenous goods and perfect competition, which leads to underestimating the room for manoeuvre left to a country under free-trade.

C. The price-elasticity of individual labour demand: decomposition and influence of international trade

So far, we have been reasoning in terms of the price-elasticity of aggregate labour demand, for the whole economy. Before extending the analysis by abandoning the hypothesis of perfect competition, it is worth coming back to the general expression of the price-elasticity of an individual firm's labour demand, as presented in labour economics (for a more detailed description, see for example Hamermesh (1993) or Cahuc and Zylberberg (1996)). With the notations of the latter, this elasticity can be expressed as follows:

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[3]   Note by the way that, in this case, differences in labour market institutions within a same currency area can induce a strongly asymmetric transmission of a symmetric shock.

(1)
$$h_w^L = \bar{h}_w^L + \bar{h}_Y^L h_w^Y$$

Where index L refers to the firm's labour demand, w to the wage and Y to the firm's output. h_w^L is, in Cahuc and Zylberberg's terminology, the *unconditional* price-elasticity of labour demand, *i.e.* without any constraint on the output level. $\bar{h}_w^L$ is the *conditional* price-elasticity of labour demand, *i.e.* under the constraint of constant output. $\bar{h}_Y^L$ refers to the elasticity of the conditional labour demand with respect to the output level. This elasticity is necessarily positive when the production function is homogenous.[4] h_w^Y is the elasticity of the firm's output with respect to wages.

Two types of effects induced by a wage variation in a firm's labour demand can be distinguished on the basis of this expression. The first term, always negative, corresponds to the pure substitution effect between labour and other production factors. Using s as the elasticity of substitution between production factors and a the share of labour compensation in value added,[5] then this elasticity can be written $\bar{h}_w^L = -(1-a)s$. The absolute value of the substitution effect is therefore a decreasing function of the share of labour in total costs.

The second term in expression (1) corresponds to a scale effect or, in the terminology of Legendre and Le Maitre (1998), which is better-suited here, to a *competitiveness effect*. It reflects the fact that a wage increase raises the firm's production cost, hence a negative effect on its output, which implies, except under exceptional configurations of labour demand,[6] a lowering in labour demand. Generally speaking, the competitiveness effect reinforces the scale effect.

From this decomposition, Slaughter (1997) highlights two effects of international trade on labour-demand elasticities. The first one concerns the substitution effect: if the production process of a firm is decomposed vertically in various stages with different factor intensities, then this firm has the possibility, consecutively to increased wages, to relocate the production or to use foreign outsourcing for the most labour-intensive production stages. This widening of substitution possibilities is likely to increase the elasticity of substitution between labour and other production factors.

The second influence of international trade put forward by Slaughter concerns the competitiveness effect. Indeed, this effect is higher when the firm's output level is more price-sensitive, and this sensitivity depends negatively on firms' mark-ups. Indeed, different international trade models predict that trade openness lowers mark-ups. By increasing the elasticity of goods demand addressed to each firm, trade thus increases the price-elasticity of their labour demand.

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[4] Its value is then the inverse of the degree of homogeneity of the production function.

[5] The possibility of substitution between production factors and intermediate consumption is not considered here.

[6] If the relative use of labour decreases strongly with the output level, this effect can be inverted. This however corresponds to exceptional configurations and, as noted above, it is incompatible with the hypothesis of homogeneity of the production function.

Empirical estimates of these effects would require working on firms individual data. Given the lack of satisfactory individual data for this type of estimate, Slaughter works on the basis of industries defined at a detailed level of classification (4-digits SIC), which he assimilates as firms, before grouping them into "aggregated industries". His estimates only provide little support to the hypotheses formulated: for production workers as well as for non-production workers, several trade variables have a significant explanatory power, with the expected sign, when only industry dummies are considered, but their significance disappears when time dummies are introduced. The variation in labour-demand elasticities are therefore mainly explained by a temporal trend. Interestingly, this trend is upward, in absolute value, for production workers, whereas it is downward for non-production workers.

D.   *Difficulties in estimating individual labour-demand elasticity variations*

Slaughter's (1997) estimates are based on differences, between sub-industries grouped into aggregated industries, in the variations of labour demand in response to shifts in its cost. This requires implicitly the existence of exogenous labour cost shocks which are sufficiently different among sub-industries. This is far from evident in practice.

Such a shock can obviously occur when the cost of a sub-industry-specific skill varies. But if the origin of this shock lies in the demand addressed to the sub-industry, then the demand variation induces a labour cost variation, and not the contrary. In order to induce a relationship corresponding to the proposed framework, it has to correspond either to an exogenous demand shock in another sub-industry using the same specific skill, either of an exogenous supply shock. But such shocks are likely to be of limited magnitude compared to other determinants of labour cost variation, making difficult the analysis of their consequences.

The labour cost variable used is deflated by the sectoral output price index. Output price variations are therefore a major source of labour cost in the sub-industry. But they can be misleading. If the price variation has a technological origin, then the labour demand variation is primarily the result of this change in the production technique, rather than the result of the labour cost evolution.

Finally, the definition of labour categories (production and non-production workers) is very large and each of them includes very different categories, in terms of skills as well as of wages. Composition biases can then alter the estimates. Suppose for example that a firm raises rapidly the skills of its non-production workers. This will logically induce both an increase in the average cost of this type of labour and an increase in its productivity, *i.e.* a decrease in its demand, compared to what would be expected on the basis of output variation, which is here included among explanatory variables.

This estimation method therefore meets several obstacles, which perhaps partly explains the results. But the approach itself can also be questioned.

II.   A reassessment of the influence of international trade on aggregate labour demand elasticity

The results mentioned above are likely to cast doubt on the impact of international trade on labour-demand elasticities. The neo-classical prediction of infinite elasticities under free-

trade is hardly realistic, and the arguments linked to firms' mark-ups do not find any clear empirical support. Are we to conclude that there is no significant relationship? In order to answer this question, we will first look at the definition of the adequate analytical framework.

