Does Trade Liberalization Lead to Unemployment? Theory and Some Evidence*

Alexandre Janiak†
ECARES, Université Libre de Bruxelles

Job Market Paper

Abstract

Exporting firms are larger and more productive than non-exporting firms. Trade openness leads to an increase in *intra-industry* firm turnover. As trade is liberalized, large firms need more labor to produce and small firms exit, leading to a reallocation of labor from the former to the latter. This mechanism leads to welfare gains as aggregate productivity is increased. This paper identifies another consequence of this transmission channel when labor market search frictions are introduced. I merge the Melitz (2003) model of intra-industry reallocations with the large firm model from Pissarides (2000) and do comparative statics on the level of employment. I find that higher trade exposure is associated with a lower level of employment, suggesting that trade generates more job destruction than creation. This result is due to interactions between goods and labor market imperfections. Finally I test the model predictions by applying GMM panel data methods to US sectoral job flows. The empirical findings confirm the theoretical results.

Keywords: International Trade, Unemployment, Firm Heterogeneity, Matching, Panel Data.

JEL codes: E24, F16, J63.

*I am deeply indebted to Etienne Wasmer, my Ph.D. supervisor, who provided me with all the guidance and encouragement a Ph.D. student needs. I thank (in alphabetical order) Manuel Arellano, Michael Burda, Paolo Casini, Nathalie Chen, Paola Conconi, Bruno Crépon, Wouter Den Haan, Mathias Dewatripont, Jan Eeckhout, Patrick Fève, Alain Guay, Georg Kirchteiger, Robert Kollmann, Franck Portier, Jean-Marc Robin, Gilles Saint-Paul, Paulo Santos Monteiro, Daniel Traca, Harald Ulhig and Philippe Weil and comments from participants at the Belgian Day for Labor Economists conference at Université de Liège (Belgium), the joint ECORE-KUL econometric seminar, the ENTER Jamboree at Stockholm School of Economics (Sweden), the 21st Annual Congress of the European Economic Association at Vienna (Austria), the macro conference at Universidade do Algarve (Portugal) and seminars at Ecares, Gremaq and *Universiteit van Amsterdam*. Special thanks to Nathalie Chen for careful reading. Part of the work presented in this paper was done at the Université du Québec à Montréal (Canada) when invited by the Canada Chair in Labor Market Dynamics and at the Université des Sciences Sociales de Toulouse (France). All remaining errors are mine.

†Contact details: ECARES, Université Libre de Bruxelles, CP 114, Av. F.D. Roosevelt, 50, 1050 Bruxelles, Belgium. Tel: +32 2 650 33 75. email: ajaniak@ulb.ac.be

1 Introduction

The most important insight in international economics is that trade leads to welfare gains[1]. Gains from trade arise from many different channels. By trading, economies can benefit from their respective diversity. International specialization leads to efficiency gains and, as the "home market" effect states, the resulting concentration of production in one place might bring scale economies[2]. Economic integration can even raise the worldwide rate of growth by increasing flows of ideas through the R&D sector, as claimed by Rivera-Batiz and Romer (1991).

Recent literature on firm heterogeneity in international economics has identified yet another mechanism leading to welfare improvement when an economy gets more exposed to trade. It appears that the presence of a fixed entry cost to international markets causes only the most productive firms (which are the largest[3]) to take part in international trade.[4] Because of this sunk cost, trade openness then has an effect on intra-industry reallocations. As trade is liberalized, those large firms that are exporting need more labor to produce as new markets provide them with new investment opportunities. This rise in labor demand from large firms makes workers to relocate from the least to the most productive firms. Large firms become larger and, since they are more productive than small firms, aggregate productivity increases, leading to welfare gains. In addition, as large firms are able to set lower prices, small firms are forced out of the industry, which again raises average productivity.

A model aimed at explaining the reallocation of labor from small to large firms is Melitz's (2003)[5]. In his model, firms are heterogeneous because of the uncertainty inherent to market entry investment. Then, because of the existence of a sunk entry cost to exports markets, only the most productive firms export and trade liberalization results in higher aggregate productivity, larger firms, but a smaller number of producers. The smallest firms are thrown out of the market because the largest push real wages up.

However, those conclusions are drawn from a *full-employment* framework. Hence, in a world characterized by frictions in the labor market, a natural question arises: what are the consequences for unemployment of this reallocation? Indeed, the average level of employment per firm increases but, as the set of domestic firms is reduced, one might actually expect this second effect to dominate the first one and cause a rise in unemployment. If so, as trade should be leading to large welfare gains in the long run, it is necessary to think about possible redistribution mechanisms or similar policies to face short-run costs. Otherwise, trade liberalization would meet opposition and might not be achieved.

This paper tries to answer this question. I extend the Melitz (2003) model (i.e.

[1] It is known that gains from trade can be quite large in the long run: see for instance Flam (1992) for an assessment of the gains for Europe and Cox and Harris (1985) for Canada.

[2] See Krugman (1980).

[3] Intra-industry trade which represents the most important portion of international trade occurs when there are economies of scale. This implies that the most productive firms are also the largest.

