Regional Science and Urban Economics 40 (2010) 45–59

Contents lists available at ScienceDirect

Regional Science and Urban Economics

journal homepage: www.elsevier.com/locate/regec

Firms' location decisions and minimum wages

Isabelle Méjean [a], Lise Patureau [b,*]

[a] Ecole Polytechnique, Department of Economics, F-91128 Palaiseau Cedex, France
[b] Université de Cergy-Pontoise, THEMA, 33 Boulevard du Port, F-95000 Cergy-Pontoise, France

ARTICLE INFO

Article history:
Received 12 February 2009
Received in revised form 28 September 2009
Accepted 29 September 2009
Available online 9 October 2009

JEL classification:
F12
F16
F21
R3

Keywords:
Minimum wage
Home Market Effect
Firms' location decisions

ABSTRACT

We consider the impact minimum wage laws have on firms' location choices in a new economic geography model with exogenous minimum wage constraints. The minimum wage policy has a twofold influence on the relative attractiveness of the home country, simultaneously affecting its relative cost competitiveness and its aggregate income. The end effect depends on interactions between the skilled and unskilled segments of the labor market. If workers are strongly substitutable, the effect of raising low-skilled workers income is more than compensated by a drop in their employment level. Under such circumstances, a high minimum wage policy reduces the country's attractiveness by increasing production costs and reducing aggregate demand. Aggregate demand is further reduced once adjustments in skilled wages linked to international competitive pressures are taken into account.

1. Introduction

The impact of labor market institutions on macroeconomic performance has long been at the heart of discussions in economic and political circles. The debate rages on today, especially given the increasing degree of trade and financial liberalization in the recent decades. The increasing mobility of factors of production opens new opportunities for firms to choose in which country to locate and produce. This is likely to have implications on the performance of various labor market policies.

In this paper, we pay a particular attention to this dimension. We focus on minimum wage laws and ask how it affects firms' location decisions in an international setting. As noted by Dolado et al. (2000) or Dickens et al. (1999), the last two decades have shown a considerable resurgence of interest towards minimum wage policy in OECD countries.[1] In general, two opposite arguments characterize the debate on the impact of minimum wage laws. On the one hand, high minimum wages are argued to prevent flexibility: By raising marginal costs, they have adverse effects on labor demand and employment. This is particularly true for unskilled workers, directly affected by the minimum wage requirement. But Cahuc et al. (2001) show that minimum wage policy may also deteriorate the situation of skilled workers, the magnitude of the effect depending on the substitutability between skilled and unskilled workers. On the other hand, proponents of the regulation argue minimum wages help maintaining the purchasing power of low-skilled workers. These workers are the most vulnerable to international competition and skill-biased technological changes (see Dolado et al., 2000 or Biscourp and Kramarz, 2003). A high-minimum wage policy would therefore entail an "income effect" that helps sustaining aggregate demand.

Our theoretical framework takes into account both the cost competitiveness loss and the income effect of minimum wage policy, which jointly affect firms' location patterns. Importantly, the model incorporates the possibility that adjustments in the unskilled labor market may also spread on the skilled labor one. This turns out to be of key importance. We show that the ultimate effect of minimum wages on production patterns crucially depends on the way both skilled and unskilled labor market segments adjust to wage rigidities. This question is central in the labor market literature but has hardly been discussed in an international context.

* Corresponding author. Tel.: +33 1 34 25 61 71.
E-mail addresses: isabelle.mejean@polytechnique.edu (I. Méjean), patureau@u-cergy.fr (L. Patureau).

[1] As illustrated by several increases in the US minimum wages during the 1990s (in 1990, 1991, 1997), the imposition of a minimum wage in the United Kingdom (2000) after its suppression in 1993 or recent successive rises in the French "SMIC" over legal requirements.

0166-0462/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.regsciurbeco.2009.09.005

The labor market literature devoted to minimum wage policies has not reached consensus, both theoretically and empirically.[2] But the vast majority of the existing work has focused on closed economy mechanisms, where production structure is taken as given. In a globalized context, however, the "cost competitiveness" argument is becoming increasingly pressing. Increases in production costs induced by wage rigidities are indeed more costly when it comes to compete with foreign producers that do not face the same constraints. Withstanding competition pushes firms to modify their production process to reduce costs, if not to relocate in countries with more flexible labor markets.

The paper takes into account this dimension by analyzing the impact of minimum wage policy on the country's attractiveness for investors. We investigate the question in a new economic geography framework. Initiated by Krugman (1991), the new economic geography literature focuses on the determinants of production patterns and firms' location decisions in an international setting. It identifies two major determinants of such decisions, relative production costs and aggregate demands. The framework is thus particularly well-suited to capture the twofold impact of minimum wages discussed in the labor market literature. However, while most of the literature assumes flexible labor markets, our paper explicitly relates labor market imperfections and endogenous entry of firms.

The link between labor market regulations and firms' location choices has recently been investigated, both empirically and theoretically. On the empirical side, Dewit, Görg and Montagna (2003), Hajkova et al. (2003), or Javorcik and Spatareanu (2005) study the role of labor market institutions in affecting foreign direct investment (FDI) flows. In general, estimation results suggest that more flexible employment protection legislations enhance FDI inflows. However, Dewit et al. (2003a) find that a high level of employment protection discourages FDI outflows.[3]

The question has also been investigated in theory. A first strand of papers addresses the role of labor market regulations on firms' location choices in presence of uncertainty and strategic interactions. Haaland and Wooton (2007) study how uncertainty on the labor market and industrial output affects investment decisions by multinational firms. Dewit, Leahy and Montagna (2003) analyze the effects of employment protection on location patterns in an oligopolistic framework. They show that more flexible employment protection is not necessarily an advantage as long as one takes into account strategic interactions between firms.

Contributions of Strauss-Kahn (2005), Picard and Toulemonde (2006) and Pflüger (2004) are closely related to the modeling approach retained in the paper. Strauss-Kahn (2005) investigates the impact of globalization on the employment inequality between skilled and unskilled workers in a general equilibrium framework with wage rigidities. While she investigates location choices of vertically-differentiated segments of production, we rather focus on the location of firms producing horizontally differentiated goods. In this framework, we explicitly study the impact of cross-country differences in minimum wage policy.

Picard and Toulemonde (2006) also study the role of wage rigidities on firms' location decisions in a model of wage bargaining, while Pflüger (2004) investigates how social policies (unemployment subsidies and taxes) affect location patterns. As in our model, both papers obtain that the "income effect" of wage rigidities is potentially reinforced in an international setting. The underlying mechanism is tied to a standard Home Market Effect: Under increasing returns to scale and costly trade, firms agglomerate near consumers with a high purchasing power. Under some conditions, the competitiveness loss of firms located in the high-wage country is thus partially compensated by the Home Market Effect. In turn, this tends to mitigate the negative impact of wage rigidities on the country's attractiveness.

The novelty of the paper is to study the way interactions between the skilled and unskilled labor markets affect firms' location patterns. In particular, we show that the strength of the Home Market Effect induced by a high minimum wage policy depends on the substitutability between skilled and unskilled workers.[4] When wages are exogenous, a minimum wage increase raises aggregate income if the nominal effect is not compensated by a drop in low-skilled employment. This is the case when skilled and unskilled workers are low substitutes. If instead substitutability is high enough, a minimum wage increase makes firms in the differentiated sector substitute unskilled for skilled workers, thereby implying a reduction in aggregate income.[5] In that case, the (negative) income effect strengthens the cost competitiveness loss induced by a country imposing a high minimum wage level.

When we take into account endogenous adjustments of skilled wages, the substitution effect in the increasing returns to scale sector is exacerbated by the decrease in equilibrium skilled wages. The source of downward pressures on skilled wages lies in international competition in the homogenous good market. By raising production costs, the minimum wage increase tends to raise the price of the homogeneous good and reduce its production. Labor demand, hence skilled wages, drop as a consequence.[6] This, in turn, lowers the income effect induced by the minimum wage shock. Thus, the case for a positive income effect due to high minimum wage policy, that counteracts the competitiveness loss of firms, is even less likely as long as one takes into account international competitive pressures.

The rest of the paper is structured as follows. Section 2 presents our general framework which incorporates the main features of the new economic geography framework and wage rigidities. After solving the model in general equilibrium, we study the impact of a rise in the domestic minimum wage on firms' entry decisions in Section 3. Section 4 concludes.

2. Theoretical framework

2.1. Main assumptions

The world economy is divided in two countries, Home and Foreign, with foreign variables denoted with a star. The domestic (foreign) country is populated with $\bar{L}$ ($\bar{L}^*$) unskilled and $\bar{Q}$ ($\bar{Q}^*$) skilled workers. As standard in the literature, we assume that workers are perfectly mobile across sectors but immobile across countries. Skilled and

[2] In the theoretical field, the adverse effect of minimum wage obtained in the neoclassical model is questioned in non-competitive frameworks, as shown by Bhaskar and To (1999) in an oligopsonistic model, Cahuc and Zylberberg (1999) in a search equilibrium model, Manning (1995) in an efficiency wage model or Cahuc and Michel (1996) in a training-enhancing framework. The related empirical literature does not reach a clear-cut conclusion either. Papers based on "natural experiments" often get insignificant effects of minimum wage shocks on employment (see Card and Krueger, 1994 for the US, Machin and Manning, 1996 for the UK, and Dolado et al., 1996 for several European countries). Yet, empirical papers on individual data most obtain a significant (and negative) impact of minimum wage on the specific segment of low-skilled workers (see Kramarz and Philippon, 2001; Cardoso and Portugal, 2006 or Laroque and Salanié, 1999).

[3] Referring to this empirical FDI literature is not fully appropriate though. Our theoretical framework indeed models entry and exit of firms in a given location, while previous empirical papers use data on FDI flows, *i.e.* data on the creation of new foreign plants by multinational firms. However, there are not much empirical studies about firms' entries and exits to refer to, as data on firms' location choices are much scarcer and poorer than FDI data. Comparing our theoretical predictions with the empirical FDI literature amounts considering determinants of location choices for new firms and for affiliates of existing multinationals to be similar.

[4] In this respect, our model shares some similarities with Toulemonde's (2006). The author builds a new economic geography model, in which the differentiated sector employs skilled labor and workers can invest to acquire skills. As in our model, firms' location choices affect the composition of the labor demand, which in turn modifies aggregate demand. However, we do not introduce endogenous skill-acquisition choices. Instead, skilled and unskilled workers are substitutable in the production of differentiated goods, so that changes in relative wages endogenously affect the composition of labor demand.