A.   *Individual or aggregate labour-demand elasticity?*

Slaughter's work deals with *firms'* individual labour-demand elasticities. It is therefore concerned with firms' reactions to firm-specific shocks, *i.e.* shocks which do not concern a firm's competitors. As far as the political consequences, as presented above, are concerned, the adequacy of this approach is questionable. Most of the shocks to the labour market, notably technological, institutional or educational, concern a set of industries, and frequently the whole economy. And the central problem is not to understand firms' individual reactions but rather to understand the evolution of the aggregate labour demand. After all, the most important problem, regarding the influence of international trade, is the decrease, in several economies, in the relative demand for unskilled labour.

Now, in spite of the fact that the aggregate labour demand is the sum of individual labour demands, the price-elasticities of these demands are not necessarily linked in a simple way, as emphasised by Slaughter (p. 8). In the neo-classical model, for example, trade openness radically modifies the aggregate labour-demand elasticity, without modifying firms individual labour-demand elasticity which, in this context of perfect competition, was already infinite in autarky.

The aggregate labour-demand elasticity is therefore a subject on its own, which cannot be studied merely through the study of individual labour demand function. Just as individual labour-demand elasticities, this elasticity can be decomposed in two effects. The substitution effect retains a degree of significance similar to that described above. It corresponds to the consequence of within-firms factor substitutions, as a consequence of a shift in factors' relative costs. This effect is therefore always negative, and its magnitude depends on the elasticity of substitution between labour and other production factors, and on the share of labour in firms' production cost.

The competitiveness effect, *i.e.* the effect resulting from the variation in outputs, corresponds, here, to mechanisms different to those described at the individual level. One the one hand, the problem is no longer to describe the reactions of firms with respect to each other. The point is rather to analyse the global evolution of national output. On the other hand, the output level is no more a unidimensional variable when considered at the aggregate level. Inter-sectoral differences in output variations can modify relative factor demand, especially when these differences are linked to initial factor intensities. Beyond the question of the global output level, it is also necessary to consider the possible effect on the sectoral specialisation of the economy's production.

B.   *The influence of international trade on the price-elasticity of aggregate labour demand*

In this context the analysis of the influence of international trade has to be reconsidered. As far as the substitution effect is concerned, the mechanisms put forward at the individual level are still relevant. But at the level of an industry or of the whole economy, trade can also

have an influence on the share of labour in value added, by modifying the specialisation (included within industries, when the goods gathered within a same industry are heterogenous - see Wood, 1994), or by spurring firms' selection (see Jean, 1998). As matter of fact, estimates of Feenstra and Hanson (1996) and those of Cortes and Jean (1999) support the hypothesis that an increase in the penetration rate of imports in an industry can increase the skills level of labour force in this industry. If this is the case, it involves a magnification of the substitution effect for unskilled labour (whose share in value added has decreased), and a lowering of this effect for skilled labour. [CSJ1]

As far as the competitiveness effect is concerned, the influence of international trade can be of various natures. We have emphasised above that trade openness lowers mark-ups, thus increasing the price-sensitivity of firms' output. But as a consequence of a wage shock common to the whole economy, all domestic producers within the same industry experience the same cost variation, at least if we assume their relative factor inputs to be identical. Hence, there is no relative cost variation among domestic producers. The relative cost of domestic producers compared to foreign producers is the only one modified. The question is then the level of price-sensitivity for the whole domestic production. In this context, the effect of international trade on firms' mark-ups is a second order one.

In sum, the two main types of analysis of the influence of international trade on the magnitude of the competitiveness effect seems somewhat caricatured. The traditional trade theory leads to an unrealistic prediction of infinite elasticity, whereas the arguments concerning firms' mark-ups correspond to second order effects, at the aggregate level.

We propose an "intermediate" approach, based on the following observation. A shift in production factors' relative costs modifies trade specialisation determinants. The more open the economy is, the more important involved inter-sectoral relocations are, and these relocations reinforce the competitiveness effect consecutive to a variation in (a given type of) labour cost. A simple model with perfect competition and goods differentiated according to their geographical origin enables this argument to be illustrated and specified.

III.   Trade openness and competitiveness effects: a simple model

The competitiveness effect induced by a shift in the cost of a production factor on its demand is the consequence of the variations in output levels. The study will therefore focus, in a first stage, on the impact of trade openness on the price-elasticity of domestic output in a given industry. We will then analyse the consequences induced, at the aggregate level, in the price-elasticity of factor demand, with unskilled labour as a basis of illustration.

A.   *The domestic output price-elasticity by industry increases with trade openness*

Let us consider an industry where firms interact under perfect competition. In order to describe simply the domestic output evolution with respect to foreign output, we will adopt the Armington's hypothesis (1969): goods produced in the home country are homogenous, but they are differentiated from foreign goods, with a constant elasticity of substitution $s > 1$. This is a rough hypothesis, which does not enable the imperfect competition effects to be considered. But as we concluded that these effects are second order ones (and moreover of the

same sign, as we will see), we can nevertheless consider that this hypothesis is likely to provide satisfactory orders of magnitude.

The relative evolution of domestic and foreign producers' sales in the domestic market, consecutively to a weak[7] variation in their relative price, can be proxied as follows:

(2)
$$\Delta \ln \frac{p_M M}{p_D D} = (1-\varsigma)\Delta \ln \frac{p_M}{p_D}$$

where D (respectively M) is the domestic demand for domestic (resp. imported) goods, and p_D (p_M) is the corresponding price.

Suppose in addition that the value of domestic demand is constant in this industry (for example because variations in national income are negligible and the elasticity of substitution of demand between different industries is unity):

(3)
$$p_M M + p_D D = C$$

where C is a constant. Using this last constraint, relationship(2) can be written:

(4)
$$\dot{D} = (1-\varsigma)m(\dot{p}_D - \dot{p}_M) - \dot{p}_D$$

where a dot above a variable refers to the logarithmic variation, and where $m = p_M M/C$ is the penetration rate of imports in the industry.