[4] See Bernard and Jensen (1995 and 1999), Aw *et al.* (2000), Clerides *et al.* (1998), Eaton *et al.* (2004), Head and Ries (1999), Levinsohn (1999), Pavcnik (2002), and Roberts and Tybout (1997). See also Tybout (2002) for a literature review.

[5] See Bernard *et al.* (2003) as well.

firm heterogeneity due to initial investment uncertainty and sunk entry cost to export markets) by assuming labor-market search frictions from the so-called "large" firm model[6] to understand how unemployment is affected by trade liberalization. I show that when labor markets are characterized with search frictions, the reallocation process is dampened by sclerosis. Job destruction due to small firms exit exceeds job creation by large firms. Job flows are unbalanced because large firms are able to extract higher rents by limiting the amount of job creation. As a result, aggregate welfare increases as in Melitz (2003), but, because of the presence of frictions in both labor and goods markets, employment drops[7].

Secondly, I analyze together the evolution of gross job flows with two indices of trade exposure (i.e. import and export penetration ratios) for 418 4-digit sectors of the US economy over the 1974-1988 period. As compared to previous studies, I find that more exposure to trade generates more job destruction than job creation (both for an increase in import and export ratios). The estimation is implemented by controlling for various aggregate shocks and fixed effects. In addition, the use of the Generalized Method of Moments enables to handle endogeneity issues.

As many empirical works have shown, an increase in import pressure reduces employment[8]. I find that a one-point increase in import penetration ratio makes job destruction rate to increase by 14.7 points and does not imply a significant increase in job creation. An interesting result of the empirical part of the present paper is that an increase in export share also has a short-run negative impact on employment. A one-point increase in export ratio generates an increase in job creation by 4.5 points and an increase in job destruction by 6.5 points. This finding is new in the literature and consistent with the model.

This paper is of course not the first to analyze unemployment in an international context. See for instance Davidson *et al.* (1999), Sener (2001), and Davidson and Matusz (2004) for theoretical approaches and Davis *et al.* (1996), Magee et al. (2005) and Cuñat and Melitz (2006) for empirical evidence. But, those papers are more related to long-run issues.

For instance, Davidson *et al.* (1999) rely on a required reallocation of labor across sectors. Such a reallocation process is known to be limited in the short run[9]. In their paper, they stress that trade economists should really start reconsidering unemployment issues in an international context. They develop a Heckscher-Ohlin type of model with frictions in both labor and capital markets and show that a large

[6]See Pissarides (2000).

[7]The mechanism is in fact similar to the introduction of higher barriers to entry in the goods market, which causes equilibrium unemployment to increase. In Blanchard and Giavazzi (2003), they explain the high level of European unemployment by high barriers to entry in the goods market. See also Bertrand and Kramartz (2002) for empirical evidence. In my model, trade liberalization will have a similar effect: because trade benefits are biased towards large firms, more trade exposure is in fact boosting barriers to entry since small firms are crowded out.
In Baldwin and Robert-Nicoud (2004, 2006), they analyze the Melitz model in a growth context and finds that the increase in the productivity threshold resulting from trade liberalization also has a negative impact on growth. They claim that the selection effect in Melitz (2003) raises the expected cost of introducing a new variety and tend to slow the rate of growth.

[8]See Trefler (2004), Kletzer (2002), Revenga (1997) and Revenga (1992), among others, for studies focusing on OECD countries.

[9]See Wacziarg and Wallack (2004).

economy like the US would experience a rise in unemployment when opening to trade since it is a capital-abundant economy and would therefore be using its labor at a lower intensity. Empirical approaches mainly illustrate the fact that more open industries display higher turnover rates.

On the other hand, the present paper aims at describing short-run consequences[10]. Moreover, to understand the political economy of globalization and the opposition this process currently meets, one can easily argue that the short run matters more.

Regarding the short-run consequences of trade on unemployment see also Davidson and Matusz (2005) and Caballero and Hammour (1996). They analyze structural changes in a multi-sector model. For example, the approach in Caballero and Hammour (1996) is based on hold-up problems that are a break on job creation in the export sector. Other interesting papers are Lamo *et al.* (2006) and Saint-Paul (2005). They argue that labor is in fact not mobile across sectors because of human capital sector-specificities[11]. Opening to trade then destroys more jobs than it creates since workers are not mobile. My paper shows that this phenomenon can even hold *within* industry. The analysis is then based on a one-sector approach as in Krugman (1980). More trade exposure then does not only destroy jobs in the declining sector, but in the booming one as well.

Unfortunately, the Melitz (2003) model has been criticized because productivity at the firm-level is exogenous and random. This has motivated other approaches like the Yeaple (2005) model, where ex-ante identical firms choose to adopt different technologies[12]. However, such an approach does not seem controversial to labor economists. Indeed, there is a large empirical literature studying the evolution of employment at the plant-level[13] which reports evidence of persistent idiosyncratic shocks. This evidence has motivated the well-known Mortensen and Pissarides (1994) approach in macro labor economics, which appears to be the most appropriate model for the study of labor market dynamics at business cycle frequencies. Since my paper mainly aims at analyzing short-run trade impact, the Melitz model perfectly fits in this framework.

