Can the HOS model explain changes in labor shares? A tale of trade and wage rigidities*

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Abstract: This paper questions the ability of the standard HOS (Heckscher-Ohlin-Samuelson) model to explain changes in the labor shares (LS) of income in OECD countries. We use the Davis (1998) version of the HOS model where there is a wage rigidity in a sub-group of countries. We show that trade openness with developing countries reduces LS in rigid-wage countries, and does not affect LS in free-wage countries. This pattern is induced by factor reallocation towards capital-intensive sectors in rigid-wage countries. Using the KLEMS dataset for 8 OECD countries over the period 1970-2005, we show that the weight of capital-intensive sectors substantially increased in Continental European countries, while it did not change or even decreased in the US and the UK. Fixed effects regressions suggest that trade intensity with China explains between 50% (IV estimates) and 80% (OLS estimates) of the observed differential labor share change between Continental Europe and Anglo-Saxon countries.

Keywords: Davis model; factor reallocation; elasticity of substitution; unemployment

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1 Introduction

Contrary to conventional wisdom, the ratio of wage bill to value-added is not constant over time and space. Since Kaldor (1958) stylized facts and despite Solow (1958) skepticism, labor share has been considered stable and this claim was commonly accepted in the literature. Recently scholars have started to challenge this view and have documented some decreasing trends in major OECD countries (see Piketty, 2014 or Karabarbounis and Neiman, 2014). For Continental European countries, Blanchard (1997) or Blanchard and Giavazzi (2003) very early pointed out a strong decrease of the labor share. In continental European countries, using data from OECD STAN database, we can see on figure 1 the labor share (LS) decreased by about 5.5 points between 1970 and 2000.\footnote{We distinguish two sets of countries we consider in the empirical part of the paper and for which data are available. Civil-law countries (continental European countries) correspond to Finland, France, Germany, Italy, the Netherlands, and Spain, whereas common-law countries (Anglo-Saxon countries) correspond to the US, Canada, and the UK. This distinction broadly maps the more usual distinction between continental European and Anglo-Saxon countries.} Over the same period, the LS only decreased by about 2 points in the UK, US, and Canada. The differential change in labor share, therefore, reaches 3.5 points.\footnote{The labor share amounts to 64.5% for Anglo-Saxon countries and 65% for European countries in 1970, which corresponds to the standard calibrated value. Continental European countries experience an increase in the labor share starting from the early 1970s, and then a sharp decrease starting from the early 1980s. The decrease overshoots the increase of the 1970s and the labor share is lower in 2000 than in 1970, 59.5% against 65%. The Anglo-Saxon labor share is more stable: it decreases from 64.5% to 62.5%. This trend disappears when we consider unadjusted labor shares. The differential change, therefore, is -3.5 labor share points against Continental Europe.}

These phenomena take place in a particular era characterized by product market globalization, and especially trade with developing countries and characterized with a strong heterogeneity in term of institutions, especially labor market institutions. The research question we address in this paper is whether the HOS model, once completed by a wage rigidity in a sub-group of countries as in Davis (1998), can account for such changes in LS in OECD countries.

Changes in LS matter for three reasons. First, the LS affects public finance because capital income is typically less taxed than labor income. In France for instance, the effective labor income tax rate is above 40%, whereas the effective capital income tax rate is below 20%. Increasing the LS by 3.5 percentage points would increase tax receipts by .7 points of GDP. Second, the labor share is strongly linked to income inequality because capital income is much more concentrated than labor income. Cheachi and Garcia-Penalosa (2009) estimate that the elasticity of the Gini coefficient to the LS is about -.6. Increasing the LS by 3.5 points would reduce the Gini coefficient by 2.1 points (a decline by 5% of its value, or half the increase in the index observed since the 1970s). Finally, nonconstant labor shares cast doubt on the Cobb-Douglas / perfect competition paradigm.

The differential LS pattern between Anglo-Saxon and continental European countries received several explanations.
Since Blanchard (1997), several papers considered the role of technological change (see e.g. Hornstein et al, 2002, Acemoglu, 2003, Bentolila and Saint-Paul, 2003, Guscina, 2006, and Ellis and Smith, 2007). The main shortcoming of this approach is that, according to Nordhaus (1997), it seems unrealistic that production techniques used in continental European countries remain unknown in the Anglo-Saxon world. More recently, Karabarbounis and Neiman point out the role of the rapid decrease in the price of investment goods to explain the recently observed decreasing trends.

The other explanation is based on institutional change (good and labor market). Blanchard (1997) and Blanchard and Giavazzi (2003) argue that the decrease in European LS may be due to (i) an increase in the mark-up of price over marginal costs related to good market regulations, and/or (ii) a decrease in workers’ bargaining power due to labor market reforms. In the same vein, Checchi and Garcia-Peñalosa (2007) put forward the roles of unemployment benefits and the minimum wage. Indeed, the decrease in unemployment benefits or the minimum wage observed during the 90’s in many OECD countries may have affected the bargaining power of workers as highlighted in standard labor market matching models (see Pissarides, 2000 for instance).

However, a mark-up increase is not really plausible given that the 1980s and the 1990s are characterized by European integration, globalization and product market deregulation. Meanwhile, reforms have been more timid and piecemeal on the labor market (Boeri et al, 2000). In France for instance, the early 1980s saw the introduction of stricter regulations rather than softer ones.

Several studies focus on labor shares at disaggregate level. They tend to show that the labor share is stable at micro level, which contrasts with the patterns of aggregate shares. In those studies aggregate movement in the factor share are therefor related to composition effects. Kyyra and Maliranta (2008)
show that all the decreases observed in Finland from 1970 to 2000 are due to factor reallocation between existing firms or plants. Böckerman and Maliranta (2009) show that trade is the main factor behind such factor reallocation. De Serres et al (2002) decompose variations in the labor share at industry level between 7 industries. From 1970 to 2000, sector reallocation implies a 7-point decrease in aggregate labor share in Germany, 4 points in France, 3 points in Italy, and 4 points in the Netherlands. More recently Author et al (2017) show that the weight of superstar firms (whose labor share is lower) have increased in the last decades and has driven the recent decrease in the labor share for the US economy.

Recent literature deals with the impact of globalization on the LS. The basic HOS model without wage rigidity predicts that trade openness between labor- and capital-abundant countries decreases the LS in capital-abundant countries and increases it in labor-abundant countries as it should lower wages in capital-abundant countries. This theory fails to explain the variety of patterns that the different groups of OECD countries experience. Rodrik (1997) argues that openness hurts workers’ bargaining power and makes wages decreasing at given output. Any increase in firms’ statu-quo position reduces the share of rents accruing to labor, thereby deteriorating the LS.\(^3\) Harrison (2002), for financial openness, and Ortega and Rodriguez (2002), for international trade, develop models along these lines. Rodrik-type arguments are probably more suited to developing countries than to OECD countries. They imply that the labor share should decrease within firms or sectors which is not the case in US (Author et al, 2017) or in Finland (Böckerman and Maliranta, 2009). Furthermore, those theories cannot predict the observed heterogeneity at the country level in the patterns of aggregate labor shares.

In this paper, we point out the role of trade and wage rigidities, or, more precisely, the fact that the trade impact on the labor share differs according to whether the country is characterized by wage rigidity or not. In standard HOS theory, markets are perfectly competitive and factor prices are determined by factor endowments at the world level. The relative scarcity of capital with respect to labor determines the relative price of the capital-intensive good. In turn, such a relative price determines the relative factor price by Stolper-Samuelson theorem. In such a framework, the labor share should unambiguously decrease in capital abundant countries as labor is relatively scarce compared to the global world endowment. In the Davis (1998) version of the HOS model, a subset of countries participating in international trade set a wage rigidity that is not compatible with full employment. The wage rigidity does not alter the Stolper-Samuelson relationship, and the relative price of the capital-intensive good goes up. This must be true at the world level, leading to factor price equalization throughout the world. The employment cost of the rigidity is magnified and unemployment increases in rigid wage countries so that capital intensity at the world level is compatible with the relative factor cost of the rigid wage country.