[5] The labor market literature offers empirical evidence that these substitution effects occur in the data, as surveyed by Neumark and Wascher (2008), Chapter 3.

[6] This perverse effect of minimum wages on skilled wages is consistent with empirical evidence in the labor market literature, stressing that changes in the minimum wage have a significant impact on wage inequality (see evidence in Lee, 1999 or Neumark and Wascher, 2008, Chapter 4).

unskilled workers only differ by their productivity levels denoted a_Q and a_L, with $a_L < a_Q$. Without loss of generality, productivity levels are assumed to be identical across countries ($a_L = a_L^*$ and $a_Q = a_Q^*$).

The representative household in each country consumes two types of goods, a homogeneous and a differentiated good. Each type of good is produced given a sector-specific technology using skilled and unskilled labor. As standard in a new economic geography setting, the homogeneous good (denoted by Z) is produced under constant returns to scale in a perfectly competitive environment; it is freely traded across countries to balance the current account. As a consequence, the law of one price holds at the world level, which makes good Z a convenient candidate to serve as numéraire. In the following, all prices are thus expressed in terms of the homogeneous good.

In the differentiated good sector X, monopolistic competing firms produce for both their domestic and export markets, under increasing returns to scale and costly international trade. Varieties produced by firms operating in the Home country are defined over the interval $[0\,;n]$ and indexed by h. Similarly, foreign varieties are defined as $f \in [0\,;n^*]$. The total number of varieties in equilibrium is endogenously determined, as well as firms' location under free entry. Firms enter a country as long as the production is profitable, given a fixed cost of producing (consisting in F units of homogeneous good) and a variable cost that depends on skilled- and unskilled-labor wages. As firms operate under monopolistic competition, the number of produced varieties in equilibrium matches the number of operating firms. In other words, each active firm settles in a single location to serve both markets.

As the exposure of the model further shows, we retain some simplifying assumptions regarding the functioning of the labor market. Labor supply is exogenous (each worker offers one unit of labor to national firms). In each country, the labor market is perfectly competitive and should define equilibrium wages, apart from minimum wages. However, national governments maintain the purchasing power of workers by setting a fixed minimum wage ($\underline{w}$ and $\underline{w}^*$ units of the numéraire good). As long as the minimum wage is binding, labor markets do not clear in equilibrium and some workers are left unemployed.

Our focus of interest lies in the case where the minimum wage is binding on the unskilled labor-market segment, while unbinding on the skilled labor-market one. Still, we consider as benchmark a framework in which both wages equalize labor demand and supply. When simulating the model, we therefore compute the equilibrium unskilled wage, to compare its value to each country's minimum wage legal requirement. For the minimum wage to be binding, it must be high enough whatever the labor demand level. Conversely, we ensure that the minimum wage remains unbinding on the skilled labor market segment. A third potential case could be considered, with a minimum wage binding on both labor market segments. We do not investigate further this possibility though, for two reasons. First, from an empirical point of view, it is highly implausible that minimum wages are sufficiently high to be binding on the skilled labor market segment. The second reason dwells on theory. When the minimum wage is binding on the skilled labor market segment, equilibrium on the homogeneous good market requires either that minimum wages are equalized across countries, or that production of good Z is fully concentrated in a single country. The first case fundamentally contradicts our assumption of national-specific exogenous minimum wage policy. We discard the second case as well, as the resulting general equilibrium is inadequate to derive meaningful predictions on the impact of minimum wage policy on location patterns.

2.1.1. Households

Within a country, all workers are assumed to belong to the same family that includes a representative consumer. Besides, we consider that the unemployment benefits system is entirely lump-sum (*i.e.*, lump-sum taxes on employed workers are redistributed as lump-sum subsidies to those unemployed inside each representative family). This simplifying assumption allows us to neglect the unemployment insurance system in the subsequent analysis. As a corollary, the income effect induced by minimum wage changes will not depend on the share of unemployed workers, nor on the amount of taxes and subsidies in place.[7] We focus attention here on the extent to which the income effect of minimum wage policy is affected by the substitution between skilled and unskilled labor.

In this framework, optimal demand functions are derived at the aggregate national level, by considering the program of the representative consumer. In the following, the domestic household's problem is solved, results being symmetric in the foreign country. Utility of the representative household is an increasing function of her consumption of homogeneous and differentiated goods. As in Strauss-Kahn (2005), we assume the following Cobb–Douglas consumption basket:

$$C(C_X, C_Z) = C_X^{\mu} C_Z^{1-\mu} \quad 0 < \mu < 1 \tag{1}$$

C_Z is the consumption level of the homogeneous good Z and C_X is a composite good of all consumed varieties of differentiated goods aggregated according to the following CES specification:

$$C_X = \left[\int_0^n c(h)^{\frac{\sigma-1}{\sigma}} dh + \int_0^{n^*} c(f)^{\frac{\sigma-1}{\sigma}} df \right]^{\frac{\sigma}{\sigma-1}}$$

with $\sigma \geq 1$ the constant elasticity of substitution across varieties and $c(h)$ ($c(f)$) the consumption level of a variety produced in the home (foreign) country.

The domestic household finances her consumption expenditures using her labor revenues and residual profits she perceives as the owner of firms. The domestic household's income I (expressed in the numéraire good Z) thus decomposes into:[8]

$$I = w_Q \bar{Q} + \underline{w} L + \Pi \tag{2}$$

where $\bar{Q}$ is the employment level of skilled workers and L the employment level of unskilled workers. Here, the minimum wage is assumed to be binding on the unskilled labor market (*i.e.* $w_L < \underline{w}$, w_L being the equilibrium unskilled wage), while it is set below the equilibrium wage for skilled workers (*i.e.* $w_Q > \underline{w}$). As a consequence, the labor market for skilled workers clears ($Q = \bar{Q}$) whereas there is some positive level of unemployment for unskilled workers ($L < \bar{L}$). Last, Π are residual profits of local firms, equal to zero in the long run equilibrium when firms are free to enter a national market.

In this setting, the budget constraint for the representative domestic household can be expressed as:

$$\int_0^n p(h)c(h)dh + \int_0^{n^*} p(f)c(f)df + C_Z \leq w_Q \bar{Q} + \underline{w} L \tag{3}$$

where $p(h)$ and $p(f)$ are equilibrium prices for varieties produced in the domestic and foreign country respectively. The minimum wage level affects aggregate demand directly through the purchasing power of low-skilled workers and indirectly through the labor-market equilibria (*i.e.* through w_Q and L).

[7] Studying the role of these various dimensions of the unemployment benefits system (the share of unemployed workers, the gap between minimum wage and unemployment benefits or the financing of such subsidies) would require substantial modifications of the model. In particular, we would have to introduce distorting taxes and endogenous labor supply. This would undoubtedly raise interesting questions, yet at the cost of a greater model's complexity. We thus choose to eliminate part of the story (notably related to labor supply), to clearly identify the impact of minimum wages on labor demand and its composition between skilled and unskilled workers. Investigating the aforementioned points further is left for future research.

[8] Note that we would reach an identical expression for aggregate income if we considered a set-up with a representative consumer facing her budget constraint, summing up demand of all consumers within a country, rather than the "family" framework. The "family" assumption conveniently prevents us from dealing with issues related to the heterogeneity among agents depending on their employment status (*i.e.* employed or unemployed).

Maximizing the representative household's consumption Eq. (1) under her budget constraint Eq. (3) implies the optimal demand functions:

$$C_X = \mu \frac{I}{P_X} \tag{4}$$

$$C_Z = (1-\mu) I \tag{5}$$

$$c(h) = \left(\frac{p(h)}{P_X}\right)^{-\sigma} C_X,\ h \in [0; n] \tag{6}$$

$$c(f) = \left(\frac{p(f)}{P_X}\right)^{-\sigma} C_X,\ f \in [0; n^*] \tag{7}$$

with the associated expenditure-minimizing price index in sector X defined as:

$$P_X = \left[\int_0^n p(h)^{1-\sigma} dh + \int_0^{n^*} p(f)^{1-\sigma} df\right]^{\frac{1}{1-\sigma}}$$

2.1.2. Firms in the homogeneous sector

The homogeneous good sector is perfectly competitive and integrated at the world level. Good Z is produced under a constant-returns-to-scale technology combining skilled and unskilled workers. In the domestic country, the production function is:

$$y_Z = (a_L l_Z)^{\beta} (a_Q q_Z)^{1-\beta} \quad 0 < \beta < 1$$

with y_Z the production of homogeneous good, obtained from q_Z and l_Z units of skilled and unskilled labor. β is assumed to be identical across countries. Profit maximization in that sector yields a decreasing relation between skilled and unskilled unit labor costs:

$$\frac{w_Q}{a_Q} = \beta^{\frac{\beta}{1-\beta}} (1-\beta) \left(\frac{w}{a_L}\right)^{\frac{-\beta}{1-\beta}} \tag{8}$$

with the associated optimal demand functions for unskilled and skilled labor respectively:

$$\underline{w} = \beta \frac{y_Z}{l_Z} \tag{9}$$

$$w_Q = (1-\beta) \frac{y_Z}{q_Z} \tag{10}$$

Eq. (8) helps in analyzing the expected effects of minimum wage policy in terms of wage dispersion. An increase in the domestic minimum wage level, presumably designed to sustain low-skilled workers' purchasing power, occurs at the expense of skilled workers, whose wage decreases in terms of numéraire. The source of downward pressures on skilled wages lies in international competition. Absent any competitive pressures, the minimum wage increase would raise the demand for skilled workers and their wages. This substitution effect is however dominated by a volume adjustment in an international setting. The minimum wage increase tends to raise the price of the homogenous goods and reduce its production. This consequently exerts a negative pressure on skilled wages that helps preserving the law of one price at the worldwide level. As shown by Eq. (8), this later volume effect is stronger than the former substitution effect and skilled wages reduce following a minimum wage increase. Such a perverse effect on skilled wages is consistent with empirical evidence in the labor market literature, stressing that changes in the minimum wage have a significant impact on wage inequality (see Lee, 1999 or Neumark and Wascher, 2008, Chapter 4, for evidence on US data).