Further, the literature on firm heterogeneity in international economics rightly assumes a one-industry approach in the sense that, regardless of whether we consider an importing or an exporting sector, the data will always present the same pattern: in any sector, we will observe large firms to export and small firms that do not[14]. As a consequence, these facts have lead to another modeling approach, in which neither exporting nor import-competing sectors are considered, but instead sectors that are somewhere in between, as in Ghironi and Melitz (2005) (where the non-tradability of goods is endogenous). Secondly, even at longer horizons, it has been

[10]By *short run*, I do not mean out-of-steady-state dynamics. I consider the impact of trade on equilibrium unemployment, but I do not allow for inter-industry labor reallocations and growth effects as in Sener (2001) for instance. Actually, it appears that with the technology given in my paper, a firm will always create enough vacancies so as to instantaneously attain any desired size (unless it is currently too large), suggesting a short adjustment. Section 3 discusses further these issues. In a companion paper, I also study labor market dynamics in the Melitz framework.

[11]See Janiak (2005).

[12]See Davidson *et al.* (2005) for a model applied to labor market issues.

[13]See for instance Davis *et al.* (1996).

[14]See for instance Bernard *et al.* (2003).

shown in Wacziarg and Wallack (2004) that trade liberalization episodes do not have any effect on inter-sectoral labor reallocations and, if it does at higher levels of disaggregation, it is statistically weak and small in magnitude. Thus, a one-industry framework looks appropriate to describe the evolution of job flows following trade openness.

The remaining of the paper is organized as follows. In Section 2, the setup of the model is introduced and the equilibrium is analyzed in both a closed and an open-economy context. In particular, the closed-economy setup will shed light on the interactions between goods and labor markets imperfections and the complementarity they generate. This will make easier to understand the impact of trade on unemployment, which will be assessed in Section 3. Section 3 also discusses implications in terms of welfare. An extension of the model with endogenous wages is explored in Section 4. In this Section, emphasis will be given to the complementarity between goods and labor market frictions to better illustrate the impact of trade liberalization on wages. Section 5 looks at the empirical evidence. Finally, Section 6 concludes.

2 The Model

2.1 Closed Economy: Setup of the Model

Preferences. Time is continuous. Goods markets are characterized by an Acemoglu (2001) type of configuration with monopolistic competition: there is a unique consumption good produced in quantities Q and the production of this good requires a continuum of intermediate goods as inputs, indexed by $z \in Z$, where Z is the set of all available intermediate goods and z one variety of input[15]. Each variety is produced by one firm, which uses labor in its production process. The firms sell their inputs on different markets characterized with monopolistic competition as in Dixit and Stiglitz (1977). The price of the final consumption good is normalized to one. Formally, the production function of the consumption good is[16]:

$$Q = \left[\int_{z \in Z} q(z)^{\rho} dz \right]^{\frac{1}{\rho}} \tag{1}$$

where $0 < \rho < 1$, $q(z)$ is the quantity of input z used in the production process and $p(z)$ stands for its price. $\sigma = \frac{1}{1-\rho}$ is the elasticity of substitution between goods.

The above assumption about preferences is considered for simplicity, in that it does not involve an aggregate price index in the demand formulation and all prices are expressed in terms of the price of the aggregate consumption good, which is normalized to one. Consequently, equilibria are computed more easily. But note that this formulation does not kill the rise in real wage following trade liberalization, which is inherent to heterogeneous firms models in international economics.

[15] I will refer to the input industry as the *goods market*.

[16] From now on the time subscript t is omitted for simplicity. This will not matter since the focus of the paper will be on steady-state values.

The Labor Market. There is a unique labor market in the economy involving a continuum mass of workers normalized to one. Those are hired by firms producing the intermediate goods through a matching process and firms may have different measure of employed workers. The measure of matches m is an increasing function of the amount of those unemployed u and the mass of posted vacancies v. As is commonly assumed[17], m is assumed to be homogeneous of degree one and concave. Hence, the probabilities to fill a vacancy, h, and for a worker to be hired, g, are respectively:

$$h(\theta) = \frac{m(u,v)}{v} = m(1, \theta^{-1}) \tag{2}$$

$$g(\theta) = \frac{m(u,v)}{u} = m(\theta, 1) \tag{3}$$

$\theta = \frac{v}{u}$ is typically called the *labor market tightness* and is an indicator of how dynamic the labor market is. $h(\theta)$ and $g(\theta)$ are then respectively decreasing and increasing in θ, and they are linked by the following property: $g(\theta) = \theta h(\theta)$.

In addition, separations occur exogenously at a rate δ and, for simplicity, on-the-job search is not modeled here[18].

Recall that, in addition to the standard features of models with heterogeneous firms in international trade[19], the adoption of a search approach in the determination of the labor market equilibrium is the only new element that has been introduced into the Melitz framework. From a theoretical point of view, it is this combination between labor and goods markets frictions that will lead to the result.

Large Firms and Pricing to Market. A large pool of potential entrants may enter the industry of inputs, but only a mass M of firms will remain in the industry. M is endogenous.