The last term is the only non-zero one in autarky: as the value of demand is constant, its price-elasticity is unity. On the other hand, when the penetration rate of imports is non-zero, any variation in the relative price of domestic goods with respect to imports induces a shift in market shares. With a constant elasticity of substitution, the corresponding effect on the demand addressed to domestic producers is increasing with penetration rate of imports. Domestic sales by domestic producers are more sensitive to the terms of the competition with foreign producers when the latter are more strongly present on the market. Practically, the price-elasticity of these domestic sales is on average between -1 and -ς, weighted respectively by (1 - m) and m.

The domestic production is also partly sold by exporting. Assuming that the market share of domestic producers in their export markets is small, and that the elasticity of substitution between domestic and foreign producers is identical on these markets and in the domestic market, the variation in exports (noted X) as a consequence of a weak price variation is:

(5)
$$\dot{X} = -\varsigma(\dot{p}_D - \dot{p}_M)$$

If we note x the export intensity in the industry (ratio of exports to output), the logarithmic variation in output can then be written, approximately:

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[7]   In this relationship and in what follows, we will assume the variations considered to be sufficiently small in order to make it possible to use log-linearised equations.

(6) $$\dot{Q} = (1-x)\dot{D} + x\dot{X}$$

Using relationships (4) et (5) and rearranging, one obtains:

(7) $$\dot{Q} = (1-\mathsf{s})\,t\,(\dot{p}_D - \dot{p}_M) - \dot{p}_D + x\dot{p}_M$$

where we have noted $t = m + x - mx = (1-x)\,m + x$. The second expression of t shows that it refers to the average market share of foreign producers in the markets where domestic firms sell their products (assuming that the market share of domestic producers in foreign markets is negligible). t can be interpreted as the degree of exposure of domestic production to international competition or, in the words of Orléan (1986), as the internationalisation rate of the industry.

The price-elasticity of domestic production is therefore an increasing function, in absolute value, of this degree of exposure to international competition. More precisely, it is an average of -1 and -s, weighted respectively by (1-t) and t. The elasticity of domestic production with respect to foreign goods price is also an increasing function of the degree of exposure to international competition. However, it is more strongly sensitive to export intensity, given the strong sensitivity of exports to their relative price.

To sum up, trade openness indeed makes the demand for goods addressed to domestic producers more elastic. The point is now to know how this is transmitted to labour demand elasticities.

B.   *Consequences for unskilled-labour-demand elasticity*

Let us consider an economy producing two goods *A* and *B* with two production factors, skilled labour (*S*) and unskilled labour (*U*). The hypotheses within each industry are the same as previously. In this framework, we aim at studying the impact on unskilled employment of an exogenous increase in the cost of this factor, for example for institutional reasons. Unskilled labour is chosen as a basis for illustration, but the same reasoning would equally apply to another production factor. In order to focus the analysis on the competitiveness effect, we will assume that there is no pure substitution effect, *i.e.* that production factors are complementary.

Such a shock has obviously an impact on the trade balance of the country, as we will see in a first stage. That is why we will afterwards study the case where the exchange rate is endogenous, and adjusts in order to leave the country's trade balance unchanged.

1.   **The case of an exogenous exchange rate**

A variation in the unskilled wage w_u modifies industries' production cost (*i.e.* prices, given the hypothesis of perfect competition) in proportion to the share of unskilled labour in this cost, that we will assimilate, for the sake of simplicity, to value added.[8] This price variation can be written, for a shock of weak magnitude:[9]

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[8]   If intermediate consumptions are considered explicitly and if they are supposed to be untraded, then the direct *and indirect* unskilled labour used in the industry has to be accounted for. If, on the contary, intermediate

(8)
$$\dot{p}_k = a_k \dot{w}_u , \quad k = A, B$$

where index k refers to industry A or B, and a_k is the share of unskilled labour in industry k's value added.[10]

Equation (7) then enables the output logarithmic variations to be expressed:

(9)
$$\dot{Q}_k = (1-s)t_k a_k \dot{w}_u - a_k \dot{w}_u$$

For the sake of simplicity, the elasticity of substitution between domestic and foreign goods is supposed to be identical in both industries. In order to highlight the link with unskilled labour demand, relative industry sizes have to be known. Noting as l_k the share of industry k in GDP, and $a = l_A a_A + l_B a_B$ the share of the unskilled-labour wage bill in GDP, the share of industry k in unskilled labour demand is $l_A a_A/a$. As a first order proxy, the logarithmic variation of unskilled labour demand is then:

(10)
$$\dot{U} = \sum_{k=A,B} \frac{l_k a_k}{a} \dot{Q}_k$$

That is, given equation (9) :

(11)
$$\dot{U} = \frac{\dot{w}_u}{a} \sum_{k=A,B} \left[(1-s)t_k l_k a_k^2 - l_k a_k^2 \right]$$

Given that $S l_k a_k^2 = a^2 + S l_k (a_k^2 - a^2) = a^2 + S l_k (a_k - a)^2$, the sum in the last term of equation (11) proves to be the variance, among productive units, of the share a_k of the unskilled labour wage bill in value added. We will note V_a as this variance, which measures in a synthetic way the dispersion of factor intensities throughout the economy. Finally:[11]

(12)
$$\frac{\dot{U}}{\dot{w}_u} = -a \left[\left(1 + \frac{V_a}{a^2} \right) + (s-1) \sum_{k=A,B} \left(\frac{a_k^2}{a^2} l_k t_k \right) \right]$$

The set between square bracket is homogenous function of degree 0 in a. This ensures that the elasticity thus measured is an increasing function of the share a of unskilled labour in value added (supposing the dispersion of industry shares around the average to be constant) and tends towards 0 when a tends towards 0.

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consumptions are traded, the calculation has to take account of the possibilities of substitution involved. Indirectly employed unskilled labour is then to be only partially accounted for.

[9]   Following the first order conditions of profit maximisation, this proxy remains valid when production factors are substituable.

[10]   For the sake of commodity, we will assume that $a_A \neq a_B$.