Situation in the foreign market is symmetric. As the homogeneous good market is perfectly integrated at the world level, the price of good Z is equalized across countries in equilibrium. Given Eq. (8) and its foreign counterpart, this implies the following relationship linking relative wages for skilled and unskilled workers:[9]

$$\left(\frac{\underline{w}}{\underline{w}^*}\right)^{\beta} = \left(\frac{w_Q^*}{w_Q}\right)^{1-\beta} \tag{11}$$

2.1.3. Firms in the monopolistic sector

In the monopolistic sector, production costs can be decomposed into a fixed and variable components. To start producing a variety, a firm incurs a fixed cost of F units of homogeneous good that implicitly defines the minimum operating profit firms must achieve for the production to be profitable (see Krugman, 1991). Once entered the market, the firm faces a technological constraint, that combines skilled and unskilled labor according to the following CES specification:

$$y(h) = \left[\alpha^{1/\gamma} [a_Q q(h)]^{\frac{\gamma-1}{\gamma}} + (1-\alpha)^{1/\gamma} [a_L l(h)]^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}} \quad \gamma > 0,\ 0 < \alpha < 1$$

where $q(h)$ and $l(h)$ are the quantities of skilled and unskilled labor used as inputs in the production of $y(h)$ units of variety h. In this expression, α is a weighting parameter that determines the share of value added paid to skilled workers, whereas γ measures the elasticity of substitution between skilled and unskilled labor. Both parameters have a peculiar importance, as they determine the sensitivity of labor demand to changes in the relative cost of unskilled labor (*i.e.* changes in $\underline{w}$).

Once produced, variety h can be sold to the domestic household or exported. Shipping goods abroad entails transportation "iceberg" costs τ *à la* Samuelson (1954): to sell one unit abroad, a firm has to produce $\tau > 1$ units because of a real loss occurring during transport.[10] Let $p(h)$ ($p^*(h)$) denote the price of one unit of variety h sold in the domestic (foreign) market. The profit function of the domestic firm h is then:

$$\pi(h) = p(h)c(h) + p^*(h)c^*(h) - \underline{w}\, l(h) - w_Q q(h) - F \tag{12}$$

The program of differentiated producers can be decomposed into two steps. First, each firm decides (or not) to enter the domestic or the foreign market. Second, it draws up its production plans by optimally setting prices and quantities to produce. The program can be solved backwards by first considering the optimization problem of firms that already entered the market.

Minimizing the total cost function yields the marginal cost of producing one unit of variety h (in terms of the numéraire good):

$$MC(h) = \left[\alpha \left(\frac{w_Q}{a_Q}\right)^{1-\gamma} + (1-\alpha) \left(\frac{w}{a_L}\right)^{1-\gamma}\right]^{\frac{1}{1-\gamma}} \tag{13}$$

and the associated optimal unskilled and skilled labor demands:

$$l(h) = \delta y(h) \frac{MC(h)}{\underline{w}} \tag{14}$$

$$q(h) = (1-\delta) y(h) \frac{MC(h)}{w_Q} \tag{15}$$

[9] When solving the model, we ensure that the Non Full Specialization condition holds, *i.e.* that some positive amount of homogeneous good is produced in each country.

[10] Given that our main focus is on location choices in the monopolistic good sector, we do not introduce such transport costs in the homogeneous sector. Modifying this assumption would not drastically affect our results as long as the homogeneous good is produced under constant returns to scale.

with δ the share of unskilled workers in the domestic (foreign) marginal cost of producing the differentiated good (δ^* being similarly defined):

$$\delta \equiv (1-\alpha)\left[\frac{w}{a_L MC(h)}\right]^{1-\gamma} \quad 0<\delta<1$$

With iceberg transport costs, the equilibrium quantity produced by an individual firm must equal the amount of domestic demand plus the one from abroad, including trade costs:

$$y(h) = c(h) + \tau c^*(h)$$

Firm h sets its prices $p(h)$ and $p^*(h)$ so as to maximize its profit Eq. (12) given the optimal marginal cost (13) and the demand for good h from both domestic and foreign households (Eq. (6) and its foreign counterpart). In the monopolistic framework *à la* Dixit and Stiglitz (1977), firms optimally set prices by applying a constant mark-up over marginal cost, multiplied by the iceberg cost for exported goods. Respectively for domestic and foreign sales, equilibrium prices for variety h are:

$$p(h) = \frac{\sigma}{\sigma-1} MC(h) \equiv p \tag{16}$$

$$p^*(h) = \tau \frac{\sigma}{\sigma-1} MC(h) \equiv \tau p \tag{17}$$

Using a similar reasoning, optimal prices set by foreign firms, on the foreign and domestic markets respectively, are defined by:

$$p^*(f) = \frac{\sigma}{\sigma-1} MC^*(f) \equiv p^* \tag{18}$$

$$p(f) = \tau \frac{\sigma}{\sigma-1} MC^*(f) \equiv \tau p^* \tag{19}$$

Given symmetry among firms located in the same country, price indices in the differentiated sector are thus given by:

$$P_X = \left[n p^{1-\sigma} + n^* \phi p^{*1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{20}$$

$$P_X^* = \left[n p^{*1-\sigma} + n^* \phi p^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{21}$$

with $\phi \equiv \tau^{1-\sigma}$ the parameter called "freeness" of trade by Baldwin et al. (2005). It increases between 0 and 1 when trade barriers diminish (lower τ) or varieties become less substitutable (higher σ).

2.2. The general equilibrium

2.2.1. Free entry and the location of the production

To characterize the model solution, optimal demands and prices are first used to rewrite profits of domestic and foreign firms (Eq. (12) and its foreign counterpart) as:

$$\pi = \frac{\mu}{\sigma}\left(\frac{I}{\Delta} + \phi \rho^{1-\sigma}\frac{I^*}{\Delta^*}\right) - F \tag{22}$$

$$\pi^* = \frac{\mu}{\sigma}\left(\frac{I^*}{\Delta^*} + \phi \rho^{\sigma-1}\frac{I}{\Delta}\right) - F \tag{23}$$

with:

- $\rho \equiv MC/MC^*$ the relative cost of producing the differentiated good in the domestic market, that depends on relative unit labor costs for skilled and unskilled workers,
- $\Delta \equiv n + n^* \phi \rho^{\sigma-1}$ and $\Delta^* \equiv n^* + n\phi\rho^{1-\sigma}$ transformations of the price indices in the differentiated good sector.

Derivation details are provided in Appendix A.1.

Eqs. (22) and (23) deliver useful insights regarding the deep mechanisms of the model. First, they put in evidence a "Home Market Effect" in production (see Martin and Rogers, 1995): *ceteris paribus*, the share of local sales in the profits of monopolistic firms is higher than the share of exports as long as trade costs are strictly positive ($\phi<1$). This asymmetry implies that, everything else equal, an increase in domestic demand ($dI>0$) favors domestic firms more than foreign ones, leading to an increase in the relative number of firms located in the home country. Second, a cost gap in the differentiated good sector (induced here by cross-country differences in minimum wages) reduces relative profits of firms located in the high-cost country, thus its attractiveness. These cost and demand effects are key elements in the model as their interaction determines where firms ultimately locate in the long run.

To determine the spatial long-run equilibrium, free-entry conditions are used, that draw profits towards zero:

$$\pi \leq 0 \quad \text{and} \quad \pi^* \leq 0 \tag{24}$$

with π (respectively π^*) being strictly negative if and only if $n=0$ ($n^*=0$). Combining the expressions for domestic and foreign firms profits Eqs. (22) and (23) with the zero-profit condition (24) leads to the following relation between aggregate incomes and the total number of active firms in equilibrium:[11]

$$(n+n^*)F = \frac{\mu}{\sigma}(I+I^*) \tag{25}$$

As usual in the Dixit–Stiglitz's framework, the total amount paid to cover fixed costs is proportional to the world expenditure spent in the monopolistic sector.

At this point, three polar cases must be distinguished regarding the spatial distribution of production in equilibrium:

- two corner equilibria in which the production of differentiated good is fully concentrated in a single country (*i.e.* $n=0$ or $n^*=0$),
- an interior equilibrium in which some varieties of the differentiated good are produced in both countries ($n>0$ and $n^*>0$).

In the interior equilibrium, operating profits are equalized across countries and the relative number of active firms in each country is:

$$\frac{n}{n^*} = \frac{I(1-\phi\rho^{\sigma-1}) - I^*\phi(\rho^{\sigma-1}-\phi)}{I^*(1-\phi\rho^{1-\sigma}) - I\phi(\rho^{1-\sigma}-\phi)} \tag{26}$$

Eq. (26) underscores the previously discussed determinants of firms' location decisions, namely the cost and demand determinants. In the interior equilibrium, the higher domestic demand (I/I^*), the higher the relative number of firms located in the domestic country (n/n^*), in a convex way because of the Home Market Effect. As well, the lower the relative cost of producing differentiated goods in the Home country (ρ), the higher the relative number of domestic firms.

As shown in Appendix A.2, the interior equilibrium is only sustainable for a small enough cost gap. Outside this interval, production is entirely concentrated in a single country and the number of active firms is simply determined by the corresponding zero-profit condition. Table 1 summarizes the equilibrium pattern of production as a function of the relative cost of producing in each country.

2.2.2. Market equilibria

The resolution of the model is achieved considering the various market-clearing conditions:

— On the skilled labor market: As the fixed minimum wage is assumed lower than the equilibrium wage for skilled workers

[11] See details in Appendix A.1.

Table 1
Equilibrium pattern of production.

Relative marg. cost ρ	$\underline{\rho}$		$\bar{\rho}$
Productive structure	CE $n^*=0$	IE $n>0, n^*>0$	CE $n=0$

CE means "Corner Equilibrium", IE "Interior Equilibrium".
$\underline{\rho}$ and $\bar{\rho}$ defined in Appendix A.2.

($\underline{w}<w_Q$ and $\underline{w}^*<w_Q^*$), full employment holds in equilibrium on that labor-market segment, hence $Q=\bar{Q}$ and $Q^*=\bar{Q}^*$.