We use the Davis model to predict the impact of trade openness and wage rigidities on the labor shares of income. We model the wage rigidity in a convenient form: we assume that the relative price of labor with respect to capital is exogenously given (and constant). It is set at the autarky level and the relative wage is not affected when the country become more open to international trade. This allows us to write the model outputs as simple functions of the relative wage rigidity. Our arguments hinge on the

\(^3\)Going from a decline in wage to a decline in LS is not so simple: as far as labor is paid its marginal product, changes in wages do not tell much about changes in the LS. Models typically assume that there are rents on the product market created by imperfect competition, and workers and firms’ owners bargain over total surplus, including rents.
following idea. In the country that implements the relative wage rigidity (higher than the free market world equilibrium level compatible with the world endowment), unemployment should increase and since the factor price is the same as in autarky, the labor share should decrease. Unemployment increases in the rigid wage country so that the capital intensity at the world level is compatible with the (rigid) relative factor cost. More precisely, globalization induces factor reallocation towards capital-intensive and low-labor share sectors in the rigid wage country. Hence the share of the capital intensive sector should increase (which lowers the aggregate labor share). In the free-wage country, globalization does not alter factor allocation across sectors. Sector weights in aggregate value-added do not change, and the aggregate labor share stays constant. In other words, the flexible wage country benefits from the wage rigidity and the relative factor price remains at the autarky level (Stolper-Samuelson relationship) without experiencing any increase in the factor employment. Nothing changes compared to autarky. The labor share remains constant as a result. Interestingly, in this model, the decrease of the labor share should coincide with an increase in unemployment in rigid wage countries. This seems to be the case for the major continental European countries, Germany, France, Italy and Spain. To quote Blanchard and Giavazzi (2003): "the major decline in the share in the 1980s coincided with a further increase in the unemployment rate during that decade". No correlation should exist for the flexible wage countries.

We focus on two main implications.

First, increasing the rigid wage is more likely to decrease the labor share in a globalized world than in a closed economy. For instance, the labor share stays constant in a closed economy when sector-specific technologies are Cobb–Douglas and the utility function is log-linear. By contrast, and under the same technological assumptions, the labor share falls when the economy is open to international trade. A decline in European labor shares does not require any product market imperfections and involves more rigid wages rather than less rigid wages. It also means that European workers not only pay a huge price in terms of foregone jobs, but they also suffer from low relative earnings prospects.

Second, we follow Davis and consider the implications of free trade between three economic zones: Europe, the US and Newly Industrialized Countries. The European wage rigidity is set at the competitive level that prevails in autarky. Trade openness leads to a decline in European LS, while keeping the US share constant. Meanwhile, such changes at the aggregate level are compatible with stable labor shares at the firm/sector level.

In the empirical part of the paper, we examine whether trade-induced factor reallocation can explain a substantial part of observed changes in labor shares across Continental Europe and the Anglo-Saxon countries. We use the KLEMS dataset, which provides sectorial data for 8 OECD countries over the period 1970-2005. To closely mimic the model, we build two super sectors. The capital-intensive sector is composed of sectors whose capital intensity is larger than the aggregate capital intensity at the country level in 1980. The labor-intensive sector is composed of the remaining sectors. The magnitude of trade with developing countries is captured by bilateral trade openness with China. The choice of this variable follows Michaels et al (2014) who argue that trade with China is a good proxy for the whole of trade with developing countries. The China trade shock is now widely used in the literature (see for instance

\footnote{This corresponds to the countries for which the capital stock was available in the KLEMS dataset over the period we consider}
Autor et al 2013 or Autor et al 2016) as a proxy for the increasing trade with developing countries. It corresponds to a huge and plausibly exogenous shock of trade with developing countries given the weight of China in the world economy. It now accounts for a large fraction of trade with developing economies. Given its strong increase over the last decades and its current weight in total trade, it is a good candidate to identify the impact of trade with developing countries.

We first provide some descriptive evidence of (i) an increase in the capital intensive sector observed only in continental European countries (ii) movements in the labor share that coincide with an increase in the unemployment rate for continental European countries only.

We then regress the share of the capital-intensive super-sector on trade with China. Trade with China is also interacted with a dummy variable taking the value one if the country is from continental Europe, and 0 otherwise. All regressions feature country fixed effects, time effects, and the aggregate countrywide ratio of capital stock to GDP to account for Rybczinski effects. IV estimates imply that trade with China explains 60% of the observed differential capital-intensive sector share change (against 100% for OLS estimates). The corresponding differential impact on the labor share is about 1.8 point (2.8 points), half (eighty percent) of the observed effect.

Section 2 describes the aggregate patterns of labor shares in OECD countries. It also discusses the microeconomic evidence. Then, Section 3 considers the Davis (1998) model. Section 4 presents the empirical analysis and section 5 concludes.

2 HOS, labor shares and wage rigidities

In this section, we confront the HOS model with wage rigidity to the set of facts reported in Section 2. We first derive well-known results concerning the impact of factor accumulation and changes in relative factor costs on the labor share. Second, we briefly remind Davis (1998) model with wage rigidity. Third, we discuss the effects of trade and wage rigidity on the labor shares using the Davis model. Finally, we distinguish sector-specific effects from composition effects across sectors induced by factor reallocation in order to study the empirical validity of the model.

2.1 A reminder

Assume that there are two production factors, $K$ and $L$, paid at their marginal product and used in a constant returns to scale technology. The Euler theorem implies that output is totally dispatched between capital and labor returns so that the labor share is:

$$\text{LS} = \frac{wL}{wL + rK} = \frac{\omega}{\omega + k}$$

where $w$ is the nominal wage, $r$ is the unit capital cost, $\omega = w/r$ is the relative wage, and $k = K/L$ is capital intensity. Changes in LS result from changes in $k$ and/or $\omega$. However, these variables are generally linked to each other.

We start with the case where the dependence is nil, which we name the trade view of the labor share.

Result 1 Trade view of the labor share
Let $\omega$ be given. Then, the labor share strictly decreases with capital intensity, that is $\partial LS_i / \partial k_i < 0$

Capital deepness lowers the labor share. This property has two implications. Suppose first that $\omega$ is the same across sectors. Then Result 1 means that capital-intensive sectors feature a lower labor share than labor-intensive sectors. Now, consider a set of countries forming a trade area. Factor Price Equalization theorem states that $\omega$ must be the same across countries. According to Result 1, country-specific labor share should decrease with capital intensity.

More generally, relative wage and capital intensity are positively related, which we summarize by the formal dependence $\omega = \omega (k)$. A change in relative wage has two opposite effects on the labor share:

$$
\frac{\omega (\partial LS/\partial \omega)}{LS} = (1 - LS) \left[ 1 - \frac{\omega (\partial k/\partial \omega)}{k} \right]
$$

(2)

**Result 2 Classical View of the Labor Share**

Let $\varepsilon = \omega (\partial k/\partial \omega) / k$ be the elasticity of substitution between capital labor. The labor share strictly decreases with relative wage if and only if the elasticity of substitution is larger than one, that is $\partial LS/\partial \omega < 0$ is equivalent to $\varepsilon > 1$

Firms substitute capital to labor when relative wage increases. The magnitude of this substitution is captured by the elasticity of substitution between capital and labor. Following the classical view, the labor share should not depend on relative factor cost when aggregate output is Cobb-Douglas.