As in Melitz (2003), in order to enter, firms have to make an initial investment and pay a fixed entry cost c_e. The productivity ϕ of a firm producing z is then drawn from a common distribution $F(\phi)$, so that the quantities produced by a firm with productivity parameter ϕ are $q(\phi) = \phi n(\phi)$, where $n(\phi)$ is the level of employment in a firm with productivity parameter ϕ.

Let's denote by ϕ^* the level of productivity as above which the entry to the industry is successful, that is, if a firm draws a productivity parameter below ϕ^*, it will earn negative profits and exit the industry. In the same manner, a shock pushing this value upwards would kill all firms for which productivity is lower than the new productivity cutoff [20].

If entry is successful, firms can then start posting vacancies to hire workers. The production process is then characterized by scale economies as in Krugman (1980)

[17]See Pissarides (2000) and, for empirical evidence, Petrongolo and Pissarides (2001).

[18]Melitz (2003) also considers that firms are subject to death. Adding such a feature would not alter any qualitative results, but it would complicate the analysis. Indeed, since in my framework firm-level employment is a sticky variable, it is necessary to keep track of the distribution of firm vintages in some cases. This is particularly true if some firms want to decrease their employment level. See Section 3 for a discussion on dynamics.

[19]Those features will be described below. See Baldwin (2005) for a discussion.

[20]As an interesting analogy, this productivity cutoff could be interpreted as the reservation productivity from the Mortensen and Pissarides (1994) model.

and Melitz (2003), but, in addition, firms face turnover costs.

Any firm with productivity parameter ϕ has to maximize the following present-discounted value of expected profits:

$$\int_0^{+\infty} e^{-rt} \{p(\phi)q(\phi) - wn(\phi) - c_v v(\phi) - c\} \, dt \tag{4}$$

where w is the (exogenous) wage[21], c_v the flow cost of posting a vacancy, c a fixed cost independent of the productivity level ϕ and $v(\phi)$ the number of vacancies posted by this firm. The above present-discounted value is maximized by taking into account the behavior of the firm producing the final consumption good and the following law of motion for $n(\phi)$:

$$\dot{n}(\phi) = h(\theta)v(\phi) - \delta n(\phi) \tag{5}$$

Market Clearing. Finally, the final consumption good market has to clear:

$$Q = \int_{z \in Z} p(z)q(z)dz \tag{6}$$

This condition will allow us to determine the equilibrium mass of firms in the industry.

2.2 Equilibrium in the Closed Economy

2.2.1 Optimal Decisions

Demand for Intermediate Goods. The demand for input z is:

$$q(z) = Qp(z)^{-\sigma} \tag{7}$$

Optimal Firms Decisions. As was stated before, firms maximize their expected profits by taking into account their production function, the demand formulation (7) and the law of motion (5) for employment. After solving for the firms' dynamic program we get that, in steady state, a firm with productivity parameter ϕ sets its level of employment, its amount of posted vacancies and its price according to the following set of equations:

$$\frac{\rho\phi^\rho Q^{1-\rho} n(\phi)^{\rho-1} - w}{r+\delta} = \frac{c_v}{h(\theta)} \tag{8}$$

$$v(\phi) = \frac{\delta}{h(\theta)} n(\phi) \tag{9}$$

$$p(\phi) = \frac{w + (r+\delta)\frac{c_v}{h(\theta)}}{\rho\phi} \tag{10}$$

[21]First, the literature related to the large firm matching model (Cahuc and Wasmer (2001)) has shown how important the strategic behaviors in wage negotiation can be. Here, such considerations are assumed exogenous as they are not directly linked to the main purpose of the paper. Second, if we replace the exogeneity assumption for wages by a rule such that $w = w(\phi, \theta)$, with $\frac{dw}{d\theta} > 0$ and $\frac{dw}{d\phi} > 0$, the results listed below remain qualitatively unchanged. See Section 4 for an extension that allow for Nash-bargaining in wage negatiations.

See the Appendix for the proof. Equation (8) is the job creation decision that states that firms will determine their level of employment such that marginal expected turnover cost is equal to discounted marginal profits. Equation (9) is the steady state formulation of (5): in steady state, the amount of posted vacancies is such that the flow of new hirings equals separations. Finally, according to (10), firms fix their price over labor costs, which are equal to the sum of two terms, wages and turnover costs[22]. The value of the markup is then independent of the number of firms in the industry.

Two remarks follow from above. First, notice that the most productive firms, which are also the largest, set lower prices. Indeed, for any ϕ_1 and ϕ_2 greater than ϕ^*, we have:

$$n(\phi_1) = n(\phi_2)\left(\frac{\phi_1}{\phi_2}\right)^{\sigma-1}; \quad p(\phi_1) = p(\phi_2)\tfrac{\phi_2}{\phi_1}; \quad q(\phi_1) = q(\phi_2)\left(\frac{\phi_1}{\phi_2}\right)^{\sigma}.$$

This implies that any shift in production from small to large firms will make the average price to decrease and hence the real wage to increase. This increase would lead to the exit of small firms. Second, from (8), monopolistic competition implies decreasing returns to scale in employment. This suggests that as employment at the firm-level increases, incentives to create more jobs are lower.