— On the unskilled labor market: As long as the minimum wage is binding and endowments large enough, it is not balanced and the effective unskilled employment level in each country (L, L^*) is determined by the optimal labor demands coming from both sectors:

$$\underline{w}\,L = \underline{w}\,nl + \underline{w}\,l_Z = n\delta(\sigma-1)F + \beta y_Z \tag{27}$$

$$\underline{w}^*L^* = \underline{w}^*n^*l^* + \underline{w}^*l_Z^* = n^*\delta^*(\sigma-1)F + \beta y_Z^* \tag{28}$$

— On each of the $(n+n^*)$ differentiated goods markets: Each firm produces the amount just sufficient to cover the demand emanating from the domestic and foreign markets:

$$y = c + \tau c^* \tag{29}$$

$$y^* = c^* + \tau c \tag{30}$$

— On the homogenous good market: Given i) the domestic and foreign consumers' optimal demand (Eq. (5) and its foreign counterpart), and ii) the demand for good Z coming from monopolistic firms so as to cover the fixed costs, the resource constraint for the integrated world market of good Z is:

$$y_Z + y_Z^* = (1-\mu)(I+I^*) + (n+n^*)F$$

In the long-run equilibrium, national equilibrium incomes solely depend on the employment level of skilled and unskilled workers: $I=w_Q\bar{Q}+\underline{w}L$ and $I^*=w_Q^*\bar{Q}^*+\underline{w}^*L^*$. Using the labor-market equilibrium conditions (Eqs. (27) and (28)), one can see that they notably depend on the equilibrium productive pattern:

$$I = y_Z + n(\sigma-1)F \tag{31}$$

$$I^* = y_Z^* + n^*(\sigma-1)F \tag{32}$$

3. Minimum wages and the location of production

This section focuses on the effect of a marginal increase in the domestic minimum wage ($d\underline{w}>0$) on the spatial distribution of firms, starting from the symmetric equilibrium. In the symmetric equilibrium, minimum wages and labor endowments are identical across countries ($\underline{w}=\underline{w}^*$,$\bar{Q}=\bar{Q}^*$, $\bar{L}=\bar{L}^*$. In that case, it is trivial to show that the number of firms entering each market is equalized across countries ($n=n^*$), as well as national incomes ($I=I^*$), employment levels ($L=L^*$), skilled wages ($w_Q=w_Q^*$) and the production of homogenous good ($y_Z=y_Z^*$). This symmetric location equilibrium is the unique stable equilibrium provided that transport costs are high enough.[12] We start from the benchmark symmetric equilibrium to investigate the properties of the model following a unilateral increase in the domestic minimum wage ($d\underline{w}>0$).

Analytical results are derived by differentiating the model in the specific case when unskilled labor is only required in the production of differentiated goods (*i.e.* when $\beta=0$). In that case, production of homogenous good Z uses skilled labor only. As detailed in Appendix A.4, good Z's market equilibrium condition implies that skilled wages in both countries are equal to the exogenous productivity level a_Q. This simplifying assumption has the nice property of allowing analytical derivation of the effects of a domestic minimum wage shock on location decisions. Results are discussed in Section 3.1. However, it also implies that minimum wage shocks do not spread into the skilled labor market, thereby eliminating part of the story. It is thus removed in Section 3.2, which investigates the effects of a domestic minimum wage increase in the general case where $\beta>0$.

The assumption that the homogeneous sector solely uses skilled workers may seem at odds with the view commonly shared in the literature, that the homogenous sector is the traditional (or agricultural) one. We view this case as fruitful though, as it enables us to derive analytical results that substantially help drawing intuitions about the impact of the wage shock. Under this assumption, we are left with a "standard" model in which the role of the homogeneous sector is to equalize wages across countries. In most of the literature, this sector is called agriculture, while the increasing-returns-to-scale industry is associated with manufacturing. This interpretation is not necessarily exclusive of others though. If one instead views the homogenous sector as a highly-qualified services industry, like e-business, which involves virtually no fixed cost of producing in comparison with the manufacturing sector, the assumption that good Z is produced exclusively with skilled workers is more meaningful. In any case, we eventually depart from this simplifying assumption in Section 3.2, to consider the more general case where both sectors in the economy employ skilled and unskilled labor.

3.1. With exogenous skilled-labor wages ($\beta=0$)

In this section, we restrict the use of unskilled workers to the differentiated good sector and assume the homogeneous good to be produced with skilled labor only ($\beta=0$). Equilibrium skilled wages (expressed in terms of numéraire) equal the productivity level of skilled workers a_Q, as shown by Z-firms' first-order condition (Eq. (8) with $\beta=0$). As a result, minimum wage changes have no distorting effect on the remuneration of skilled workers.

To get insights about the impact of the wage shock on location decisions, the model is differentiated around the symmetric equilibrium. In a first step, we determine the off-equilibrium effect of the shock on the profitability of firms already located in both countries (*i.e.* for a given number of existing firms n, n^*). This allows to infer the impact on the spatial distribution of firms in a second step. Moreover, as the fixed cost of producing is set identical across countries, one can restrict the analysis to the impact of the wage shock onto relative operational profits, $\pi_{op}\equiv\pi+F$ and $\pi_{op}^*\equiv\pi^*+F$.

Given the values for I, I^*, p, p^*, P_X and P_X^* in the symmetric equilibrium, one can derive the elasticity of operating profits to $\underline{w}$ in each country off equilibrium (*i.e.*, for a fixed number of firms in each country, $\dot{n}=\dot{n}^*=0$). As detailed in Appendix A.4, it can be decomposed in two elements, the Price Competitiveness Effect (*PCE* hereafter) and the Income Effect (*IE* hereafter):

$$\left.\frac{d\pi_{op}/\pi_{op}}{d\underline{w}/\underline{w}}\right|_{\dot{n}=\dot{n}^*=0} = \underbrace{-2(\sigma-1)\delta\frac{\phi}{(1+\phi)^2}}_{PCE} + \underbrace{\frac{\sigma-1}{\sigma}\mu\delta(1-\delta)\frac{1-\gamma}{1+\phi}}_{IE} \tag{33}$$

[12] We refer to the stability criterion proposed by Fujita et al. (1999) and Fujita and Thisse (2002). Stability of the symmetric interior equilibrium requires that:

$$\phi<\hat{\phi}\equiv\left|\frac{1-\psi\mu}{1+\psi\mu}\right|$$

with $\psi=1-\frac{1-\delta}{1-\beta}\frac{\sigma-1}{\sigma}$. Proof is available upon request. Picard and Toulemonde (2006) or Toulemonde (2006) similarly obtain that the stability condition depends on the size of transport costs.

$$\left.\frac{d\pi^*_{op}/\pi^*_{op}}{d\underline{w}/\underline{w}}\right|_{\dot{n}=\dot{n}^*=0} = \underbrace{2(\sigma-1)\delta\frac{\phi}{(1+\phi)^2}}_{PCE} + \underbrace{\frac{\sigma-1}{\sigma}\mu\delta(1-\delta)\frac{\phi(1-\gamma)}{1+\phi}}_{IE} \tag{34}$$

The Price Competitiveness Effect is always negative for domestic firms and positive for foreign ones. The Income Effect may be positive or negative in both countries.

The Price Competitiveness Effect may be rationalized as follows. The domestic policy shock increases the cost of unskilled workers. Given that skilled wages are exogenous, the increase in $\underline{w}$ translates into an increase in the relative cost of unskilled labor ($\underline{w}/w_Q$), which entices domestic firms to substitute skilled to low-skilled workers. Yet, as long as both types of labor are not perfect substitutes, firms cannot fully compensate for the relative increase in production costs. By raising the relative cost of producing in the domestic country, the wage shock lowers price competitiveness of domestic firms relative to that of foreign ones, both on the local and export markets. Conversely, foreign firms' competitiveness on both markets benefits from the domestic policy shock. For given values of n, n^* and starting from the symmetric equilibrium, one can indeed show that:

$$\frac{d(p/P_X)}{d\underline{w}}>0,\ \frac{d(\tau p/P_X^*)}{d\underline{w}}>0,\frac{d(p^*/P_X^*)}{d\underline{w}}<0,\frac{d(\tau p^*/P_X)}{d\underline{w}}<0$$

Absent any income effect, the wage shock would always negatively affect the relative attractiveness of the domestic country. With free entry of firms, the relative increase in domestic production costs would entice a larger number of firms to locate and produce abroad. In that respect, the relocation of firms strengthens the negative impact of the minimum wage shock on domestic employment and production obtained in the neo-classical framework with an exogenous number of firms.

However, operating profits are also altered by aggregate demand changes, leading to the Income Effect. Everything else equal, the domestic wage shock tends to increase local aggregate income by raising low-skilled workers' purchasing power. Nevertheless, it also reduces demand for low-skilled labor coming from each domestic monopolistic firm, and aggregate unskilled labor demand as well. Besides, there is no effect on the skilled labor-market segment, given that skilled wages are left unaffected by the minimum wage shock in a context with full employment. As a result, for the existing number of firms, the income effect may be positive or negative.[13]

As shown by Eqs. (33) and (34), the (necessary and sufficient) condition for it to be positive is $\gamma<1$, the elasticity of substitution between skilled and unskilled workers has to be low. If positive, the income effect increases profits in both countries. However, as shown by comparing both IE terms in Eqs. (33) and (34), the upward pressure is stronger for local firms than for foreign ones because of the Home Market Effect. *Ceteris paribus*, the income effect enhances the domestic country's attractiveness in relative terms.

Out-of-equilibrium analysis of changes in the profits of domestic and foreign incumbents further allows to derive the effect of the wage shock on the spatial distribution of firms *i.e.* taking into account free-entry conditions. As firms are free to decide where to locate, the ultimate long-run impact on the relative number of firms located in the home country depends on the out-of-equilibrium changes in profits in the domestic country *relative* to those in the foreign one. Proposition 1 states the condition under which a marginal increase in the home minimum wage raises the domestic country's attractiveness for firms.

Proposition 1. Starting from the symmetric interior equilibrium, a unilateral marginal increase in the home minimum wage leads to a concentration of firms in the domestic country if the elasticity of domestic profits to the wage shock is larger than the elasticity of foreign profits. It is the case if:

$$\underbrace{-4(\sigma-1)\delta\frac{\phi}{(1+\phi)^2}}_{PCE} + \underbrace{\frac{(\sigma-1)}{\sigma}\mu\delta(1-\delta)(1-\gamma)\frac{1-\phi}{1+\phi}}_{IE} > 0 \tag{35}$$

Proof. See Appendix A.4. □

Everything else equal, the price competitiveness effect always benefits to foreign firms, thereby reducing the domestic country's relative attractiveness. On the other hand, as long as the income effect is positive ($\gamma<1$), it raises domestic attractiveness in relative terms because of the Home Market Effect. If strong enough, the income effect may even more than compensate for the price competitiveness loss, in what case the relative number of firms located in the domestic country raises with the minimum wage increase.

As shown by Eq. (35), the balance between the cost and demand effects depends on the parameters γ, δ, μ, and ϕ. Their influence goes by different transmission channels.

- μ, γ and δ affect the response of domestic income to the wage shock ($dI/d\underline{w}$). The lower the elasticity of substitution between skilled and unskilled labor in the differentiated sector (γ), the more limited the substitution of skilled to unskilled workers induced by the relative increase in $\underline{w}/w_Q$ and the stronger the income effect. As well, low δ and high μ tend to favor the income effect everything else equal.
- The size of trade barriers (ϕ) alters the impact of a change in aggregate income on domestic profits relative to foreign ones in the short run (*i.e.* $d\pi/dI$ relative to $d\pi^*/dI$). The higher ϕ, *i.e.* the lower transport costs, the smaller the benefit of being located in the market whose national income increases.[14] When international trade barriers are low (ϕ high), following the domestic minimum wage shock, more firms choose to enter the foreign market to benefit from an improved price competitiveness, and to export on the domestic market whose income has increased with the minimum wage shock.