**Result 3 Labor Market View of the Labor Share**

Let $K$ be given and $\eta = \omega (\partial L/\partial \omega) / L$ be the elasticity of the labor demand with respect to relative wage. The labor share strictly decreases with relative wage if and only if the elasticity of the labor demand is lower than $-1$, that is $\partial LS/\partial \omega < 0$ is equivalent to $\eta < -1$

When capital does not adjust, relative factor cost alters capital intensity through its impact on employment:

$$
dk = - \frac{K}{L^2} \frac{dL}{d\omega}
$$

(3)

Hence, we can rewrite the elasticity of substitution

$$
\frac{\omega dk/d\omega}{k} = - \frac{\omega dL/d\omega}{L}
$$

(4)

The labor market view states that the labor share decreases with relative wage when the labor demand is sufficiently responsive to changes in relative factor cost.

Globalization in the context of relative factor price rigidity affects capital intensity, the aggregate elasticity of substitution between capital and labor, and the elasticity of the labor demand with respect to relative factor price.
2.2 HOS model with relative wage rigidity

Davis (1998) examines the impacts of wage rigidities on wage inequality and unemployment in the HOS framework. We now briefly remind Davis model. The general assumptions of the model are very standard. There are two sets of countries denoted by $i = 1, -1$, and two final goods produced from capital $K$ and labor $L$. Technologies have constant-returns to scale in each sector, and they are the same in both countries (with possibly some difference in total factor productivity). The relative price of the capital-intensive good is $p$. Preferences over the two goods are the same across countries, while factor endowments differ between countries. Country $1$ is endowed with $(K_1, N_1)$, while country $-1$ is endowed with $(K_{-1}, N_{-1})$. Capital is relatively more abundant in country $1$ than in country $-1$, so that $K_1/N_1 > K_{-1}/N_{-1}$. The relative supply of capital at the world level is $k^* = (K_1 + K_{-1}) / (N_1 + N_{-1})$. There is perfect competition in the good market. The labor market is perfectly competitive in country $1$, while factor prices are not flexible in country $-1$. Davis considers an absolute wage rigidity. We slightly alter his reasoning and focus on a relative wage rigidity. Hereafter, the relative wage $\omega = w/r$ is fixed where $w$ is the nominal wage and $r$ the cost of one unit of capital. This choice is made for exposition clarity.

Davis model contains three endogenous variables: world relative price $p$, effective capital intensity $k$, and employment $L_1$ in country $1$. These three variables solve:

$$
\begin{align*}
p &= p(k), \ p' < 0 & \text{(HO)} \\
\omega &= \omega(p), \ \omega' < 0 & \text{(SS)} \\
L_1 &= \frac{K}{k} - N_{-1} & \text{(BR)}
\end{align*}
$$

with $\omega \geq \omega(p(k^*))$ and $k = (K_1 + K_{-1}) / (L_1 + N_{-1}) \geq k^*$.

The first relationship is the Heckscher-Ohlin curve HO comes from Rybczinski. Following the Rybczinski theorem, an increase in capital intensity in a given country raises the relative supply of the capital-intensive good. In general equilibrium, this makes the relative price of that good (capital intensive) lower. This gives the familiar HO relation between capital endowment and the relative price of capital intensive good. That is, $p' < 0$. Evidently, the relationship goes both ways, a feature that the model with wage rigidity extensively uses. The second relationship is the Stolper-Samuelson curve SS. The relative price $p$ is the same in the whole integrated economy. When such a price of the capital intensive good increases, producing capital intensive good becomes more profitable at a given factor cost. Firms adjust the relative demand for capital as a result and the relative wage goes down. Owing to Factor Price Equalization theorem, the adjustment is the same in both countries. Here again, the relationship goes both ways and an increase in relative wage translates into a decrease in the relative price of the capital-intensive good. The third curve BR is a variant of the Brecher (1974) curve. Following an increase in the relative demand for capital (an increase in the capital intensity $k$ at the world level), employment must fall in the integrated economy. As wages are perfectly flexible in country $-1$, such a fall in employment can only take place in country $1$.

Figure 2 depicts the working of the model.

The model with perfectly competitive factor markets starts from the right with the relative supply of capital, and ends up left with the relative wage. The model with wage rigidity works the other way.
around. Start from country 1 relative wage $\bar{\omega}$. The (SS) curve gives the relative price of the capital-intensive good as a result. This relative price must hold at the integrated level. Factor price equalization results and $\bar{\omega}$ prevails for the whole trade area. The corresponding relative price is not compatible with full employment. At such a price, the (HO) curve implies that the relative demand for the capital-intensive good is larger than the relative supply with full employment. Consequently, the relative demand for capital is larger than the relative supply $k^*$. Finally, the (BR) curve gives the resulting employment in country 1.

What happens when the relative wage rigidity increases, or when globalization expands to less-developed trade partners? An increase in $\omega$ lowers the relative price of the capital-intensive good, thereby further increasing the relative demand for capital. Employment in country 1 decreases as a result, leaving unchanged employment in country $-1$. Alternatively, opening to trade with less-advanced economies means that $K_{-1}$ increases by less than $N_{-1}$. The relative supply of capital falls as a result. The (BR) curve moves rightward, which further deteriorates employment in country 1. The following Result summarizes these predictions of the Davis model.

**Result 4 Davis (1998) Predictions**

Let $d\omega$ define a marginal increase in relative wage rigidity, and $(dK_{-1},dN_{-1}) > 0$ define a marginal increase in globalization.

(i) A marginal increase in relative wage rigidity raises the relative demand for capital and lowers employment in country 1, that is $dk/d\omega > 0$ and $dL_1/d\omega < 0$;
(ii) A marginal increase in globalization increases capital intensity and lowers employment in country 1 whenever the relative supply of capital decreases at the world level, that is \( dK_1 < 0 \) and \( dN_{-1} < 0 \) if and only if \( dK_{-1}/dN_{-1} < k \)

We now turn to the original part of the analysis: the labor share predictions and the ability of the Davis model to explain recent trends in the labor shares. The next sections present some corollaries of the Davis’ model we derive with a focus on the labor share of income.

### 2.3 Labor share and globalization

Suppose that there is a marginal increase in globalization, that is \((dK_1, dN_1) > 0\), in the particular context where \( \omega \) is fixed. Such a change in factor endowment alters the relative supply of capital at the world level, thereby changing the relative demand for capital and employment in country 1 (the rigid wage country). The labor share in country 1 is \( LS_1 = \omega / (\omega + k_1) \). It responds to the marginal change in globalization as follows:

\[
dLS_1 = \frac{\partial LS_1}{\partial k_1} dN_{-1} + \frac{\partial LS_1}{\partial K_{-1}} dK_{-1}
\]

(5)

The marginal change in capital intensity with respect to \( N_{-1} \) is

\[
\frac{\partial k_1}{\partial N_{-1}} = \frac{-K_1}{(L_1)^2} \frac{\partial L_1}{\partial N_{-1}} > 0
\]

(6)

Using the Brecher relationship (BR), we obtain

\[
\frac{\partial k_1}{\partial N_{-1}} = \frac{K_1}{(L_1)^2} > 0
\]

(7)

Similarly, \( \partial k_1/\partial K_{-1} = -K_1/ (L_1)^2 (1/k) < 0 \). Therefore,

\[
dLS_1 = \frac{\partial LS_1}{\partial k_1} \frac{K_1}{(L_1)^2} \left( dN_{-1} - \frac{dK_{-1}}{k} \right)
\]

(8)

**Proposition 1** Labor share and trade globalization

At given \( \omega \), a marginal increase in globalization negatively affects the labor share in country 1 whenever it increases the relative supply of capital, that is \( dLS_1 < 0 \) if and only if \( dK_{-1}/dN_{-1} < k \).