[11]   Note that the following expression, a well as its interpretation, remains valid when the number of industries is superior to 2.

Two terms can be distinguished in equation (12). The first one corresponds to an autarchic effect. As the demand is supposed to be constant in value in each industry, this term would be equal to unity if the factor intensity of production were uniform throughout the economy. When it is not the case, this effect is increasing with the dispersion of factor intensities, as reflected by the presence of the standardised variance (*i.e.* the variance divided by the squared average).

The second term reflects the influence of international trade. Always positive, it indicates unambiguously that *trade openness magnifies the competitiveness effect consecutive to a variation in unskilled labour cost.* Not surprisingly, the more substitutable foreign goods are for domestic goods, the more important this effect is. However, it does not increase proportionally to the degree of openness, but in proportion to an average of degree of exposure to international competition, weighted (besides, of course, the share of industries in GDP) by the squared share of unskilled labour in value added. This share has indeed a double role in setting the impact on unskilled labour by industry: through the impact of the wage variation on the industry's price, and through the expression of the share of the industry in the global demand for unskilled labour.

This link between international trade and competitiveness effect has nevertheless to be put in perspective, as it is essentially the consequence of a shift in the trade balance. In the medium or long term, this type of disequilibrium is theoretically counterbalanced by an automatic adjustment in the exchange rate.[12] If we are to measure the "structural" effect, this constraint must be taken into account.

2. The case of a trade balance kept unchanged through an endogenous adjustment of the exchange rate

In order for the trade balance to be kept unchanged after an exogenous shock $\dot{w}_u$ on unskilled wage, the real exchange rate must adjust endogenously, by an amount that we will note $\dot{e}$ (the logarithmic variation of foreign prices expressed in national currency, which here has necessarily the same sign as the wage variation). The price of foreign goods, expressed in national currency, has therefore change proportionally, whatever the industry ($\dot{p}_M = \dot{e}$). The logarithmic variation of an industry's output is then:

$$(13) \qquad \dot{Q}_k = (1-s)t_k(a_k\dot{w}_u - \dot{e}) - a_k\dot{w}_u + x_k\dot{e}$$

From this expression, the logarithmic variation of unskilled labour demand can be expressed as follows:

$$(14) \qquad \dot{U} = \frac{\dot{w}_u}{a}\left(\sum_{k=A,B}\left[(1-s)t_k l_k a_k^2\right] - (a^2 + V_a)\right) + \frac{\dot{e}}{a}\sum_{k=A,B}\left[(x_k - (1-s)t_k)l_k a_k\right]$$

In this relationship, the last term corresponds to the effect induced by the exchange rate adjustment. In order to express it as a function of exogenous variables, the unchanged-trade-

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balance constraint has to be taken into account. Given the hypothesis that the value of demand is constant in each industry, this constraint is equivalent to assuming that the value of global production has not changed ($\Sigma \Delta(p_k Q_k) = 0$). This constraint can therefore be written:

$$(15) \qquad \sum_{k=A,B} \mathord{\mathsf{I}}_k (\dot{p}_k + \dot{Q}_k) = 0$$

Using relationships (8) et (13), the expression of the endogenous variation of exchange rate can be obtained:

$$(16) \qquad \dot{e} = \frac{\displaystyle\sum_{k=A,B}[t_k \mathord{\mathsf{I}}_k \mathsf{a}_k]}{t + \dfrac{x}{\mathsf{s} - 1}} \dot{w}_u$$

where $t = \displaystyle\sum_{k=A,B}[\mathord{\mathsf{I}}_k t_k]$ and $x = \displaystyle\sum_{k=A,B}[\mathord{\mathsf{I}}_k x_k]$ refer respectively to the average degree of exposure to international competition and to the average export intensity in the economy.[13]

Using this expression in equation (14), simplifying (note in particular that $\mathord{\mathsf{I}}_A \mathord{\mathsf{I}}_B (\mathsf{a}_A - \mathsf{a}_B)^2 = V_a$) and rearranging, we finally obtain:

$$(17) \qquad \frac{\dot{U}}{\dot{w}_u} = -\mathsf{a} \left[\underbrace{\left(1 + \frac{V_a}{\mathsf{a}^2}\right)}_{\substack{1st\,term \\ (\text{"}autarchic\text{"}effect)}} + \underbrace{\frac{(\mathsf{s}-1)^2}{x+(\mathsf{s}-1)t} \frac{V_a}{\mathsf{a}^2} t_A t_B}_{2nd\,term} + \underbrace{\frac{(\mathsf{s}-1)}{x+(\mathsf{s}-1)t} \frac{V_a}{\mathsf{a}^2} \frac{\mathsf{a}_A t_A x_B - \mathsf{a}_B t_B x_A}{(\mathsf{a}_A - \mathsf{a}_B)}}_{3rd\,term} \right]$$

As previously, this elasticity, which corresponds exclusively to a competitiveness effect, increases with the share of the unskilled wage-bill in GDP. We also find a first term which still corresponds to the autarchic effect.

The sum of the two following terms therefore reflects the influence of international trade on the unskilled-labour-demand elasticity. In order to understand better the significance of these terms, let us come back on the general intuition of underlying mechanisms. An increase in unskilled labour cost has a different effect on industries' production costs, striking the most unskilled-intensive industry more heavily. The constraint on the trade balance then induces a devaluation; this devaluation improves the production costs of domestic firms with respect to their foreign competitors, in the same proportion for both industries. In a fairly "regular" configuration, the sum of both effects is thus expected to be unfavourable for the unskilled-intensive industry, and favourable for the other one. In this case, trade openness would reinforce the competitiveness effect with respect to the autarchic situation: an increase in unskilled labour cost modifies the economy's trade specialisation, at the expense of the unskilled-intensive industry. This is indeed what is suggested by the second term $((...)t_A t_B)$,

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[13] Note, however, that the degree of exposure to international competition is not additive. As a consequence, the calculation of this indicator at the level of the whole economy would not give the same result than the weighted average used here.

always negative (remember that square brackets are preceded by a negative sign). For a given degree of exposure to international competition, this effect is more important when the exposure is more uniformly shared among industries. Contrary to Kenen's arguments (1969), trade diversification is not a guarantee of stability in this case. The more varied the industries concerned by foreign trade, the more contrasted the repercussion of a change in unskilled-labour costs on competitive positions are likely to be, thus inducing significant changes in trade specialisation. On the other hand, an economy whose trade concerns only one industry would not experiment any change in its sectoral trade specialisation.