2.2.2 Aggregation

Total Amount of Consumption Good. It can be shown that the total amount of consumption good produced in the economy is [23]:

$$Q = M^{\frac{1}{\rho}} q(\phi^e) \tag{11}$$

where ϕ^e is the average productivity across all firms belonging to the industry and is a function of the productivity cutoff ϕ^*:

$$\phi^e(\phi^*) = \left(\int_0^\infty \phi^{\sigma-1}\mu(\phi)d\phi\right)^{\frac{1}{\sigma-1}} \tag{12}$$

where $\mu(\phi)$ is the distribution of ϕ among the producing firms:

$$\mu(\phi) = \begin{cases} \frac{f(\phi)}{1-F(\phi^*)} & \text{if } \phi \geq \phi^* \\ 0 & \text{otherwise} \end{cases}$$

A nice property of the Melitz's model is that the value of ϕ^e will summarize all the information relevant for all aggregate variables. It is an increasing function of the reservation productivity ϕ^*, under which firms do not enter the market or leave it and above which they go on producing.

[22] For notational simplicity, I will hereafter denote total labor cost by $C(\theta)$, that is $C(\theta) = w + (r+\delta)\frac{c_v}{h(\theta)}$.

[23] The proof is the same as Melitz (2003).

On Labor Force Concentration and the Labor Market State. Given the above notation ϕ^e, some properties of the economy can already be derived. Indeed, all relations described so far and referring to any given productivity value ϕ of course hold for the particular value ϕ^e. In particular, equation (8) characterizes an important interaction between goods and labor markets imperfections, which lead to a complementarity between firms pricing behavior and the level of labor market tightness. This complementarity will explain the main mechanism derived in the open-economy model. As a firm has to determine its level of employment when choosing the price of the good it will sell, this equation links labor market tightness to firm-level employment. Specifically, the first-order condition for the average firm is[24]:

$$\frac{\rho\phi^{e\rho}Q^{1-\rho}n(\phi^e)^{\rho-1} - w}{r+\delta} = \frac{c_v}{h(\theta)}$$

In the economy, the variable $n(\phi^e)$ is actually an indicator of concentration of the labor force in a given set of firms. When $n(\phi^e)$ is high, it means that a large amount of workers is contained in few firms, while a low value for $n(\phi^e)$ suggests a rather spread labor force. From this equation and holding Q and ϕ^e constant, it follows that a high concentration of workers is associated with a low level of the labor market tightness, while a low concentration suggests a lower competition between workers in the labor market. This remark is summarized in the following proposition:

PROPOSITION 1. *The economy is characterized by a complementarity between goods and labor market imperfections. Holding the aggregate state of the economy Q and ϕ^e constant,*

- *a slack labor market (low θ) leads to a high concentration of workers in few firms (a high average level of employment $n(\phi^e)$).*
- *In turn, a shift of resources from small to large firms deteriorate the labor market situation.*

2.2.3 Equilibrium

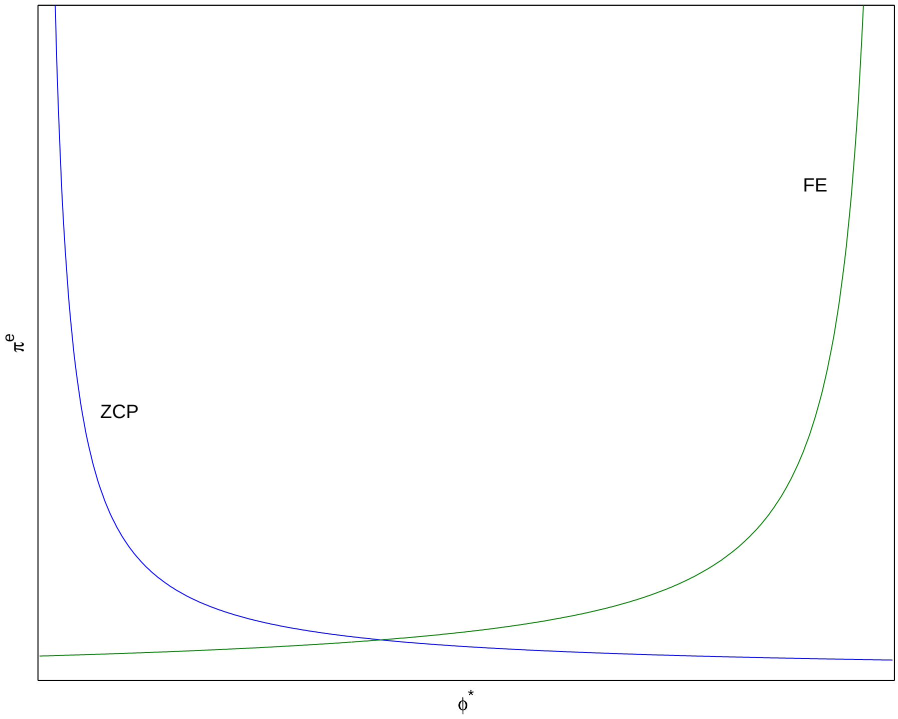
Equilibrium in the Goods Market. The equilibrium on the goods market, as displayed in Figure 1, is determined by two relations, the free entry and zero cutoff profit conditions. Both relations involve the values of average profits π^e and reservation productivity ϕ^*. The first accounts for the entry decision of firms that relies on the equality between entry cost and expected profits. It is increasing in the (ϕ^*, π^e) space since a high productivity cutoff means a high average productivity and, because of increasing returns to scale, higher expected profits. The second one determines if firms incur negative profits and are thrown out of the market. It is decreasing in the (ϕ^*, π^e) space. Indeed, a high productivity cutoff means high real wages, which reduces profits. This equilibrium exists and is unique[25].