Proposition 1 can be understood in light of Result 1. As labor-abundant economies enter the set of country \(-1\), the relative supply of capital goes down, which further requires to increase capital intensity in country 1 (so that the world’s capital intensity \( k \) is compatible with the rigid relative factor cost set by country 1). Accordingly, Result 1 implies that at given \( \omega \), an increase in the relative demand for capital leads to a decrease in the labor share of income. In other words, country 1 keeps the same relative factor cost but experiences a decrease in employment. This leads to a decrease in the labor share.

Proposition 1 also states that trade causes a negative correlation between unemployment and the labor share in countries that implement relative wage rigidities. By contrast, the correlation should not exist in countries where the labor market is perfectly competitive. This is consistent with the sharp increase in unemployment observed in continental European countries during the 80’s and the 90’s.
2.4 Labor share and relative wage rigidity

Changes in relative factor cost affect the labor share according to the values of the elasticity of substitution and elasticity of the labor demand. However, trade affects such elasticities, and, therefore, alters the effects of wage rigidities. The aggregate elasticity of the labor demand is

\[
\frac{\omega \partial L_1/\partial \omega}{L_1} = \frac{\omega}{L_1} \left( -\frac{K}{k^2} \frac{dk}{d\omega} \right)
\]  

(9)

Using the Brecher relationship (BR), we can decompose (9) in two terms

\[
\frac{\omega \partial L_1/\partial \omega}{L_1} = O(K, N_{-1}, k) \left( -\frac{\omega dk/\partial \omega}{k} \right)
\]  

(10)

where \( O(K, N_{-1}, k) = K/(K - N_{-1}k) \). The first term depends on globalization. It is larger than 1 unless the autarkic case where \( N_{-1} = 0 \). Globalization increases the elasticity of labor demand with respect to autarky. The second term only depends on the technology as it corresponds to the aggregate elasticity of substitution at the world level.

**Proposition 2 Labor share and relative wage rigidity**

A marginal increase in relative wage rigidity implies a fall in the labor share when the elasticity of substitution at the world level is lower than \( O(K, N_{-1}, k) \), that is \( \partial LS_1/\partial \omega < 0 \) if and only if \( (\omega dk/\partial \omega)/k \leq 1/O(K, N_{-1}, k) = (K - N_{-1}k)/K \)

In a globalized world, wage rigidities are more likely to lower the labor share than in a closed economy. Globalization increases the elasticity of substitution between capital and labor at the country level. Indeed, a marginal increase in globalization modifies the openness term \( O \) in equation (10):

\[
dO = (O - 1)(dN_{-1}/N_{-1} - dK_{-1})
\]  

(11)

It has the sign of \( dN_{-1}/N_{-1} - dK_{-1} \).

As an illustration, we solve the model with Cobb-Douglas technologies. Per capita output in sector \( i = a, b \) is \( f(k_i) = A_i k_i^{\alpha_i} \), with \( 1 > \alpha_a > \alpha_b > 0 \). The utility function is \( U(c_1, c_2) = \beta \ln c_1 + \gamma \ln c_2 \). The HO and SS relationships write

\[
p(k) = B_b \left[ \frac{\beta(1 - \alpha_a) + \gamma(1 - \alpha_b)}{\beta \alpha_a + \gamma \alpha_b} \right]^{\alpha_b - \alpha_a} k^{\alpha_b - \alpha_a}
\]  

(12)

\[
\omega(p) = \left( \frac{B_a}{B_b} \right)^{1/(\alpha_a - \alpha_b)}
\]  

(13)

where \( B_i = (1 - \alpha_i)(\alpha_i/(1 - \alpha_i))^{\alpha_i} A_i \). Hence,

\[
\omega(k) = \frac{\beta(1 - \alpha_a) + \gamma(1 - \alpha_b)}{\beta \alpha_a + \gamma \alpha_b} k
\]  

(14)

Consequently, \( k \omega'(k)/\omega = 1 \). Therefore, \( dLS/d\omega < 0 \) whenever \( N_{-1} > 0 \). In autarky, factor accumulation and relative wage rigidity do no impact the aggregate labor share of income. Aggregate elasticity of substitution is equal to one. This corresponds to the standard Kaldor’s stylized fact. This is no longer the case when the economy is open. This is due to the fact that the employment reaction to an increase in the relative factor cost \( w/r \) is much more important in an open economy and overcompensates the increase in relative wages.
2.5 Sector-specific vs aggregate labor share

Globalization and wage rigidities alter the aggregate labor share of income. Aggregate changes reflect changes within and between sectors. Formally, aggregate labor share can be decomposed as follows:

\[ LS_1 = \phi_a LS_a + (1 - \phi_a) LS_b \]  

with \( \phi_a = \frac{p_a Y_a}{(p_a Y_a + p_b Y_b)} \) the share of the capital intensive good \( a \) in total value-added and with \( Y_a \) and \( Y_b \) the output of sector \( a \) and \( b \) and with \( p_a \) and \( p_b \) the price of good \( a \) and \( b \). As \( p = p_a/p_b \), and denoting \( y = Y_a/Y_b \) relative output, we have \( \phi_a = py/(py + 1) \).

Consider a marginal increase in relative wage \( \omega \):

\[ \frac{dLS_1}{d\omega} = \frac{d\phi_a}{d\omega} (LS_a - LS_b) + \phi_a \frac{dLS_a}{d\omega} + (1 - \phi_a) \frac{dLS_b}{d\omega} \]  

The global effect results from a composition effect and sector-specific effects. We start with the composition effect. The relative wage rigidity increases the relative demand for capital \( k_1 \). The Rybczinski theorem implies an increase in the supply of capital intensive good and factor reallocation towards the capital-intensive sector. It follows that \( dy/d\omega > 0 \). However, the increase in \( \omega \) also causes a price effect, namely a decline in the relative price \( p \) of the capital-intensive good. The relative strength of the two effects depends on preferences, technologies, and trade openness. In a globalized world, the Rybczinski effect is stronger than in autarky, and the share of the capital-intensive sector is more likely to increase.

Now consider sector-specific effects. Their signs depend on the technology along Result 2:

\[ \frac{dLS_i}{d\omega} < 0 \text{ if and only if } \frac{\omega dk_i/d\omega}{k_i} > 1 \]  

In the case of Cobb-Douglas technologies, the elasticity \( \omega (dk_i/d\omega)/k_i = 1 \). This implies \( dLS_i/d\omega = 0 \). Changes in aggregate labor share then reflect sector share changes. When preferences are log-linear, the Rybczinski effect exactly offsets the price effect in autarky, and overcrowds it when the country is open to trade. The labor share, therefore, stays constant under autarky and decreases otherwise.

Using the same rational we can decompose the impact of globalization (an increase in the world’s labor or capital endowment \( N_{-1} \) or \( K_{-1} \)) . We know the overall impact, namely \( dLS_1/dN_{-1} < 0 \) while \( dLS_1/dK_{-1} > 0 \). Such overall effects only reflect sector share changes: as \( \omega \) and \( p \) stay constant, capital intensity does not change within sector (the maximization problem of the firms do not change). Unlike the case of wage rigidity, globalization has non-ambiguous effects on sector shares. Owing to the relative factor price rigidity, the relative price \( p \) of the capital-intensive good stays constant. In the rigid wage country 1, unemployment goes up and \( k_1 \) increases as a result. The Rybczinski effect then implies that the relative supply of the capital intensive good increases and that the capital-intensive sector share \( \phi_a \) increases as a result.