This last result is of particular interest for economic policy design in the current context of trade liberalization. A high-minimum wage policy is all the more likely to negatively affect the country's relative attractiveness as international trade is freer (ϕ high). Given that skilled labor costs are unaffected by the minimum wage increase, pressures exerted by cost competitiveness motives are more prevalent in the arbitrage faced by firms regarding location choices. This result however relies on the exogeneity of skilled wages, and may accordingly be altered when w_Q adjusts to changes in $\underline{w}$, as investigated in the next section.

3.2. With endogenous skilled wages adjustment ($\beta\neq 0$)

Analysis driven in Section 3.1 has been conducted in the particular case where skilled wages are independent of minimum wage policy, achieved by setting $\beta=0$. We now depart from that assumption to take into account the potential distorting effects of minimum wage policy on the whole remuneration structure. As shown by Eq. (8) when $\beta=0$, an increase in $\underline{w}$ leads to a drop in the equilibrium wage of skilled workers w_Q. Endogenous adjustments of w_Q alter the impact

[13] As shown in Appendix A.4, a marginal increase in the home minimum wage potentially induces an income effect abroad, due to changes in foreign firms' profits out off equilibrium. Yet, this effect disappears as we consider small deviations from the symmetric equilibrium where profits are nil.

[14] Note that the impact of the elasticity of substitution across varieties σ is ambiguous. As σ is high, competition between firms is keener, and the negative PCE stronger. Yet it also strengthens the Home Market Effect by reducing ϕ, raising the (possibly positive) IE.

of the wage shock on firms' location decisions, with respect to those derived in Section 3.1.

Taking into account endogenous skilled wages adjustment is therefore likely to enrich the analysis concerning the impact of a unilateral minimum wage increase on location decisions. We investigate that point by relying on numerical simulations of the model, given the calibration of structural parameters displayed in Table 2.

The share of differentiated goods in the utility function μ is taken from Strauss-Kahn (2005). The value for α is taken from Salanié's (2000) estimate of the share of skilled workers in the French value-added during the 1990s. We retain the same reference for calibrating β.[15] The literature delivers contrasted results for the value of the elasticity of substitution between skilled and unskilled workers. We set $\gamma = 0.7$ based on Gianella (1999).[16] The ratio a_L/a_Q is chosen so as to reproduce the relative productivity level of unskilled workers observed in the data (arbitrarily setting $a_Q = 1$).[17] The value $\tau = 1.2$ lies within the range commonly found in the literature (see Hummels, 2001 among others). The elasticity of substitution across varieties $\sigma = 6$ corresponds to a mark-up rate of 20% and is consistent with Broda and Weinstein's (2006) estimates. We arbitrarily set the fixed cost of production $F = 1$.[18] Last, and as discussed below, the model's predictions are sensitive to the calibrated value of $s_Q \equiv \frac{\overline{Q}}{\overline{Q} + \overline{L}}$, that is the share of skilled workers in the working population. In what follows, it is set equal to 0.5, which is consistent with the share of skilled workers in the working-age population in European countries (EU 12) in the end of the 1990s. Note that this value constitutes a lower bond, given the decrease in the share of unskilled workers in population in many (European) countries in the recent years. We check that the value could be increased without altering qualitative results.[19]

Given calibration summed up in Table 2, the model is simulated to study the effects of a unilateral increase in the domestic minimum wage $\underline{w}$ on optimal firms' location decisions. Fig. 1 reports the equilibrium values of n and n^*, for increasing values of $\underline{w}$ relative to $\underline{w}^*$.[20]

In the general case with $\beta \neq 0$, one can still rationalize the impact of minimum wage policy on the spatial distribution of firms into a price competitiveness effect (PCE) and an income effect (IE). However, endogenous changes in the remuneration of skilled workers substantially affect both mechanisms. First regarding PCE, the decrease in w_Q reduces domestic firms' competitiveness loss induced by the minimum wage increase. Second, the Income Effect is affected by the reduction in the equilibrium wage of skilled workers as well. As previously, the upward pressure on aggregate income induced by the increase in $\underline{w}$ is counteracted by the decrease in unskilled employment. Besides, it is now dampened by the decrease in w_Q under full employment on the skilled labor-market segment. Everything else equal, endogeneity in w_Q reduces the probability that the policy shock induces a positive Income Effect.

Table 2
Calibration.

μ	α	F	a_Q	a_L	γ	β	σ	τ	s_Q
0.55	0.53	1	1	0.86	0.7	0.47	6	1.2	0.5

The final outcome is again driven by the balance between both effects. Simulations show that it is notably affected by the share of skilled workers in the working population (s_Q), according to the following underlying mechanisms:

- The Income Effect is all the more negative as the share of skilled workers is high. With endogenous skilled wages, the remuneration of this labor-market segment is negatively affected by the wage shock (as shown by Eq. (8)). This is all the more likely to imply a negative income effect as the share of skilled workers in the working population is high.
- The Price Competitiveness Effect is shown to be sensitive to s_Q as well. Namely, the lower s_Q, the less negative the competitiveness loss induced by the minimum-wage shock. This is because, under decreasing marginal productivity of labor the equilibrium wage of skilled workers decreases relatively more when the supply of skilled workers Q (hence s_Q) is small. Would the endogenous decrease in w_Q be strong enough, the minimum wage shock could even imply a positive PCE. However, simulation results suggest that this is the case for an implausibly low share of skilled workers in the population.

For empirically plausible values of s_Q (*i.e.*, not too low), the PCE induced by the minimum wage shock remains negative, and is reinforced by a negative IE. Accordingly, the minimum wage increase reduces the domestic country's attractiveness, as shown in Fig. 1 where n/n^* decreases all the more since $\underline{w}/\underline{w}^*$ raises.

When w_Q adjusts to changes in $\underline{w}$, the minimum-wage shock is thus more likely to induce an attractiveness loss for the high minimum-wage country because the positive impact on unskilled workers' income is partially compensated by a drop in the remuneration of skilled workers. This distortion in the whole wage structure induced by the minimum wage shock is consistent with empirical evidence found in the labor market empirical literature, as reported by Lee (1999) or Neumark and Wascher (2008), Chapter 4. Next section asks how these results are affected by changes in other key parameters of the model.

3.3. Sensitivity analysis

Section 3.1 derives analytical conditions under which a unilateral increase in $\underline{w}$ positively influences the propensity of firms to locate in

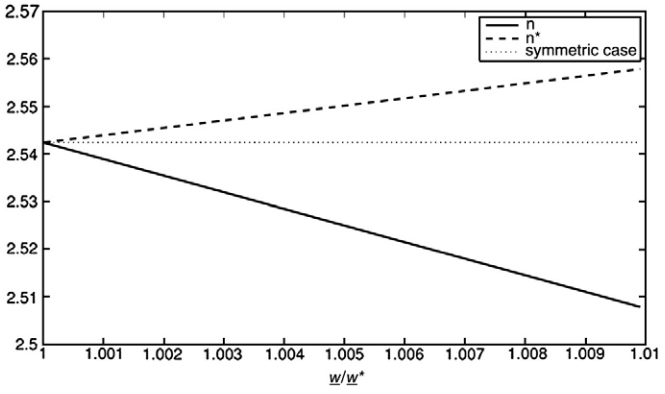

Fig. 1. Spatial impact of a domestic shock on minimum wages.

[15] Simulation exercises show that results are not substantially altered for values of β around this calibration.

[16] Note that this calibration meets the condition for the income effect to be positive in the case $\beta = 0$.

[17] Calibration is based on French data, using information delivered by the OECD-STAN database. Productivity in the services sector is taken as reference for a_L, whereas the productivity of skilled workers corresponds to the productivity in total manufacturing. Reference year is 2000.

[18] Simulation exercises show that the value for F does not play a crucial role in our results.

[19] Calibration of s_Q is based on data from the European Labor Force Survey, provided by Eurostat. Precisely, we refer to the share of people in the working-age population (15–64) with a low educational attainment, *i.e.* with an education level ISCDE (International Standard Classification of Education) of 2 or less. ISCDE levels 0–2 include pre-primary, primary and lower second education.

[20] As for the symmetric equilibrium, for each value of $\underline{w}$ departing from $\underline{w}^*$, we check i) that the model's solution is the interior one, ii) that minimum wages values are still binding in the unskilled labor market while unbinding in the skilled one, and iii) that the interior equilibrium fulfils the stability condition.

the high-minimum wage country. According to Eq. (35), it namely depends on i) the degree of substitution between skilled and unskilled workers in the differentiated sector (γ should be low), and ii) the size of trade costs (τ should be high). By symmetry, this section investigates the sensitivity of results to both parameters under endogenous skilled wages.

To that aim, we simulate the model for increasing values of γ and ϕ and look at how it affects the relative number of firms located in the domestic country when its minimum wage is 1% higher than in the foreign country. Other structural parameters are calibrated as reported in Table 2. Results are illustrated in Fig. 2.

3.3.1. Sensitivity analysis to γ

We first investigate the role of the elasticity of substitution between skilled and unskilled labor in the differentiated good sector.

As displayed in the left-panel of Fig. 2, the ratio n/n^* is all the lower as γ is high. This is consistent with our previous analytical results derived in Section 3.1, according to which the case of an attractiveness gain for the high-minimum wage country becomes less and less likely as skilled and unskilled workers become more substitutable. Similar mechanisms are at work with endogenous skilled wages. The income effect is all the more negative as γ is high and the home country's relative attractiveness as well.