If one compares those two relations with those in Melitz (2003), one would notice that the introduction of search frictions on the labor market does not affect the

[24] $n(\phi^e)$ is the level of employment of a firm with productivity ϕ^e, but it can be shown it is also the average level of employment at the firm-level in the economy.

[25] The proof is in Melitz (2003).

Figure 1: Equilibrium on the Goods Market



expression of both the free entry and the zero cutoff profit conditions. One could find this surprising as turnover cost push total labor costs upwards and expect that for a given productivity cutoff the required level of average profits should be higher for firms to enter the industry. However, this is not the case and the reason is due to markup adjustment: when labor costs increase by 1%, so will selling prices. Hence the following Lemma:

LEMMA 1. *The introduction of search frictions does not affect the free entry nor the zero cutoff profit conditions. Thus, the goods market equilibrium, defined as the pair* (ϕ^*, π^e)*, is given by the intersection of the two locus:*

$$\pi^e = \frac{rc_e}{1 - F(\phi^*)} \tag{FE-1}$$

$$\pi^e = c\left\{\left(\frac{\phi^e(\phi^*)}{\phi^*}\right)^{\sigma-1} - 1\right\} \tag{ZCP-1}$$

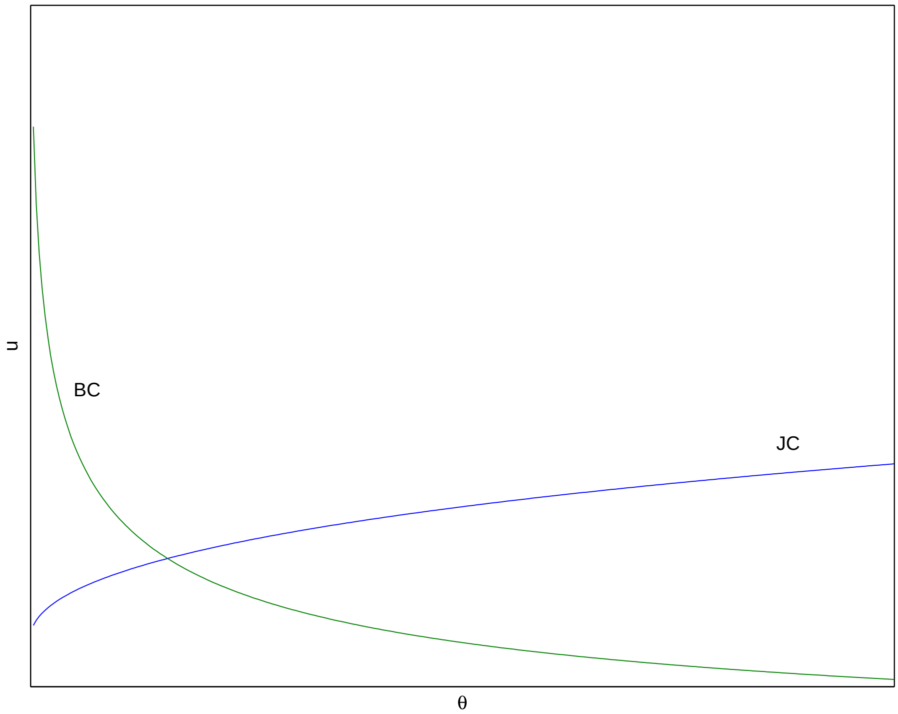
Proof. See the appendix.

Equilibrium Mass of Firms. The market clearing condition (6) allows to determine the equilibrium mass of firms in the economy:

LEMMA 2. *The equilibrium mass of firms in the economy is:*

$$M = p(\phi^e)^{\sigma-1} \tag{13}$$

Figure 2: Equilibrium on the Labor Market



Proof. See the Appendix.

Thus, the equilibrium mass of firms decreases as the average price increases.

Equilibrium on the Labor Market. Given the equilibrium on the goods market, the one on the labor market follows. As displayed in Figure 2, this equilibrium is the intersection of two curves: a Beveridge curve and a Job Creation curve. The first states that inflows to unemployment must equate outflows in steady state. The second is the aggregation of the job creation decision of each firm and implies that total steady-state employment merely equals the mass of firms times average employment per firm.