2.6 Explaining LS changes

The model can predict the set of facts presented in the introduction, namely constant labor share in Anglo-Saxon countries, decreasing shares in continental European countries, and broadly constant shares at sector/firm level.
Time $t$ goes from 1970 to 2000. There are three sets of countries, two equally developed (Continental Europe $E$, and Anglo-Saxon countries $AS$) and one set of developing countries ($D$). Europe corresponds to country 1, while Anglo-Saxon and developing countries belong to the set of countries $-1$. The set of factor endowments at date $t$ is $\{(K_{E,t}, N_{E,t}), (K_{AS,t}, N_{AS,t}), (K_{D,t}, N_{D,t})\}$. The relative supply of capital is $k_s^t = \sum K_{i,t} / \sum N_{i,t}$. The relative supply of capital is initially the same in Europe and in the US. It also stays fixed over time, so that $K_{E,t} = k_s^t E N_{E,t}$ and $K_{AS,t} = k_s^t E N_{AS,t}$ for all $t$. Developing countries gradually open to trade. Therefore $K_{D,t}$ and $N_{D,t}$ increase over time.

The relative wage rigidity $\omega_t$ takes place in Europe. It stays fixed over time. As a benchmark, the initial value ensures that full employment holds in Europe in 1970, so that $\omega_t = \omega(k_s^{70})$.

The model writes:

\begin{align*}
\omega_t &= \omega(k_t) \\
L_{E,t} &= \frac{K_t}{k_t} - (N_{AS,t} + N_{D,t}) \\
LS_{i,t} &= \frac{\omega_t}{\omega_t + k_{i,t}}
\end{align*}

with $k_{D,t} = K_{D,t}/N_{D,t}$, $k_{AS,t} = K_{AS,t}/N_{AS,t}$, and $k_{E,t} = K_{E,t}/L_{E,t}$.

Figure 3 depicts the patterns of $LS_{AS}$, $LS_{E}$, and $LS_{D}$.

We start with the US labor share. As $\omega_t$ remains fixed at the competitive level of 1980 and the US relative supply of capital $k_s^t AS = k_s^t E$ does not change over time, US employment adopts the pattern of the labor supply $N_{AS,t}$. Meanwhile, the US labor share remains constant from 1970 to 2000. Employment and the labor share have independent patterns. Put differently, they should not be correlated.

In Continental European countries, employment and the labor share jointly move. The rigid relative factor price $\omega_t$ does not correspond to the competitive one after the inclusion of new traders. That is $\omega_t = \omega(k_s^{70}) \neq \omega(k_t^t)$. The impacts on European employment and labor share are given by Result 4 and Proposition 1. They both decrease from one year to the other whenever $\Delta K_{D,t}/\Delta N_{D,t} < k$, stay
constant when $\Delta K_{D,t}/\Delta N_{D,t} = k$, and increase when $\Delta K_{D,t}/\Delta N_{D,t} > k$. European employment and labor share should be positively correlated.

The fall in European share observed in the 1980s and 1990s can be predicted assuming that $\Delta K_{D,t}/\Delta N_{D,t} < k$ for $t = 1980, ..., 2000$. As new countries open to trade, the relative supply of capital decreases over a decade. The stagnation of the share observed in the mid-1990s means that the relative supply of capital stays constant from 1990 to 2000. This is possible if older entrants in world trade accumulate physical capital at a rate that compensates the entry of newer and more labor-abundant countries.

The fall in European aggregate labor shares is associated with factor reallocation towards capital-intensive sectors. The pattern of aggregate labor shares may contrast with micro (sector-specific) patterns. The model predicts that sector-specific shares do not change at industry/firm level provided that technologies are Cobb-Douglas. This prediction distinguishes the HOS model with wage rigidity from the Rodrik-type models discussed in the introduction. In such models, the labor share goes down because globalization boosts the outside options of capital owners, pushing wages down at given output. This mechanism should take place at firm level, which contradicts the micro evidence presented in the introduction.

In developing countries, employment is determined by the labor supply $N_{D,t}$. Globalization affects the labor share through two distinct mechanisms, depending on whether we consider the country at world trade entry or after entry.

At entry, say in $t$ (so the country is closed in $t-1$), the variation in the labor share is:

$$\Delta L S_{D,t} = \frac{\omega}{\omega + k^s_{D,t}} - \frac{\omega(k^s_{D,t-1})}{\omega(k^s_{D,t-1}) + k^s_{D,t-1}} > 0$$

The labor share increases at world trade entry. It is consistent with labor share patterns observed in some Newly Industrialized Countries and East Asian countries.

After entry, the labor share is larger than in Europe and the US. The year-to-year change $\Delta L S_{D,t}$ has the sign of $-\Delta k^s_{D,t}$. As long as those countries accumulate physical capital over time, the labor share must go down. This explanation to the decrease in the labor share of developing countries hinges on the fact that the corresponding countries belong to the diversification cone of the developed economies. The evidence is mixed in this respect. Cunat (2000) and Debaere and Demiroglu (2003) show that factor price equalization must hold among developed countries but not with all developing countries suggesting multiple diversification cones. Schoot (2003) argues that there are two diversification cones. Debaere and Demiroglu (2006) suggest that newly industrialized countries and developed countries belong to the same diversification cone. Overall, factor price equalization may hold at local level and countries accumulating capital at a higher rate than trade partners in the cone of diversification can experience a decrease in the labor share.

3 Empirical evidence

This section confronts the model predictions to sectorial data. We want to assess whether trade with developing countries specifically increased the pace of factor reallocation towards capital-intensive sectors.
in Continental Europe, and whether such an increase leads to significant changes in the labor share. We first present our dataset, and then turn to fixed effects regressions.

3.1 Dataset

The KLEMS dataset provides sectorial data for 8 OECD countries among the 9 discussed in Section 2 over the period 1970-2005. We use this dataset to compute labor shares and sector shares at sector level. The COMTRADE dataset provides country-specific data on trade intensity with China. We use this variable as a proxy for trade with developing countries. The China trade shock is now widely used in the literature (see for instance Autor et al 2013 or Autor et al 2016) as a proxy for the increasing trade with developing countries. It corresponds to a huge and plausibly exogenous shock of trade with developing countries given the weight of China in the world economy. It now accounts for a large fraction of trade with developing economies. Given its strong increase over the last decades and its current weight in total trade, it is a good candidate to identify the impact of trade with developing countries.

The KLEMS dataset covers 28 sectors. In each sector, there are data on wages, employment, output, and capital stock. Sector-specific and aggregate labor shares are computed as the ratio of total wage bill to value-added. The ratio is corrected from self-employment. Namely, we attribute the mean wage of employees at sector level to self-employed workers.

Figure 3.1 depicts the labor share at the sector level as a function of the capital stock. The relation suggests that capital intensive sectors have a much lower labor share than the labor intensive ones. Thus, the assumption of our model that $\omega$ is the same across sectors is a good approximation.

We build two super-sectors from the 28 sectors. A sector is capital-intensive if capital intensity is larger than the aggregate countrywide capital to labor ratio in 1980. That is, when a sector in a given country is classified as capital intensive given its capital output ratio, it is considered as capital intensive for every years in this given country. This corresponds to the SS$_1$ variable. For robustness purposes, we isolate tradable and business sectors and proceed similarly (respectively SS$_3$ and SS$_2$ variables). The tradable sectors are "Agriculture, Hunting, Forestry and Fishing", "Mining and Quarrying", and "Total manufacturing". The business sector (27 sectors) excludes "Community social and personal services", which accounts for a large share of GDP in OECD countries.

5The limited number of countries is due to the availability of the capital stock at the sector level.