A last effect remains to be considered. The exchange rate adjustment does not only induce a redistribution in market shares, it also modifies the average price of domestic consumption, with a consequence on the volume of consumption. If for instance the initial shock is an increase in the cost of unskilled labour, it induces a devaluation. This raises the average price of consumption in each industry, in proportion to the penetration rate of imports. Apart form the effect described above on market shares, domestic producers thus also experience a decrease in the global level of the domestic consumption in their industry, which is more important when the penetration rate of imports is higher. This is what reflects the last term in equation (17). Under the constraint of an unchanged trade balance, only the relative effect on both industries is relevant as far as unskilled-labour demand is concerned. If industry A is assumed to be unskilled intensive ($a_A > a_B$), then the sign of this last term is (given the negative sign preceding the square brackets) the sign of ($a_B t_B / x_B - a_A t_A / x_A$). This expression is positive only when the ratio of the degree of exposure to international competition to the export intensity, t / x, is "sufficiently" lower in industry A than in industry B. This is the case when the unskilled-intensive industry is mainly export-oriented, while the other industry is mainly import-oriented, *i.e.* for an economy presenting a sectoral specialisation typical of a low-wage country. For a country presenting a weak, revealed advantage in industry B, and if trade openness is far higher in industry A, the ratio t / x can also be lower in this latter industry. If factor intensities are sufficiently similar in the two industries, the term can then be positive. This case is however very specific and hardly realistic. On the contrary, for an economy presenting a significant revealed comparative advantage in the skill-intensive industry, *i.e.* broadly speaking for a rich country, the last term is necessarily of the same sign as the previous one: it increases the magnitude of the competitiveness effect.

To sum up, we have proved that, for a country presenting a significant revealed comparative advantage in the skill-intensive industry, trade openness rises the price-elasticity of unskilled-labour demand, with respect to autarky. This effect is stronger the more open the economy is and the more uniform the degree of exposure to international competition is between industries. It is also an increasing function of the elasticity of substitution between domestic and foreign goods, and of the standardised inter-sectoral variance of the shares of the unskilled-labour wage-bill in value added.

Two industries have been considered so far, for the sake of simplicity. However, the results presented above and their interpretation can be generalised to the case where the number of industries is higher.

3.   Generalisation to *n* industries

The results presented in the case of an exogenous exchange rate do not depend on the number of industries. In particular, equation (12) remains valid for a number *n* of industries superior to 2.

On the other hand, when the exchange rate adapts in order to keep the trade balance unchanged, the expressions cannot be simplified in the same way. Relationships (14) and (16) are nevertheless valid, and their combination make it possible to write:

$$(18) \quad \frac{\dot{U}}{\dot{w}_u} = -a\left(1+\frac{V_a}{a^2}\right)$$

$$-\frac{1}{a}\left[(s-1)\sum_{k=1..N} l_k a_k^2 t_k - \frac{(s-1)}{x+(s-1)t}\left(\sum_{k=1..N} l_k a_k t_k\right)\left(\sum_{k=1..N} l_k a_k \left(x_k + (s-1)t_k\right)\right)\right]$$

Rearranging and using the explicit expressions for *t* and *x*, as defined previously, we obtain:

$$(19) \quad \frac{\dot{U}}{\dot{w}_u} = -a\left(1+\frac{V_a}{a^2}\right) - \frac{1}{a}\frac{(s-1)}{x+(s-1)t}\sum_{k=1..N}\left[l_k a_k t_k \left(\sum_{j=1..N} l_j (a_k - a_j)(x_j + (s-1)t_j)\right)\right]$$

And finally:

$$(20) \quad \frac{\dot{U}}{\dot{w}_u} = \underbrace{-a\left(1+\frac{V_a}{a^2}\right)}_{\substack{1st\ term \\ "autarchic\ effect"}} - \underbrace{\frac{1}{a}\frac{(s-1)^2}{x+(s-1)t}\left[\sum_{\substack{k,j=1..N \\ k>j}} l_k l_j (a_k - a_j)^2 t_k t_j\right]}_{2nd\ term}$$

$$\underbrace{-\frac{1}{a}\frac{(s-1)}{x+(s-1)t}\left[\sum_{\substack{k,j=1..N \\ k>j}} l_k l_j (a_k - a_j)(a_k t_k x_j - a_j t_j x_k)\right]}_{3rd\ term}$$

The decomposition in three terms proposed for equation (17) is still present here. The interpretation given previously also remains broadly unchanged. This is fairly clear for both first terms, but it also true for the last one. Indeed, this term is negative as soon as a sufficient negative sectoral correlation between a_k and x_k / t_k exists, *i.e.* as soon as the economy considered is sufficiently specialised in skill intensive industries.

IV.   Discussion and assessment

What is the practical importance of this effect of international trade on the price-elasticity of unskilled-labour demand? Before answering this question, it is worth recalling some orders of magnitude.

A.   *Labour-demand elasticity: recalling some orders of magnitude*

Significant differences exist concerning the assessment of the price-elasticity of aggregate labour demand. According to a detailed survey of the literature on this topic, Hamermesh (1993) concludes that this elasticity lies between -0.15 and -0.75. He proposes -0.3 as a reference value, which suggests that the elasticity of substitution between labour and other production factors is close to unity.[14] Observing that, on the basis of macroeconomic data, the unconditional elasticity of labour demand is frequently close to -0.4 or -0.5, Cahuc and Zylberberg (1997, p. 127) conclude that the competitiveness effect is weak, between -0.1 and -0.2.