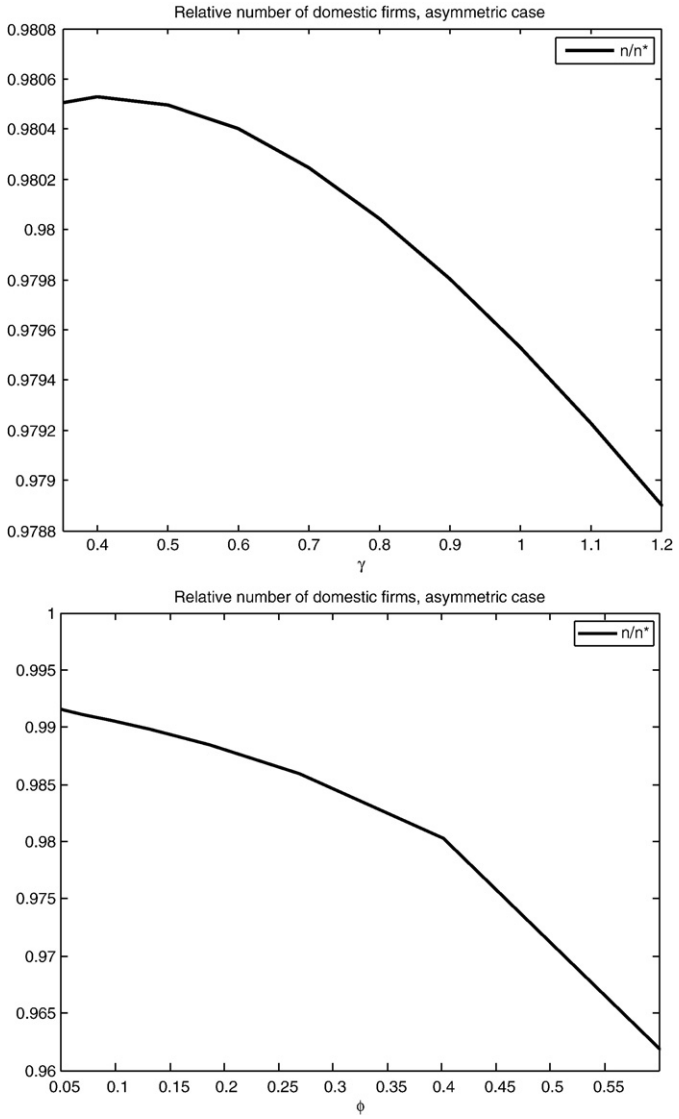

Fig. 2. Sensitivity analysis.

3.3.2. Sensitivity analysis to ϕ

Section 3.1 makes clear that, with exogenous skilled wages, an increase in $\underline{w}$ all the more reduces the home country's attractiveness as trade costs are low, *i.e.* as ϕ is high. This is still the case when endogenous skilled wage adjustments are taken into account, as shown by the sensitivity analysis to ϕ reported in the right-panel of Fig. 2.

As in the case with exogenous skilled wages, the attractiveness loss of the high minimum-wage country is all the stronger since international trade is liberalized: The ratio n/n^* decreases with ϕ. First, trade liberalization makes the cost-competitiveness of firms more prevalent in international competition. Everything else equal, the negative PCE induces firms to locate in the low-cost country. Second, with endogenous skilled wages, this effect is strengthened by the negative income effect in the home country. For both price-competitiveness and market potential motives, firms are all the more enticed to settle in the foreign country as international trade is free.

4. Conclusion

Using insights of the labor market literature and the new economic geography, the paper contributes to the debate on the effect of labor market laws on a country's attractiveness for investors. Precisely, our theoretical framework studies the link between minimum wages and firms' location choices in an international setting. We show that the impact of a minimum wage increase on the country's attractiveness is far from trivial. Firms' location decisions are affected through a negative cost effect and a possibly positive impact on aggregate demand.

The originality of the paper is to explore how interactions between skilled and unskilled segments of the labor market affect firms' location patterns. In particular, we show that the direction and strength of the Home Market Effect induced by a high minimum wage depend on the substitutability between skilled and unskilled workers. When skilled wages are exogenous, a positive minimum wage shock may well benefit to the home country's attractiveness through a positive income effect. This occurs provided that skilled and unskilled workers are low substitutes. If instead substitutability is high enough, a minimum wage increase makes firms in the differentiated sector substitute unskilled for skilled workers. This substitution reduces aggregate income. In that case, the (negative) income effect strengthens the cost competitiveness loss induced by the initial minimum wage shock.

Taking into account endogenous skilled wage adjustments reinforces the negative impact of high minimum wages on the country's attractiveness. The substitution effect in the increasing returns to scale sector is exacerbated by the decrease in equilibrium skilled wages and aggregate income further reduces. The source of downward pressures on skilled wages lies in international competition in the homogenous good market. The minimum wage increase raises the price of the homogeneous good, whose production reduces. Labor demand, hence skilled wage, drop as a consequence. The case for a positive income effect counteracting the firms' competitiveness loss is thus even less likely as long as one takes into account international competitive pressures.

Our overall results underline the importance of taking into account the impact of labor market policies on firms' location decisions, if willing to consistently evaluate their whole consequences on the national economy. Moreover, the analysis has to fully account for general equilibrium adjustments that may potentially reverse the direct impact of labor market regulations on firms' profits.

Acknowledgements

We would like to thank two anonymous referees, Martine Carré, Pierre-Philippe Combes, Matthieu Crozet, Jean-Olivier Hairault, Philippe Martin for their helpful comments. The paper has also benefited from the remarks made by the participants of the seminars organized at CEPII, CREST and THEMA. Omissions and mistakes are, of course, ours.

Appendix A

A.1. Equilibrium profits

This section details the derivation of domestic firms' profit given by Eq. (22). A similar reasoning holds for foreign profits.
To obtain this equation, start from the definition of the firm's profit Eq. (12) rewritten as follows (suppressing the h index to alleviate notations):

$$\pi = pc + p^*c^* - MCy - F$$

Given optimal prices Eqs. (16) and (17) and the good-market equilibrium condition (29), it can be rewritten as

$$\pi = \frac{py}{\sigma} - F \tag{A.1}$$

From the domestic household's optimal demand function (6) and its foreign counterpart, the total nominal demand addressed to the domestic firm can be expressed as:

$$py = \left(\frac{p}{P_X}\right)^{1-\sigma} \mu I + \phi\left(\frac{p}{P_X^*}\right)^{1-\sigma} \mu I^*$$

Eq. (A.1) thus becomes:

$$\pi = \frac{\mu}{\sigma}\left[\left(\frac{p}{P_X}\right)^{1-\sigma} I + \phi\left(\frac{p}{P_X^*}\right)^{1-\sigma} I^*\right] - F \tag{A.2}$$

Given the expression of manufactured price indices (20) and (21), the domestic firm's relative prices on each market can be written as:

$$\left(\frac{p}{P_X}\right)^{1-\sigma} = \frac{1}{n + n^*\phi\rho^{\sigma-1}}$$
$$\left(\frac{p}{P_X*}\right)^{1-\sigma} = \frac{\rho^{1-\sigma}}{n\phi\rho^{1-\sigma} + n^*}$$

Integrating this in Eq. (A.2) finally gives Eq. (22):

$$\pi = \frac{\mu}{\sigma}\left[\frac{I}{\Delta} + \phi\rho^{1-\sigma}\frac{I^*}{\Delta^*}\right] - F$$

with $\Delta \equiv n + n^*\,\phi\rho^{\sigma-1}$ and $\Delta^* \equiv n^* + n\phi\rho^{1-\sigma}$.
In the free-entry equilibrium, profits are drawn towards zero, in the domestic and the foreign markets:

$$F = \frac{\mu}{\sigma}\left[\frac{I}{\Delta} + \phi\rho^{1-\sigma}\frac{I^*}{\Delta^*}\right]$$
$$F = \frac{\mu}{\sigma}\left[\frac{I^*}{\Delta^*} + \phi\rho^{\sigma-1}\frac{I}{\Delta}\right]$$

Multiplying previous equations by n and n^* respectively, and summing term-by-term gives:

$$n\frac{\mu}{\sigma}\left(\frac{I}{\Delta} + \phi\rho^{1-\sigma}\frac{I^*}{\Delta^*}\right) + n^*\frac{\mu}{\sigma}\left(\frac{I^*}{\Delta^*} + \phi\rho^{\sigma-1}\frac{I}{\Delta}\right) = (n + n^*)F$$

Rearranging terms, we obtain Eq. (25) that relates the total number of firms at the word level to aggregate incomes.

A.2. The interior equilibrium

In the interior equilibrium, the relative number of firms in each country is jointly determined by the nullity of Eqs. (22) and (23). The relative number of active firms in each country is:

$$\frac{n}{n^*} = \frac{I(1 - \phi\rho^{\sigma-1}) - I^*\phi(\rho^{\sigma-1} - \phi)}{I^*(1 - \phi\rho^{1-\sigma}) - I\phi(\rho^{1-\sigma} - \phi)}$$

Combined with Eq. (25), this gives the number of firms located in each country as a function of incomes and wage costs:

$$n = \frac{I(1 - \phi\rho^{\sigma-1}) - I^*\phi(\rho^{\sigma-1} - \phi)}{(1 + \phi^2) - \phi(\rho^{\sigma-1} + \rho^{1-\sigma})}\frac{\mu}{\sigma F} \tag{A.3}$$

$$n^* = \frac{I^*(1-\phi\rho^{1-\sigma}) - I\phi(\rho^{1-\sigma}-\phi)}{(1+\phi^2)-\phi(\rho^{\sigma-1}+\rho^{1-\sigma})}\frac{\mu}{\sigma F} \tag{A.4}$$

This relation is only valid in the interior equilibrium, *i.e.* for $n>0$ and $n^*>0$. It is the case if the following three expressions are all positive (or negative):

$$I(1-\phi\rho^{\sigma-1}) - I^*\phi(\rho^{\sigma-1}-\phi) > 0 \tag{A.5}$$

$$I^*(1-\phi\rho^{1-\sigma}) - I\phi(\rho^{1-\sigma}-\phi) > 0 \tag{A.6}$$

$$(1+\phi^2) - \phi(\rho^{\sigma-1}+\rho^{1-\sigma}) > 0 \tag{A.7}$$

Manipulating Eq. (A.5) yields that:

$$I(1-\phi\rho^{\sigma-1}) - I^*\phi(\rho^{\sigma-1}-\phi) > 0$$
$$\Leftrightarrow \rho^{\sigma-1} < \overline{\rho}^{\sigma-1}$$

with $\bar{\rho}$ defined as

$$\overline{\rho} \equiv \left[\frac{I+\phi^2 I^*}{\phi(I+I^*)}\right]^{\frac{1}{\sigma-1}}$$

Besides, after some calculus on Eq. (A.6), you get that:

$$I^*(1-\phi\rho^{1-\sigma}) - I\phi(\rho^{1-\sigma}-\phi) > 0$$
$$\Leftrightarrow \rho^{\sigma-1} > \underline{\rho}^{\sigma-1}$$

with $\underline{\rho}$ defined as:

$$\underline{\rho}^{\sigma-1} \equiv \left[\frac{\phi(I+I^*)}{\phi^2 I + I^*}\right]^{\frac{1}{\sigma-1}}$$

Finally, condition on Eq. (A.7) implies that:

$$(1+\phi^2) - \phi(\rho^{\sigma-1}+\rho^{1-\sigma}) > 0$$
$$\Leftrightarrow \phi < \rho^{\sigma-1} < \frac{1}{\phi} \tag{A.8}$$

Taken together, this means that condition (26) holds if and only:

$$\frac{\phi(I+I^*)}{\phi^2 I + I^*} < \rho^{\sigma-1} < \frac{I+\phi^2 I^*}{\phi(I+I^*)} \tag{A.9}$$

Before concluding, one has to ensure that it is always the case that:

$$\frac{\phi(I+I^*)}{\phi^2 I + I^*} < \frac{I+\phi^2 I^*}{\phi(I+I^*)}$$

After some calculations, this condition becomes:

$$I^* I(1-\phi^2)^2 > 0$$

Provided that both aggregate incomes are positive, it is thus always true that $\frac{\phi(I+I^*)}{\phi^2 I + I^*} < \frac{I+\phi^2 I^*}{\phi(I+I^*)}$.