6we choose 1980 as the reference year because we do not want some sectors jump from capital intensive to labor intensive which would have possibly created some jumps in our aggregate sector share variable. In practice only very few sectors with intermediate capital intensities moove from capital intensive to labor intensive sectors and the classification of capital intensive sectors is very similar if we had taken 1990 or 2000 as the reference period. We have chosen to take the first year in our sample for which capital at the sector level is available for all countries. Also, 1980 correspond to the year during which the labor started to decline in continental european countries.
Labor share and capital intensity at sector level in 2000. K/L is the capital labor ratio, while LS is the ratio of wage bill to value-added corrected for self-employment. There are 28 sectors and 8 countries. Source: KLEMS dataset and authors’ computations.

More precisely, we compute the share of the capital-intensive (super-)sector in total value-added. Let \( i \in \{1, \ldots, 28\} \) denote the sector index, \( k \in \{1, \ldots, 8\} \) be the country index, and \( t \in \{1970, \ldots, 2005\} \) be the time index. Let also \( T = \{i \in \{1, \ldots, 28\}, \, i \text{ is tradable}\} \) denote the subset of tradable sectors and \( B = \{i \in \{1, \ldots, 28\}, \, i \text{ is a business sector}\} \). For all \( t \), we have

\[
SS_{1t} = \sum_{i=1}^{28} 1_{ik} P_{ikt} Y_{ikt} / P_{kt} Y_{kt} \quad \text{with} \quad 1_{ik} = \begin{cases} 1 & \text{if } (K/L)_{ik1980} > (K/L)_{k1980} \\ 0 & \text{else} \end{cases},
\]

(22)

\[
SS_{2t} = \sum_{i \in B} 1_{ik} P_{ikt} Y_{ikt} / P_{kt} Y_{kt}^{T} \quad \text{with} \quad 1_{ik} = \begin{cases} 1 & \text{if } (K/L)_{ik1980} > (K/L)_{k1980}^{B} \\ 0 & \text{else} \end{cases},
\]

(23)

\[
SS_{3t} = \sum_{i \in T} 1_{ik} P_{ikt} Y_{ikt} / P_{kt} Y_{kt}^{T} \quad \text{with} \quad 1_{ik} = \begin{cases} 1 & \text{if } (K/L)_{ik1980} > (K/L)_{k1980}^{T} \\ 0 & \text{else} \end{cases},
\]

(24)

where \( P_{kt} Y_{kt} = \sum_{i} P_{ikt} Y_{ikt}, \ (K/L)_{k1980} = (\sum_{i} K_{ik1980}) / \sum_{i} L_{ik1980}, \) the upperscript \( T \) denotes that the variable is computed within the set of tradable sectors and the upperscript \( B \) denotes that the variable is computed within the set of business sectors.
Table 1: Super-sector shares and labor shares

Table 1 presents the descriptive statistics for our sector share variables $SS_1$, $SS_2$ and $SS_3$ (and the labor intensive sector $1-SS_1$, $1-SS_2$ and $1-SS_3$). The labor share within the capital-intensive super-sector for the whole economy ($SS_1$) is 58\%, against 78\% for the labor-intensive super-sector. The difference is even stronger when we focus on tradable ($SS_3$) or business sectors ($SS_2$). In the Appendix, we show that this result holds at a more disaggregate level. Factor reallocation between sectors, therefore, can affect the aggregate labor share. We will use those statistics to derive the impact of changes in the weight of the capital intensive sector in term of the labor share.

We need a trade variable that varies across countries, and that reflects trade with developing countries rather than trade in general. We follow Michaels et al (2014) and consider the ratio of Chinese exports plus imports to GDP. This variable must be viewed as a proxy for overall trade with developing countries.

![Graph showing Trade with China in Continental Europe and in the US-UK, 1970-2005. Continental Europe: Finland, France, Germany, Netherlands, Spain.](image-url)
Figure 3.1 shows that trade with China massively increased from 1970 to 2005, starting from 0 and reaching 1.5% on average for the two sets of countries by the end of the period. The rise in trade is a homogenous phenomenon in our sample of countries. Variance decomposition shows that most of trade volatility is actually driven by the time dimension rather than by cross-country heterogeneity. Indeed, the standard deviation is roughly equal to the trade mean, which approximately corresponds to the within deviation, and represents 3 times the between deviation.

Table 2 provides descriptive statistics for the variables we use in sub-section 4.2.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Stand. dev.</th>
<th>min</th>
<th>max</th>
<th>obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS1</td>
<td>0.34</td>
<td>0.06</td>
<td>0.20</td>
<td>0.46</td>
<td>281</td>
</tr>
<tr>
<td>SS2</td>
<td>0.48</td>
<td>0.07</td>
<td>0.30</td>
<td>0.66</td>
<td>281</td>
</tr>
<tr>
<td>SS3</td>
<td>0.36</td>
<td>0.06</td>
<td>0.22</td>
<td>0.54</td>
<td>281</td>
</tr>
<tr>
<td>Trade</td>
<td>0.0043</td>
<td>0.0048</td>
<td>0</td>
<td>0.0331</td>
<td>271</td>
</tr>
<tr>
<td>K/L</td>
<td>6.68</td>
<td>2.93</td>
<td>1.65</td>
<td>16.03</td>
<td>281</td>
</tr>
<tr>
<td>(K/L)\text{B}</td>
<td>8.02</td>
<td>3.81</td>
<td>1.82</td>
<td>21.13</td>
<td>281</td>
</tr>
<tr>
<td>(K/L)\text{T}</td>
<td>6.12</td>
<td>3.52</td>
<td>1.07</td>
<td>16.74</td>
<td>281</td>
</tr>
</tbody>
</table>

Table 2: Descriptive statistics

Theory predicts that labor shares decrease in rigid-wage countries where strong factor reallocation towards capital-intensive sectors take place. By contrast, factor reallocation should be much weaker in free-wage countries.

3.2 Preliminary evidence

3.2.1 The sector shares

The panel of Figures 6 reveals four facts. For each year, we compute the mean share of the capital-intensive sector in civil-law (Continental European) and common-law (Anglo-Saxon) countries. We confront it to the mean value of the trade ratio with China within each group of countries. Note that we will use indifferently common-law for Anglo-Saxon countries and Civil law for Continental European countries in the remaining as this distinction is widely used in empirical works and can be seen as exogenous. The share of the capital-intensive sector substantially increased in civil-law countries (left panel). From 1970 to 2005, the share goes from 29% to 35%, a 6-point increase. If we restrict the analysis to tradable sectors only, the increase has a similar magnitude. In the right panel, we can see the share of the capital-intensive super-sector decreased in common-law countries (if we focus on the whole economy), or did not show any trend (if we only focus on tradable sectors).
The magnitude of factor reallocation in civil-law countries is potentially promising to explain changes in aggregate labor share. For instance, SS1 experiences a 6-point increase in civil-law countries and a 5-point decrease in common-law countries. The differential change amounts to 11 points. The mean labor share is 58% in the capital-intensive sector, while it is 78% in the labor-intensive sector. Factor reallocation between sectors, therefore, can lead to a differential change in labor share that amounts to $11 \times (0.78 - 0.58) = 2.2$ points. Introduction shows that the observed differential change is about 3.5 points. Factor reallocation between sectors, therefore, can explain up to 60% of the observed differential change between the two sets of countries.

Of course, part of this change has nothing to do with trade. The purpose of the next sub-section is to measure the proportion of this change that can be directly attributed to trade with developing countries.

Figure 6: Capital intensive sector shares in Civil-law countries (left panel) and Common-law countries (right panel)
### 3.2.2 The labor share and unemployment

In this subsection, we provide some evidence in line with our theory that the overall changes in European labor shares broadly mirror changes in unemployment rates. European unemployment massively increased during the 1980s, and stayed high afterwards. By contrast, Anglo-Saxon unemployment rates did not change much. To quote Blanchard and Giavazzi (2003), for the major Continental European countries, Germany, France, Italy and Spain, "the major decline in the share in the 1980s coincided with a further increase in the unemployment rate during that decade". However the theory predicts that there is no link between the labor share and the unemployment rate for Anglo-Saxon countries.