However, it is difficult to disentangle the substitution effect and the competitiveness effect at the aggregate level. Even when the global output is constant, variations in product-mix can occur within an aggregated sector as a consequence of a variation in the labour cost. These variations, at the expense of the most labour-intensive productions, are then interpreted as a substitution effect at this level of sectoral breakdown, while they belong in fact to a competitiveness effect.

As a matter of fact, on the basis of firms' panel data, the conclusion of Legendre and Le Maitre (1998) is significantly different about the relative importance of the pure substitution effect and of the competitiveness effect. According to their results, the first one would correspond approximately to -0.2 while the second one would be close to -0.75. The competitiveness effect would therefore be overwhelming at the level of the individual firms. As we noted above, however, the link is not direct with the aggregate elasticity of substitution, at least for the competitiveness effect. And the authors note indeed that the reality of this competitiveness effect remains to be proved, because their approach in partial equilibrium can lead to a "composition sophism". By this, they refer to a mechanism, incoherent at the global level for an autarchic economy, where each firm increases its market share. Consequently, they note that "the reality of this effect depends crucially on the degree of openness of our economy (and of the fact that it is impossible for our partners to react to an increase in our firms' market share)" (p. 14). The mechanisms described here show that the competitiveness effect may exist even without any increase in the global market share of firms. A significant part of the competitiveness highlighted by Legendre et Le Maitre may therefore be active in a durable way through variations in trade specialisation.

B.   *Importance and sensitivity in two textbook-cases*

These points of comparison being established, the magnitude of the effects highlighted remains to be specified. As first evaluation, we propose to study two "textbook cases", in a 2x2 framework. The first one corresponds to the case of a country whose trade is balanced in both industries, with the same degree of openness ($m_A = m_B = x_A = x_B = m$). For the sake of simplicity, the share of each industry in GDP is supposed to be 1/2. Graph 1 plots the price-elasticity of aggregate labour demand (under the constraint of balanced trade) as a function of the degree of openness m of the economy. Three cases are represented, according to the value

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[14] This elasticity however seems to be higher for unskilled labour (see for example Dormont and Pauchet, 1997).

of the elasticity of substitution between domestic and foreign goods and to the standardised variance (V_a/a^2) of shares of unskilled labour in value added. When both parameters are weak (2 and 1/16 respectively), the elasticity hardly depends on the degree of openness: it increases from -0.35 in autarky to -0.37 for an degree of openness of 50%. When they are high (6 and 1/12 respectively), on the other hand, the competitiveness effect turns out to be very sensitive. An degree of openness of 37% is enough to double its value compared to its autarchic value (-0.5). For intermediate values (4 and 1/4), probably more realistic, the impact of trade remains significant. Compared to its autarchic level of -0.42, the value of the elasticity of substitution increases by around a quarter when the degree of openness increases to 25%, and almost by a half for an degree of openness of 50%.
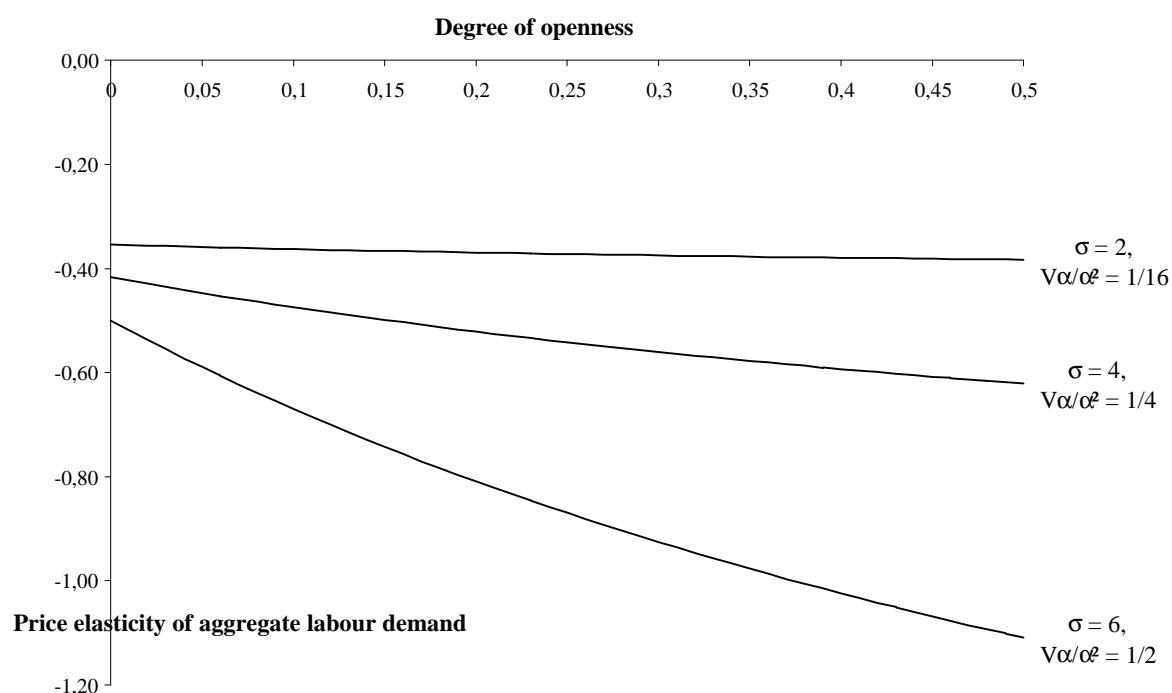
Graph 1 :
The price-elasticity of aggregate labour demand as a function of the degree of openness, for a country whose foreign trade is uniformly intra-industry
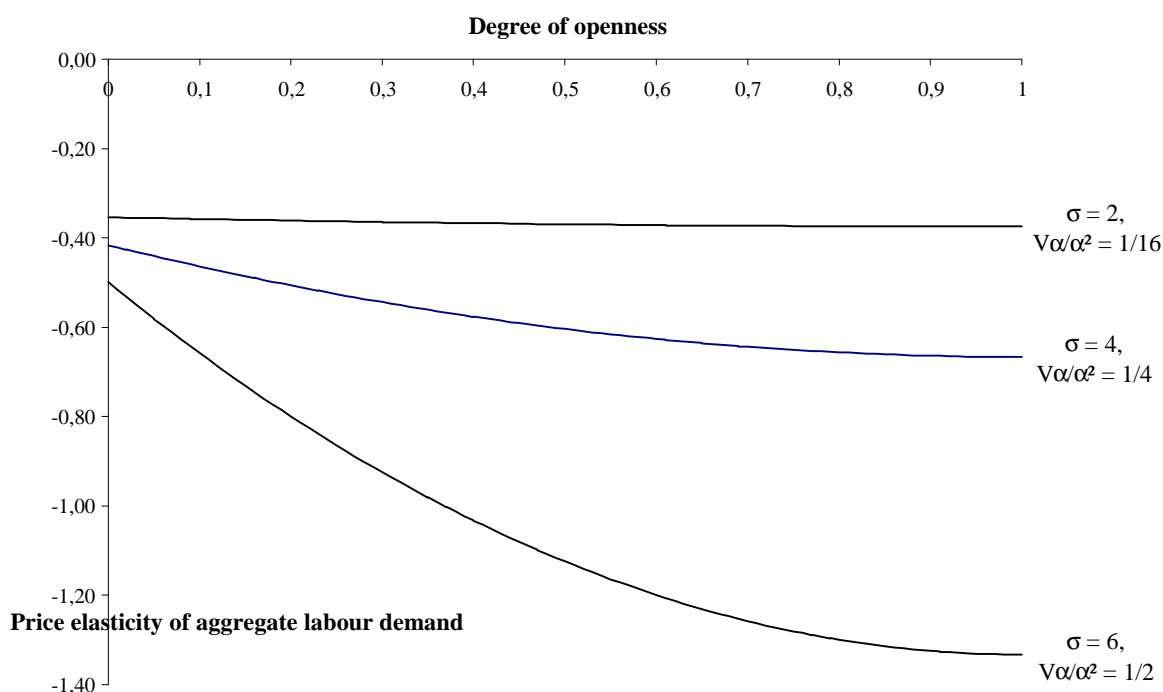
Note : graph plotted for $a = 1/3$, $l_A = l_B = 1/2$, $m_A = m_B = x_A = x_B = m$.