Moreover, under condition (A. 9), condition (A.8) never binds as $\phi < \underline{\rho}$ and $\overline{\rho} < \frac{1}{\phi}$ always hold.

As long as $\rho^{\sigma-1} < \frac{\phi(I+I^*)}{\phi^2 I + I^*}$, production is entirely concentrated in the domestic (low minimum wage) country (*i.e.* $n^*=0$). This corner equilibrium is stable because no foreign firm has an incentive to enter the foreign market:

$$E\{\pi^*(f)\,|\,n^*=0\} = \frac{\mu}{\sigma}\left(\frac{I^*}{n\phi\rho^{1-\sigma}} + \phi\rho^{\sigma-1}\frac{I}{n}\right) - F$$
$$= \frac{F}{I+I^*}\left(\frac{I^*+\phi^2 I}{\phi\rho^{1-\sigma}} - (I+I^*)\right)$$

which is negative when $\rho^{\sigma-1} < \frac{\phi(I+I^*)}{\phi^2 I + I^*}$.

On the other hand, if $\rho^{\sigma-1} > \frac{I+\phi^2 I^*}{\phi(I+I^*)}$, production is entirely concentrated in the foreign country (*i.e.* $n=0$), as the production in the domestic country is unprofitable:

$$E\{\pi(h)|n=0\} = \frac{\mu}{\sigma}\left(\frac{I}{n^*\phi\rho^{\sigma-1}} + \phi\rho^{1-\sigma}\frac{I^*}{n^*}\right) - F$$
$$= \frac{F}{I+I^*}\left(\frac{I+\phi^2 I^*}{\phi\rho^{\sigma-1}} - (I+I^*)\right)$$

which is negative when $\rho^{\sigma-1} > \frac{I+\phi^2 I^*}{\phi(I+I^*)}$.

A.3. The general equilibrium in the corner equilibrium

This section details one of the two corner equilibria, when $n=0$ and $n^*>0$. The second one (when $n^*=0$ and $n>0$) can be inferred by symmetry. As soon as:

$$\rho^{\sigma-1} > \frac{1+\phi^2 I^*}{\phi(I+I^*)}$$

the relative marginal cost is so low in the foreign country, that all firms are enticed to enter the foreign market to produce and serve it. The number of differentiated varieties produced in the domestic country becomes null. As a result, $n=0$ while $n^*>0$.

In such corner equilibrium, the general equilibrium solution is defined by the following system:

$$w_Q = a_Q \beta^{\frac{\beta}{1-\beta}}(1-\beta)\left(\frac{w}{a_L}\right)^{\frac{-\beta}{1-\beta}}$$
$$w_Q^* = a_Q \beta^{\frac{\beta}{1-\beta}}(1-\beta)\left(\frac{w^*}{a_L}\right)^{\frac{-\beta}{1-\beta}}$$
$$I = y_Z$$
$$I^* = y_Z^* + n^*(\sigma-1)F$$
$$MC_X^* = \left[\alpha\left(\frac{w_Q^*}{a_Q}\right)^{1-\gamma} + (1-\alpha)\left(\frac{w^*}{a_L}\right)^{1-\gamma}\right]^{\frac{1}{1-\gamma}}$$
$$n^* = \frac{\mu}{\sigma}\frac{I+I^*}{F}$$
$$y_Z + y_Z^* = (1-\mu)(I+I^*) + n^*F$$
$$w_Q\overline{Q} = (1-\beta)y_Z$$

A.4. Minimum wage shocks and location decisions under exogenous skilled wages

A.4.1. Setup

In the following, we derive analytical results in the special case where unskilled workers are only in use in the differentiated good sector, whereas good Z is entirely produced from skilled workers. Analytically, this is achieved by setting β equal to 0. This is a convenient case to study because equilibrium skilled wages are then equalized across countries and insensitive to minimum wage shocks. In that case, Z-firms' first-order condition in both countries (Eq. (8) and its foreign counterpart) yield:

$$1 = \frac{w_Q}{a_Q} = \frac{w_Q^*}{a_Q} \Leftrightarrow w_Q = w_Q^* = a_Q$$

Throughout the paper, we retain the simplifying assumption $a_Q=1$. When $\beta=0$ then, skilled wages are equal to the price of the numéraire good, *i.e.* $w_Q=1$.

Moreover, as unskilled workers are only employed by differentiated good producers, labor-market equilibria imply:

$$\underline{w}\, L = n\delta(\sigma-1)F$$
$$\underline{w}^* L^* = n^*\delta^*(\sigma-1)F$$

with δ and δ^* defined as in the general case.

Making use of these labor market equilibrium conditions, the expression of aggregate incomes (Eq. (2) and its foreign counterpart) can be re-written as:

$$I = \overline{Q} + n(\sigma-1)F\delta + n\pi \tag{A.10}$$

$$I^* = \overline{Q}^* + n^*(\sigma-1)F\delta^* + n^*\pi^* \tag{A.11}$$

Last, the expression for marginal costs simplifies into:

$$MC = \left[\alpha + (1-\alpha)\left(\frac{\underline{w}}{a_L}\right)^{1-\gamma}\right]^{\frac{1}{1-\gamma}} \tag{A.12}$$

A.4.2. Symmetric equilibrium

In the symmetric equilibrium, minimum wages and labor endowments are set identical across countries ($\underline{w}=\underline{w}^*$, $\overline{Q}=\overline{Q}^*$, $\overline{L}=\overline{L}^*$. As a consequence, the number of firms entering each market is identical in both countries, *i.e.* the equilibrium is an interior one. From Eqs. (25), (26), (31) and (32), we characterize the symmetric equilibrium as follows:

$$n = n^* = \frac{\mu}{\sigma - \mu(\sigma-1)\delta}\frac{\overline{Q}}{F}$$
$$I = I^* = \frac{\sigma}{\sigma - \mu(\sigma-1)\delta}\,\overline{Q}$$
$$Q = Q^* = \overline{Q}$$
$$L = L^* = \frac{\mu(\sigma-1)\delta}{\sigma - \mu(\sigma-1)\delta}\frac{\overline{Q}}{\underline{w}}$$

In that case, as trade flows of differentiated goods are balanced, each country produces the quantity of homogeneous good necessary to cover the representative household's consumption and the fixed costs paid by domestic firms:

$$y_Z = y_Z^* = C_Z + nF$$

A.4.3. Impact of a minimum wage shock

Starting from domestic firms' profits:

$$\pi^{op} = \frac{py}{\sigma} = \frac{\mu}{\sigma}\left[\left(\frac{p}{P_X}\right)^{1-\sigma} I + \left(\frac{\tau p}{P_X}\right)^{1-\sigma} I^*\right] \tag{A.13}$$

we can decompose the off-equilibrium effect of the wage shock on domestic firms' operational profits in two elements:

$$\frac{d\pi^{op}/\pi^{op}}{d\underline{w}/\underline{w}} = \underbrace{\frac{d\pi^{op}/\pi^{op}}{dI/I}\frac{dI/I}{d\underline{w}/\underline{w}} + \frac{d\pi^{op}/\pi^{op}}{dI^*/I^*}\frac{dI^*/I^*}{d\underline{w}/\underline{w}}}_{\text{Income Effect}} + \underbrace{\frac{d\pi^{op}/\pi^{op}}{d(p/P_X)/(p/P_X)}\frac{d(p/P_X)/(p/P_X)}{d\underline{w}/\underline{w}} + \frac{d\pi^{op}/\pi^{op}}{d(\tau p/P_X^*)/(\tau p/P_X^*)}\frac{d(\tau p/P_X^*)/(\tau p/P_X^*)}{d\underline{w}/\underline{w}}}_{\text{Price Competitiveness Effect}}$$

Making use of Eqs. (20), (21), (A.10), (A.11) and (A.12), totally differentiating Eq. (A.13) with respect to a marginal change in $\underline{w}$ yields:

$$\frac{d\pi^{op}/\pi^{op}}{dI/I} = \frac{\left(\frac{p}{P_X}\right)^{1-\sigma} I}{\left(\frac{p}{P_X}\right)^{1-\sigma} I + \left(\frac{\tau p}{P_X^*}\right)^{1-\sigma} I^*}$$

$$\frac{dI/I}{d\underline{w}/\underline{w}} = \frac{I-\overline{Q}}{I}(1-\gamma)(1-\delta) + \frac{n\pi}{I}\left[\frac{d\pi}{d\underline{w}}\frac{\underline{w}}{\pi} - (1-\gamma)(1-\delta)\right]$$

$$\frac{d\pi^{op}/\pi^{op}}{dI^*/I^*} = \frac{\left[\frac{\tau p}{P_X^*}\right]^{1-\sigma} I^*}{\left[\frac{p}{P_X}\right]^{1-\sigma} I + \left[\frac{\tau p}{P_X^*}\right]^{1-\sigma} I^*}$$

$$\frac{dI^*/I^*}{d\underline{w}/\underline{w}} = \frac{n^*\pi^*}{I^*}\frac{d\pi^*}{d\underline{w}}\frac{\underline{w}}{\pi^*}$$

$$\frac{d\pi^{op}/\pi^{op}}{d(p/P_X)/(p/P_X)} = (1-\sigma)\frac{\left(\frac{p}{P_X}\right)^{1-\sigma} I}{\left(\frac{p}{P_X}\right)^{1-\sigma} I + \left(\frac{\tau p}{P_X^*}\right)^{1-\sigma} I^*}$$

$$\frac{d(p/P_X)/(p/P_X)}{d\underline{w}/\underline{w}} = \frac{n^*\phi\delta}{n\rho^{1-\sigma} + n^*\phi}$$

$$\frac{d\pi^{op}/\pi^{op}}{d(\tau p/P_X^*)/(\tau p/P_X^*)} = (1-\sigma)\frac{\left(\frac{\tau p}{P_X^*}\right)^{1-\sigma} I^*}{\left(\frac{p}{P_X}\right)^{1-\sigma} I + \left(\frac{\tau p}{P_X^*}\right)^{1-\sigma} I^*}$$

$$\frac{d(\tau p/P_X^*)/(\tau p/P_X^*)}{d\underline{w}/\underline{w}} = \frac{n^*\delta}{n\phi\rho^{1-\sigma} + n^*}$$