We regress the labor share on the unemployment rate. Table 3 emphasizes the divide between the two subsets of countries. We proceed to fixed-effects regressions. We estimate a single coefficient for the whole sample and for each subsample of countries. The results show that the coefficient is generally negative, and much larger for European countries than for Anglo-Saxon countries. The idea we put forward in this paper is that such a correlation between the labor share and the unemployment rate reflects the impact of an X factor that jointly determines the labor shares and corresponding unemployment rates. This X factor is trade globalization, and mostly trade with labor-abundant economies.

<table>
<thead>
<tr>
<th>Legal origin</th>
<th>Estimated coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common law/Anglo-Saxon</td>
<td>-0.04 (0.09)</td>
</tr>
<tr>
<td>Civil law/Continental Europe</td>
<td>-0.68*** (0.07)</td>
</tr>
<tr>
<td>Overall</td>
<td>-0.55*** (0.05)</td>
</tr>
</tbody>
</table>

*** significant at 1%. The Table reports the coefficient of unemployment from fixed effects regressions. Squared errors between brackets.

Table 3: Unemployment and the labor share, fixed-effects regressions

We now investigate in more details the prediction of the model that trade should increase the share of the capital intensive sector in the economy, leading to a decrease in the labor share.

### 3.3 Fixed-effects regressions

We proceed to the following fixed effects regressions:

$$ SS_{it} = \beta_1 Trade_{it} \times EU_{i} + \beta_2 Trade_{it} + \beta_3 (K/L)_{it} + \alpha_i + \alpha_t + \epsilon_{it}, \quad (25) $$

where $EU$ is a dummy variable that takes the value 1 if civil law is the legal origin of the country and 0 otherwise. We regress the share of the capital-intensive super-sector $SS$ for country $i$ at time $t$ on trade and its interaction with the dummy $EU$. The statistical model allows us to test whether trade with China has a distinctive and significantly positive effect on the weight of the capital-intensive sector in civil-law countries. Theory, therefore, predicts that parameter $\beta_1$ is positive.
In addition to Trade variables, we add a control for capital intensity at the aggregate level \((K/L)_{it}\) for country \(i\) at time \(t\). At given relative factor price, the Rybczynski theorem predicts that capital intensity should increase the weight of the capital-intensive sector. In each case, we use the capital-labor ratio specific to the set of sectors we focus on (namely, the overall, business and tradable sectors). Note that we use the labor input adjusted for the number of hours worked, available in the KLEMS dataset.

Finally, we add country fixed effects and time dummies. Country fixed effects control for time-invariant unobserved characteristics that are correlated with trade and the weight of the capital-intensive sector. Time dummies account for shocks that affect all countries simultaneously and may be correlated with trade as a result. For instance, changes in relative wage rigidities in Continental European countries increase the weight of capital-intensive sectors in all developed countries. Changes in factor endowments in developing countries have similar effects. Capital accumulation in China should reduce the share of capital-intensive sectors in developed countries. Note that the specification do not include a dummy for EU since country fixed effect are already included in all the specifications.

Endogeneity bias must be taken into account. There are two sources of potential biases. On the one hand, the share of the capital-intensive sectors may cause trade with China. Capital-intensive industries may require inputs especially produced in developing countries. On the other hand, there may be an omitted variable that causes both trade and the growth of capital-intensive industries. We choose to address the problem by means of an explicit IV strategy.

We need an instrument that is highly correlated with the trade variables, but is not related to sector shares in developed countries. The Fraser Institute provides various institutional variables for developing countries over a long time range. Institutions in developing countries are not necessarily correlated with sector shares in developed countries, and could well be correlated with trade development with China. All the variables take values between 0 (highly regulated) and 10 (no regulation).\(^7\)

We choose the variable "Access to Sound Money" (ASM) in China which should be exogenous to the share of the capital-intensive super-sector in developed countries.\(^8\) The inclusion of other instruments leads to a strong rejection of the Hansen overidentification test of instrument exogeneity. The correlation of this variable with trade is due to the fact that people involved in international trade need to convert foreign money, and to have banking accounts in foreign countries to pay, to receive payments, and borrow money (see Berman and Héricourt, 2010). The variable is available since 1970.

The other instruments are more usual. We consider trade and trade*EU lagged 10 years. Such trade flows are not related to the share of the capital-intensive sector ten years later. In addition, they have been available since 1960.

---

\(^7\)The list is the following: "Economic Freedom", "Size of Government", "Legal Structure and Security of Property Rights", "Access to Sound Money", "Freedom to Trade Internationally", and "Regulation of Credit, Labor and Business". These variables are defined over 5-year periods, from 1980 to 2005 for most, and for 1970-2005 for "Access to Sound Money" and "Regulation of Credit, Labor and Business". We complete the variables by linear interpolation.

\(^8\)The index ranges from 0-10 where 0 corresponds to ‘high annual money growth’, ‘high variation in the annual rate of inflation’, ‘high inflation rate’, and ‘restricted foreign currency bank accounts’ and 10 corresponds to ‘low annual money growth’, ‘low or no variation in the annual rate of inflation’, ‘low inflation rate’, and ‘foreign currency bank accounts are permissible without restrictions’.
First-stage regressions are the following:

\[
\begin{align*}
\text{Trade}_{it} &= \lambda_1 \text{ASM}_t + \lambda_2 \text{ASM}_t \times EU_i \\
&\quad + \lambda_3 \text{Trade}_{it-10} + \lambda_4 \text{Trade}_{it-10} \times EU_i + \lambda_5 [\text{included}] + \epsilon_{it},
\end{align*}
\]

(26)

\[
\begin{align*}
\text{Trade} \times EU_{it} &= \mu_1 \text{ASM}_t + \mu_2 \text{ASM}_t \times EU_i \\
&\quad + \mu_3 \text{Trade}_{it-10} + \mu_4 \text{Trade}_{it-10} \times EU_i + \mu_5 [\text{included}] + \epsilon_{it},
\end{align*}
\]

(27)

The excluded instruments are ASM\(_t\), ASM\(_t \times EU_i\), Trade\(_{it-10}\), and Trade\(_{it-10} \times EU_i\). The included instruments are all the regressors but trade variables: country fixed effects, time effects and capital to labor ratio (as a result, first stage regressions differ with the field of the economy we focus on).

In appendix A1, Table A1.1 displays the results. We only report the coefficients of the first stage regression associated with the excluded instruments. Results suggest our instruments are reasonably strong.\(^9\) We report the F statistic, Partial R\(^2\) and the shea partial R\(^2\) for each first stage regressions. Shea (1997) partial R\(^2\) is much higher than the standard partial R\(^2\) suggesting instruments are independant and there exists no redundancies across instruments (see Baum et al, 2003). Finally, in table 4, for each regression, we quantify the bias of IV compared to the bias of OLS due to the potential weakness of instruments using the stock and yogo (2005) methodology. We also complete classical inference in table 6 (which could be invalid due to eventual instrument weakness) reporting the Anderson-Rubin joint significance test of endogenous regressors which is valid even using weak instruments (but invalid if instruments are not exogenous). Also, Excluded instruments are strongly significant. The sign of the various parameters is economically relevant: lagged trade has a positive impact on current trade, and Access to sound money as well.