As a second example, let us consider the case of a "rich" country, with a balanced, purely inter-industry trade (the exporting industry is the skill-intensive one). As previously, the share of each industry in GDP is supposed equal to 1/2. Graph 2 plots the price-elasticity of aggregate unskilled-labour demand (under constraint of balanced trade) as a function of the degree of openness *m* of the economy. As in the previous example, three cases are represented, corresponding to different values of the Armington's elasticity of substitution and of the variance of factor intensities. The labour-demand elasticity is here approximately twice as sensitive as previously to the degree of openness (which cannot exceed 50%, by definition). Compared to its initial value of 0.42, the value of the elasticity is increased by around one third for a degree of openness of 30% in the intermediate case (parameters set to 4 and 1/4 respectively).

Graph 2 :
The price-elasticity of aggregate labour demand as a function of the degree of openness,
for a country whose foreign trade is purely inter-industry

Note : graph plotted for $a = 1/3$, $I_A = I_B = 1/2$, $x_A = m_B = 0$, $m = x = x_B/2 = 1/(2/m_A-2)$. The choice of supposing that the share of industries in value added is constant is made for the sake of simplicity.[CSJ2] However, this choice prevents these curves from being considered as trajectories, described by a given economy while it opens to trade: the changes in sectoral specialisation would in this case also induce a modification of industries' share in GDP, as well as possibly a change of the sharing out of value added among production factors within each industry.

These simulations highlight the overwhelming importance of two key-parameters in setting the "international competitiveness" effect, linked to trade: the elasticity of substitution between foreign and domestic goods, and the standardised inter-sectoral variance of the share of unskilled labour in value added. But they also show, by and large, that the influence of trade openness on labour-demand elasticity is potentially important. Moreover, it seems to be more important, the more specialised the economy is in skill-intensive productions, for equal levels of trade intensity.

C.   *"International competitiveness" effect: an assessment*

Beyond the "textbook cases" presented above, equation (20) enables the described effects to be assessed, on the basis of real data. As the mechanisms described concern mainly the industrial sector, we will limit the analysis to this part of the economy. A reservation has first to be made: such an assessment depends on the sectoral classification chosen. The data used here come from the classification NAP 100 of French national accounts. The field of industry, excluding energy and quarrying, is disaggregated in 39 sectors. The definition for unskilled labour includes manual workers and employees, as opposed to intermediate and superior professions, which are supposed to be skilled.

For the simplicity, intermediate consumption are not considered in the analysis. Implicitly, the production has so far been assumed to be totally integrated vertically. In order to fit this hypothesis more closely, it would be necessary to include direct *and* indirect national unskilled labour input, and to base the calculation on the share of their wage bill in production cost. A simpler calculation is made here, as a proxy; it only takes into account the direct employment and is therefore based on its share in value added.

Table 1 :
Assessment of elasticities associated with the competitiveness effect in autarky and to the "international competitiveness" effect for French industry in 1977, 1985 and 1993

		1977	**1985**	**1993**
Competitiveness effect under autarky (elasticity)		- 0,350	- 0,317	- 0,255
"International competitiveness effect" (elasticity) with an elasticity of substitution between domestic goods and foreign goods equal to	2 :	- 0,132	- 0,139	- 0,117
	3 :	- 0,264	- 0,278	- 0,234
	4 :	- 0,396	- 0,417	- 0,350
	5 :	- 0,528	- 0,555	- 0,467
For information :				
Share of unskilled labour wage bill in value added (%)		33,1	28,2	22,3
Inter-sectoral standard deviation of the share of unskilled labour in value added, weighted by the sectoral value added (%)		8,0	9,9	8,4
Average export intensity (%)		23,3	29,2	32,0
Average import penetration rate (%)		20,5	26,7	30,6
Average degree of exposure to international competition				
(weighted average of sectoral degrees) (%)		38,0	46,3	50,1
(direct calculation for the whole industry) (%)		39,0	48,1	52,8

Source : French national accounts, INSEE ; *Enquêtes sur la structure de l'emploi*, INSEE ; *Déclarations Annuelles de Données Sociales* (DADS), INSEE-DARES. All data are based on the classification NAP 100 of the French national accounts.
Field : The data presented concern all industry, excluding energy and quarrying.