When evaluated in the neighborhood of the symmetric equilibrium (defined in Appendix A.4.2), previous expressions become:

$$\frac{d\pi^{op}/\pi^{op}}{dI/I} =^{SE} \frac{1}{1+\phi}$$
$$\frac{dI/I}{d\underline{w}/\underline{w}} =^{SE} \frac{\mu\delta}{1+\phi}\frac{\sigma-1}{\sigma}(1-\gamma)(1-\delta)$$
$$\frac{d\pi^{op}/\pi^{op}}{dI^*/I^*} =^{SE} \frac{\phi}{1+\phi}$$
$$\frac{dI^*/I^*}{d\underline{w}/\underline{w}} =^{SE} 0$$
$$\frac{d\pi^{op}/\pi^{op}}{d(p/P_X)/(p/P_X)} =^{SE} \frac{1-\sigma}{1+\phi}$$
$$\frac{d(p/P_X)/(p/P_X)}{d\underline{w}/\underline{w}} =^{SE} \frac{\phi\delta}{1+\phi}$$
$$\frac{d\pi^{op}/\pi^{op}}{d(\tau p/P_X^*)/(\tau p/P_X^*)} =^{SE} \frac{\phi(1-\sigma)}{1+\phi}$$
$$\frac{d(\tau p/P_X^*)/(\tau p/P_X^*)}{d\underline{w}/\underline{w}} =^{SE} \frac{\delta}{1+\phi}$$

where *SE* means the expression is evaluated at the symmetric equilibrium.

Around the symmetric equilibrium, the elasticity of domestic profits to the domestic minimum wage is given by:

$$\frac{d\pi^{op}/\pi^{op}}{d\underline{w}/\underline{w}} =^{ES} -2(\sigma-1)\delta\frac{\phi}{(1+\phi)^2} + \frac{\sigma-1}{\sigma}\mu\delta(1-\delta)\frac{1-\gamma}{1+\phi}$$

which is positive if:

$$\mu(1-\delta)(1-\gamma) > \sigma\frac{2\phi}{1+\phi}$$

Using the same reasoning as previously, we can decompose the effect of the wage shock on foreign firms' profits, in two elements:

$$\frac{d\pi^{op*}/\pi^{op*}}{d\underline{w}/\underline{w}} = \underbrace{\frac{d\pi^{op*}/\pi^{op*}}{dI/I}\frac{dI/I}{d\underline{w}/\underline{w}} + \frac{d\pi^{op*}/\pi^{op*}}{dI^*/I^*}\frac{dI^*/I^*}{d\underline{w}/\underline{w}}}_{\text{Income Effect}}$$
$$+ \underbrace{\frac{d\pi^{op*}/\pi^{op*}}{d(\tau p^*/P_X)/(\tau p^*/P_X)}\frac{d(\tau p^*/P_X)/(\tau p^*/P_X)}{d\underline{w}/\underline{w}} + \frac{d\pi^{op*}/\pi^{op*}}{d(p^*/P_X^*)/(p^*/P_X^*)}\frac{d(p^*/P_X^*)/(p^*/P_X^*)}{d\underline{w}/\underline{w}}}_{\text{Price Competitiveness Effect}}$$

When evaluated in the neighborhood of the symmetric equilibrium, we obtain the following expression:

$$\frac{d\pi^{op*}/\pi^{op*}}{d\underline{w}/\underline{w}} =^{ES} 2(\sigma-1)\delta\frac{\phi}{(1+\phi)^2} + \frac{\sigma-1}{\sigma}\mu\delta(1-\delta)\frac{\phi(1-\gamma)}{1+\phi} > 0$$

In the long-run, the impact of the wage shock on the country's attractiveness is determined by its *relative* effect on domestic and foreign operational profits. Namely, the relative number of domestic firms increases if the elasticity of operational profits to the shock is higher than the elasticity of foreign profits:

$$-2(\sigma-1)\delta\frac{\phi}{(1+\phi)^2} + \frac{\sigma-1}{\sigma}\mu\delta(1-\delta)\frac{1-\gamma}{1+\phi} > 2(\sigma-1)\delta\frac{\phi}{(1+\phi)^2} + \frac{\sigma-1}{\sigma}\mu\delta(1-\delta)\frac{\phi(1-\gamma)}{1+\phi}$$
$$\Leftrightarrow -4(\sigma-1)\delta\frac{\phi}{(1+\phi)^2} + \frac{\sigma-1}{\sigma}\mu\delta(1-\delta)(1-\gamma)\frac{1-\phi}{1+\phi} > 0$$

We obtain Eq. (35).

References

Baldwin, R., Forslid, R., Martin, P., Ottaviano, G., Robert-Nicoud, F., 2005. The footloose capital model. Economic Geography and Public Choice. Princeton University Press. chapter 3.

Bhaskar, V., To, T., 1999. Minimum wages for Ronald McDonald monopsonies: a theory of monopsonistic competition. Economic Journal 190, 190–203.

Biscourp, P., Kramarz, F., 2003. Internationalisation des entreprises industrielles et emploi: une analyse sur la période 1986–1992. Economie et Statistique 363–365, 60–91.

Broda, C., Weinstein, D.E., 2006. Globalization and the gains from variety. The Quarterly Journal of Economics 121 (2), 541–585.

Cahuc, P., Michel, J., 1996. Minimum wage, unemployment and growth. European Economic Review 40, 1463–1482.

Cahuc, P., Zylberberg, A., 1999. Job protection, minimum wage and unemployment. Discussion Paper 9914, IZA.

Cahuc, P., Saint Martin, A., Zylberberg, A., 2001. The consequences of the minimum wage when other wages are bargained over. European Economic Review 45, 337–352.
Card, D., Krueger, A., 1994. Minimum wages and employment: a case study of the fast-food industry in New Jersey and Pennsylvania wage. American Economic Review 84, 772–793.
Cardoso, A.R., Portugal, P., 2006. Disentangling the minimum wage puzzle: an analysis of worker accessions and separations. Journal of the European Economic Association 4 (5), 988–1013.
Dewit, G., Görg, H., Montagna, C., 2003a. Should I stay or should I go? A note on employment protection, domestic anchorage, and FDI. Discussion Paper 845, IZA.
Dewit, G., Leahy, D., Montagna, C., 2003b. Employment protection and globalization in dynamic oligopoly. Discussion Paper 3871. CEPR.
Dickens, R., Machin, S., Manning, A., 1999. The effects of minimum wages on employment: theory and evidence from Britain. Journal of Labor Economics 17 (1), 1–22.
Dixit, A., Stiglitz, J., 1977. Monopolistic competition and optimum product diversity. American Economic Review 67 (3), 297–308.
Dolado, J., Kramarz, F., Machin, S., Manning, A., Margolis, D., Teulings, C., 1996. The economic impact of minimum wages in Europe. Economic Policy 23, 317–372.
Dolado, J.J., Felgueroso, F., Jimeno, J.F., 2000. The role of the minimum wage in the welfare state: an appraisal. Swiss Journal of Economics and Statistics 136 (3), 223–245.
Fujita, M., Thisse, J.-F., 2002. Economics of agglomeration. Cambridge University Press, Cambridge.
Fujita, M., Krugman, P., Venables, A., 1999. The spatial economy: cities, regions and international trade. MIT Press, Cambridge.
Gianella, C., 1999. Une Estimation de l'élasticité de l'emploi Peu Qualifié à son Coût, Document de travail G9912 bis. INSEE.
Haaland, J., Wooton, I., 2007. Domestic labour markets and foreign direct investment. Review of International Economics 15 (3), 462–480.
Hajkova, D., Golub, S., Mirza, D., Nicoletti, G., Yoo, K., 2003. Policy and international integration: influences on trade and foreign direct investment. Working Paper 359. OECD Economic Department.
Hummels, D., 2001. Time as trade barrier. GTAP Working Paper 1152. Purdue University.
Javorcik, B.S., Spatareanu, M., 2005. Do foreign investors care about labor market regulations? Review of World Economics (Weltwirtschaftliches Archiv) 127 (3), 375–403.
Kramarz, F., Philippon, T., 2001. The impact of differential payroll tax subsidies on minimum wage employment. Journal of Public Economics 82, 115–146.
Krugman, P., 1991. Increasing returns and economic geography. Journal of Political Economy 99 (3), 483–499.
Laroque, G., Salanié, B., 1999. Breaking down married female non-employment in France. Discussion Paper 2239. CEPR.
Lee, D., 1999. Wage inequality in the United States during the 1980s: rising dispersion or falling minimum wage? The Quarterly Journal of Economics 114, 977–1023.
Machin, S., Manning, A., 1996. Employment and the introduction of a minimum wage in Great-Britain. Economic Journal 106, 667–673.
Manning, A., 1995. How do we know that real wages are too high? The Quarterly Journal of Economics 110, 1111–1126.
Martin, P., Rogers, C.A., 1995. Industrial location and public infrastructure. Journal of International Economics 39 (3–4), 335–351.
Neumark, D., Wascher, W.L., 2008. Minimum wages. MIT Press, Cambridge.
Pflüger, M., 2004. Economic integration, wage policies, and social policies. Oxford Economic Papers 56 (1), 135–150.
Picard, P.M., Toulemonde, E., 2006. Firms agglomeration and unions. European Economic Review 50, 669–694.
Salanié, B., 2000. Une Maquette Analytique de Long Terme du Marché du Travail. Economie et Prévisions 146, 1–13.
Samuelson, P.A., 1954. The transfer problem and transport costs, II: analysis of effects of trade impediments. Economic Journal 64, 264–289.
Strauss-Kahn, V., 2005. Firms location decision across asymmetric countries and employment inequality. European Economic Review 49, 299–320.
Toulemonde, E., 2006. Acquisition of skills, labor subsidies, and agglomeration of firms. Journal of Urban Economics 59, 420–439.