Hence the following Lemma:

LEMMA 3. *Labor Market Equilibrium:*

- *The equilibrium on the labor market, defined as the pair (θ, u), is given by the intersection of the two locus:*

$$u = \frac{\delta}{\delta + \theta h(\theta)} \tag{BC-1}$$

$$1 - u = n(\phi^e)M \tag{JC-1}$$

where the second equation rewrites as:

$$u = 1 - \frac{C(\theta)^{\sigma-2}}{\rho^{\sigma-2}} \frac{\pi^e + c}{[1 - \rho H(\theta)]\phi^{e\sigma-1}}$$

with $H(\theta) = \frac{w + \frac{\delta}{h(\theta)} c_v}{w + \frac{r+\delta}{h(\theta)} c_v}$.

- *A sufficient condition for the labor market equilibrium to exist and to be unique is* $\rho \leq \frac{1}{2}$.
- *If* $\rho > \frac{1}{2}$, *then the labor market equilibrium either does not exist or is multiple.*

Proof. See the appendix.

The Beveridge curve is strictly decreasing to zero, meaning that the greater the vacancy-unemployment ratio is, the easier a worker will find a job and the lower will be the unemployment rate. But the sign of the slope of the job creation condition is ambiguous and depends on the value of the elasticity of substitution. This ambiguity is due to two effects. On the one hand, equation (8) states that as labor market tightness increases, it is harder for firms to hire new workers, which increases turnover cost and depreciates employment. On the other hand, as equation (10) suggests, firms benefit from market power and any increase in turnover cost is so reported into prices. Then, as prices grow, new firms enter the industry and the strength of this effect depends on the elasticity of substitution (as (13) suggests). This in fact results from the complementarity between goods and labor markets imperfections that were illustrated in Proposition 1. Consequently, with a large elasticity of substitution, either multiple labor market equilibria might characterize the economy or no equilibrium might exist.

I will from now on rely on the following assumption, which ensures the existence and uniqueness of the labor market equilibrium:

ASSUMPTION 1. $\rho \leq \frac{1}{2} \Leftrightarrow \sigma \leq 2$.

Note that under Assumption 1 an increase in ϕ^* will shift the job creation curve upwards, which will increase unemployment, while an increase in π^e will shift it downwards, leading to a drop in unemployment.

2.3 Opening to Trade

2.3.1 The Extended Framework

The economy considered previously is now able to trade part of its inputs z with γ other economies that are exactly identical[26]. Formally, when analyzing the impact of greater exposure to trade on unemployment, we will consider an increase in the γ parameter.

In addition to the sunk cost a firm has to pay when entering the industry, the payment of another cost is required if it wants to export to the γ other economies. Since there is no uncertainty about firms' productivity once this second fix cost is paid, the open economy model will be equivalent to a model where, instead of an entry cost to the export market, a flow cost c_x has to be paid when producing. This latter specification is now considered.

I also consider an iceberg transportation cost specification, so that if a firm wants to sell 1 unit of good abroad it needs to ship τ units. A decline in c_x or τ also corresponds to an increase in trade exposure.

[26] Thus, our trade area will be composed of $(\gamma + 1)$ economies.

As in Melitz (2003), the c_x and τ costs will be considered as being large enough (i.e., $\tau^{\sigma-1}c_x > c$) so that a partitioning among firms will be observed. The firms, which productivity is not high enough will only sell on the domestic market, others will serve both (the most productive firms).

This implies that we need to consider another productivity cutoff ϕ_x^* to distinguish between firms that are exporting and those that are not. The product z will then be sold on the domestic market in quantities $q^d(z)$ and $q^x(z)$ in any given foreign market. In the same fashion, the use of the superscript notation d and x refer to variables that concern *domestic* and *export* markets respectively, whereas the superscript T refers to *total* sales.

The dynamic program for a firm that does not export remains the same as before, while for a firm exporting the following expression should be maximized:

$$\int_0^{+\infty} e^{-rt}\left\{p^d(\phi)q^d(\phi) + \gamma p^x(\phi)q^x(\phi) - w\left(n^d(\phi) + \gamma n^x(\phi)\right) - c_v\left(v^d(\phi) + \gamma v^x(\phi)\right) - c - \gamma c_x\right\} dt \tag{14}$$

given:

$$\begin{aligned}\dot{n}^d(\phi) &= h(\theta)v^d(\phi) - \delta n^d(\phi)\\ \dot{n}^x(\phi) &= h(\theta)v^x(\phi) - \delta n^x(\phi)\end{aligned}$$

Finally, the market clearing condition is:

$$Q = \int_{z\in Z} p^d(z)q^d(z)dz + \gamma\int_{z\in Z} p^x(z)q^x(z)dz \tag{15}$$

Let's now see how trade affects agents' decisions.