Table 4 reports the IV for SS\(_1\) (capital intensive sector share for the whole economy) , SS\(_2\) (capital intensive sector share for the tradable only) and SS\(_3\) (capital intensive sector share for the business sectors only) dependant variables. The OLS estimates are reported in the Appendix A1.2 and confirm the IV results. According to the Stock and Yogo methodology (2005) - the bias of our IV coefficients estimates relative to the OLS bias can be evaluated at 15%-20% which remains quite low. Instruments seems to be quite strong. As a result standard errors should not be downward biased and basic inference should be valid. Anderson-Rubin test confirms this claim: For all IV, endogenous regressors are jointly significant, in line with classical inference. A second requirement for the IV estimates to be valid is that instruments are exogenous. For each IV regressions, we report the Hansen test and in each case it fails to reject the null hypothesis of instrument exogeneity with a high degree of confidence. Squared errors are corrected by the Eicker-Huber-White method.

\(^9\)Cragg and Donald (1993) underidentification test in its robust version (Kleibergen and Paap, 2006) suggest that instruments are basically correlated with endogenous regressors and the model identified. Since Staiger and Stock (1997) we know that the weak instrument problem can arise even when the first-stage t-tests and F-tests are significant at conventional levels in a large sample. The consequences of using weak instruments are twofold. First, the estimates are always biased in finite samples and second, two stage least squares’ estimated standard errors become far too small.
The results for trade are in line with theory. Trade has a highly differentiated impact on the sector shares for common law and civil law countries. Trade has no significant impact on sector share in common-law countries for the overall economy (SS1). It even has a negative and significant impact for the business sector (SS2). By contrast, trade has a strong positive and significant effect in civil-law countries. The differentiated impact seems to be smaller for the tradable sector (SS3). However, the labor share differential between the capital- and labor-intensive super-sectors is larger in this latter case. Those results are in line with the descriptive evidence on the evolution of the sector shares provided in the previous section.

### 3.4 From the sector share to the labor share

Using our estimates, we can quantify the impact of trade with China on the capital-intensive sector share, and then on aggregate labor share. The rise in trade is roughly similar across countries. It increases by about 1.5 percentage points of GDP. In this section we focus on the impact for the whole economy (SS1). The first line of Table 4 for IV estimates (and table A1.2 for OLS results) allows us to quantify the differential impact on Continental European capital-intensive sector shares. According to the OLS estimate, (see appendix A1.2), this impact is about $9.11\times1.5\approx13.5$ percentage points. This broadly corresponds to the observed differential change in capital-intensive sector share between Continental Europe and Anglo-Saxon countries. The OLS estimate, therefore, attributes the whole differential change in the capital intensive sector to trade with developing countries. According to the IV estimate, this impact is about $6.11\times1.5\approx9$ percentage points. The predicted impact is reduced by more than 40%, which seems more reasonable given the fact that part of trade with China may be caused by the capital-intensive sector share. Given the mean labor share differential between the capital-intensive and the labor-intensive super-sector from table 1 (78% for labor intensive sector and 58% the capital intensive one), we can compute the resulting impact on the labor share by multiplying the predicted differentiated change
in the share of the capital intensive sector and the difference in the factor shares for both sectors (0.78 - 0.58). The OLS estimate predicts that Continental European labor shares are reduced by $13.5^*(0.78-0.58) \approx 2.7$ points compared with Anglo-Saxon countries. The IV estimate predicts a more modest and more realistic decline by $9^*(0.78-0.58) \approx 1.8$ points.

Overall, the predicted differential labor share change between Continental Europe and the US-UK is not far from the observed one. For instance, our preferred estimate, the IV estimate, predicts a 1.8-point difference, which is about 60% of the observed difference.

Our study provides a lower bound to the magnitude of trade effects on factor reallocation. Sectorial data do not allow us to capture the whole phenomenon of factor reallocation predicted by trade theories based on factor endowment heterogeneity. Schott (2003, 2004) for instance shows that factor intensities vary considerably within a sector. In addition, within-product specialization alters our ability to distinguish capital-intensive sectors from labor-intensive sectors. To quote Schott: "[The] evidence suggests that conventional tests of trade theory using industry level data are problematic because much of the endowment-driven specialization occurs at a level that was, until recently, hidden from the researcher."

### 4 Conclusion

This paper questions the ability of the HOS model to reproduce the patterns of labor shares in two sets of countries. Namely, labor shares stay constant in Anglo-Saxon countries, and go down in continental European countries. In addition, the labor share does not change much at sector or firm level. We show that once completed with a relative wage rigidity in Europe, the model can predict such facts. The key mechanism at work relies on the fact that trade globalization with developing or newly industrialized countries increases European unemployment. Factors are reallocated towards low labor-share sectors in Europe, which decreases the aggregate labor share.

The model predictions are broadly confirmed by the empirical evidence at sector-level data. We use the KLEMS dataset for 8 OECD countries over the period 1970-2006. We build a super capital-intensive sector in each country. The share of this sector in overall GDP increased with trade with China in Continental European countries compared with Anglo-Saxon countries. Put otherwise, the fall in European labor shares is partly due to trade-induced factor reallocation towards capital-intensive industries. Fixed effects estimates imply that the pattern of trade with China between the 1970s and the 2000s predicts a differential labor share change between Continental Europe and Anglo-Saxon countries that is comprised between 1.8 point (OLS estimates) and 2.7 points (IV estimates).
References


Guscina, A., 2006. Effects of Globalization on the labor share. IMF WP/06/294


5 Appendix

5.1 Appendix A1: Regressions

5.1.1 First stage regressions

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* significant at 10%; ** significant at 5%; *** significant at 1%.
The Table only reports parameters associated with excluded instruments.

Table A1.1

5.1.2 OLS results

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* significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors between brackets. The variable is the capital-intensive super-sector share.

All regressions feature country and time dummies.

Table A1.2
5.2 Appendix A2

Fig. A2.1: Labor shares over time
• List of sectors: Agriculture, Hunting, Forestry and Fishing; Mining and Quarrying; Food products, Beverages and Tobacco; Textiles, Textile Products, Leather and Footwear; Wood and Products of Wood and Cork; Pulp, Paper, Paper products, Printing and Publishing; Coke, Refined Petroleum Products and Nuclear Fuel; Chemicals and Chemical Products; Rubber and plastics products; Other Non-Metallic mineral products; Basic Metals and Fabricated metal products; Machinery, nec; Electrical and Optical equipment; Transport equipment; Manufacturing nec, recycling; Electricity Gas and Water supply; Construction; Sale, maintenance and repair of motor vehicles and motorcycles, retail sale of; Wholesale trade and commission trade, except of motor vehicles and motorcycles; Retail trade, except of motor vehicles and motorcycles; repair of household goods; Hotel and Restaurants; Transport and Storage; Post and Telecommunications; Financial intermediation; Real estate activities; Renting of machinery and equipment and other business activities; Community social and personal services.

• List of tradable sectors: Agriculture, Hunting, Forestry and Fishing; Mining and Quarrying; Food products, Beverages and Tobacco; Textiles, Textile Products, Leather and Footwear; Wood and Products of Wood and Cork; Pulp, Paper, Paper products, Printing and Publishing; Coke, Refined Petroleum Products and Nuclear Fuel; Chemicals and Chemical Products; Rubber and plastics products; Other Non-Metallic mineral products; Basic Metals and Fabricated metal products; Machinery, nec; Electrical and Optical equipment; Transport equipment; Manufacturing nec, recycling
Figure A2.2 and the panel of Figures A2.3 show that the labor share decreases with capital intensity at sector level. All Figures use data from the 28 sectors of the dataset in 2000. Figure A2.2 pools the 8 countries, while the panel of Figure A2.3 separately considers each country.

Fig. A2.2: Labor share and capital intensity at sector level in 2000. K/L is the capital labor ratio, while LS is the ratio of wage bill to value-added corrected for self-employment. There are 28 sectors and 8 countries. Source: KLEMS dataset and authors’ computations.
Panel of Figures A2.3: Labor shares and capital intensity at sector level, country-specific patterns, 2000