The results obtained show that the "international competitiveness" effect (corresponding to second and third terms of equation (20)), linked to the variation in sectoral trade specialisation, was far from negligible, in 1993, compared to the competitiveness effect under autarky (see Table 1). The assessment depends on the choice made on the Armington's elasticity, which in each case is assumed to be identical for all industries. With a fairly low elasticity of 2,[15] the international competitiveness effect already corresponds to half the

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[15] For orders of magnitude of this elasticity in a framework comparable to that adopted here, see for example Bismut and Oliveira-Martins (1986).

autarchic effect. If we assume, what is probably more realistic, that this elasticity is close to 3 or 4, then the international competitiveness effect turns out to be equivalent to, or more important than, the autarchic effect. The proportion is even closer to two for one when the Armington's elasticity is assumed equal to 5.

These calculations can only give orders of magnitude. They are sufficient, however, to show that trade openness explains an important share of the competitiveness effect linked to a variation in unskilled labour cost, for a country like France. In other words, the price-elasticity of unskilled-labour demand is significantly higher than it would be under autarky.

Whatever the hypothesis made concerning the elasticity of substitution, the weight of the international competitiveness effect in the total competitiveness effect increased between 1977 and 1985, and between 1985 and 1993, because of the intensification of international trade. However, both effects significantly decrease in absolute value. This evolution is primarily the result of the sharp fall of the share of unskilled labour wage bill in industrial value added, from 33.1% in 1977 to 22.3% in 1993. As we noted above, the competitiveness effect is mechanically linked to the share of the production factor considered in the value added. Must we conclude that the competitiveness effect linked to a variation in unskilled labour costs is progressively decreasing?

It depends in fact on the definition adopted for the labour category studied. If the share of unskilled labour in value added clearly decreases, it is not the same, for example, for the share of workers whose wage is inferior to twice the minimum wage. Broadly speaking, the evolution is not thus clear when the categories are defined on the basis of relative wage criteria. And if we admit that the cost of a worker is closely linked to her/his skill level, then this second approach corresponds approximately to a classification based on relative (instead of absolute) skill levels. From an economic policy point of view, this second type of classification is not less interesting than the first. The problem on which institutional or fiscal policies may have an influence, is more the employment of *less-skilled* (or low-wages) rather than the employment of *unskilled*.

The time evolutions presented in Table 1 are misleading in this respect, as they are most of all determined by the fall in the share of unskilled labour in value added. When the calculation is done assuming that the share of unskilled labour in value added has remained constant within each industry, then the international competitiveness effect is found to have increased by 20%, while the autarchic effect has slightly decreased. Such an evolution is after all important, as it corresponds to the evolution of a structural parameter, over a period (16 years), which relatively short compared to the big transformations of an economy.

Conclusion

The influence of international trade on labour-demand elasticities has so far been analysed essentially through two approaches. According to the neo-classical theory of trade, this elasticity is infinite at the aggregate level, for a small economy under free-trade. Recent studies, on the other hand, have focused on the effect induced by trade openness on the elasticity of firms' individual labour demands, through the lowering of their mark-ups. These approaches seem to us unsatisfactory: the first one leads to unrealistic results, while the second one focuses on effects which are probably of a second order.

The analysis proposed here, and illustrated by a rather simple model, is intermediate. The intuition is that an increase in the cost of a production factor has an effect on the sectoral trade specialisation of an economy, at the expenses of the production using intensively this factor. This mechanism is more important the more the economy is opened, because the sharing of markets between domestic and foreign producers is then more sensitive to relative prices.

It is not only an effect of the trade balance: even when the trade balance is supposed to be maintained constant through an endogenous adjustment of exchange rate, the variation in the sectoral trade specialisation increases the own-price-sensitivity of the aggregate demand for a given production factor. Trade openness therefore magnifies the competitiveness effect linked to the variation in a factor's cost. In the formal framework used here, this result may be established unambiguously, under the constraint of an unchanged trade balance, as soon as the economy enjoys a sufficiently important comparative advantage in the productions which do not use this factor intensively. For rich economies, this hypothesis is not dubious in the case of unskilled labour, which we took as a basis for illustration.

The modification induced in the competitiveness effect appears significant. For France, the assessments presented suggests that trade openness would explain one to two thirds of the competitiveness effect linked to a variation in unskilled-labour cost. Moreover, the magnitude of this "international competitiveness" effect is clearly sensitive to trade intensity. It would thus have risen by 20%, between 1977 and 1993, for low wages in France. Finally, this sensitivity is likely to be very important for a very open country presenting a strong specialisation in unskilled intensive production, *i.e.* in particular for small rich countries.

This impact of international trade on the price-elasticity of aggregate demand for unskilled labour (or for another factor) deserves further research. Its empirical validation is nevertheless problematic, as it involves estimating variations in parameters already difficult to estimate.

In any case, this type of mechanism underlines the fact that the impact of international trade on labour markets is not only a problem of factor relocations. The increasing trade openness of economies modifies significantly the rules of the "economic game". The competition in the goods markets is strengthened, not only between firms, but also between domestic producers as a whole and foreign producers. The greater sensitivity of the labour market is a consequence of this evolution.

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8[CSJ1] Si l'on en juge par les ordres de grandeur donnés au chapitre 3, cet effet devrait toutefois rester relativement faible.

18[CSJ2]It enables the share of unskilled labour wage bill in GDP to be kept constant throughout each curve, for which this share is fixed within each industry (it is determined jointly by the average, the standardized variance and the shares in value added).