Demand and Firms' Strategy. The demand for z remains as in equation (7). In steady state, a firm with productivity parameter ϕ, selling only on the domestic market, sets its level of employment, its amount of posted vacancies and its price according to (8), (9) and (10), but when exporting, its strategy becomes:

$$\frac{\rho\phi^\rho Q^{1-\rho}n^d(\phi)^{\rho-1} - w}{r+\delta} = \frac{c_v}{h(\theta)} \tag{16}$$

$$\frac{\rho\left(\frac{\phi}{\tau}\right)^\rho Q^{1-\rho}n^x(\phi)^{\rho-1} - w}{r+\delta} = \frac{c_v}{h(\theta)} \tag{17}$$

$$v^i(\phi) = \frac{\delta}{h(\theta)}n^i(\phi), \forall i \in \{d, x\} \tag{18}$$

$$p^d(\phi) = \frac{w + (r+\delta)\frac{c_v}{h(\theta)}}{\rho\phi} \tag{19}$$

$$p^x(\phi) = \tau\frac{w + (r+\delta)\frac{c_v}{h(\theta)}}{\rho\phi} \tag{20}$$

The proof is in the Appendix. Firstly, notice that, for a given variety z, the amount of labor used to produce the exported good tends to be larger than the one required for the domestic market when liberalizing trade since firms face a larger market[27]: resources devoted to exports are $\gamma\tau^{1-\sigma}$ times larger than for the domestic market, which also brings a larger amount of posted vacancies. This implies that, when liberalizing, large firms' labor demand will increase, which will partly explain the reallocation of labor from small to large firms.

Secondly, for a given variety, exported goods are more expensive than goods sold on the domestic market. The reason for this is due to the iceberg transportation cost assumption. This implies that the marginal cost is τ times higher when producing goods to be shipped abroad. *Ceteris paribus*, a decrease in τ should then reduce the average price.

Finally, the open economy also displays a complementarity between goods and labor market imperfections as in the closed economy.

2.3.2 Aggregation in the Open Economy

The partitioning of firms requires to distinguish between different types of average productivities. Hereafter, ϕ_d^e denotes the average productivity across all firms selling on the domestic market, i.e. excluding imported goods; ϕ_x^e refers to average productivity across all national firms exporting abroad and, finally, ϕ_T^e is the average productivity across all firms selling their goods to one of the $(\gamma+1)$ economies. Hence,

$$\phi_T^e = \left[\frac{M{\phi_d^e}^{\sigma-1} + \tau^{1-\sigma}\gamma M_x {\phi_x^e}^{\sigma-1}}{M_T}\right]^{\frac{1}{\sigma-1}} \tag{21}$$

where:

$$\phi_d^e = \left\{\frac{\int_{\phi^*}^{\infty}\phi^{\sigma-1}f(\phi)d\phi}{1-F(\phi^*)}\right\}^{\frac{1}{\sigma-1}} \quad \text{and} \quad \phi_x^e = \left\{\frac{\int_{\phi_x^*}^{\infty}\phi^{\sigma-1}f(\phi)d\phi}{1-F(\phi_x^*)}\right\}^{\frac{1}{\sigma-1}}$$

In the above expression, M refers as before to the number of firms in one of the $(\gamma+1)$ economies and $M_x < M$ is the mass of firms that are exporting and belonging to one economy. M_x is then defined as $M_x = \frac{1-F(\phi_x^*)}{1-F(\phi^*)}M$. Finally, M_T refers to the total mass of firms (national and foreign) providing with inputs a given economy. Thus, $M_T = M + \gamma M_x = \left[1 + \gamma\frac{1-F(\phi_x^*)}{1-F(\phi^*)}\right]M$.

As shown in the Appendix, it is possible to derive the relationship linking ϕ_x^* to ϕ^*:

$$\phi_x^* = \phi^*\tau\left(\frac{c_x}{c}\right)^{\frac{1}{\sigma-1}} \tag{22}$$

Finally, the total amount of consumption good produced in one of the given economies is[28]:

$$Q = {M_T}^{\frac{1}{\rho}}q(\phi_T^e) \tag{23}$$

[27]This is true only if γ is large enough with respect to τ.

[28]See Melitz (2003) for a proof.

2.3.3 Equilibrium in the Open Economy

Equilibrium in the Goods Market. When considering trade opportunities, the equilibrium on the goods market is still represented by a free entry and a zero cutoff profit conditions. As before, the introduction of search frictions does not alter the equations presented in Melitz (2003)[29]:

$$\pi^e = \frac{rc_e}{1 - F(\phi^*)} \tag{FE-2}$$

$$\pi^e = c\left\{\left(\frac{\phi^e(\phi^*)}{\phi^*}\right)^{\sigma-1} - 1\right\} + \frac{1 - F(\phi_x^*)}{1 - F(\phi^*)}\gamma c_x \left\{\left(\frac{\phi_x^e(\phi_x^*)}{\phi_x^*}\right)^{\sigma-1} - 1\right\} \tag{ZCP-2}$$

Trade liberalization, which is modeled as an increase in the number of trade partners γ or a decrease in trade costs c_x and τ, increases both ϕ^* and π^e.

Equilibrium Mass of Firms. As in the closed economy framework, the use of the market clearing condition can determine the equilibrium number of firms[30]:

$$M_T = p^d(\phi_T^e)^{\sigma-1} \Leftrightarrow M = \frac{p^d(\phi_T^e)^{\sigma-1}}{1 + \gamma\frac{1-F(\phi_x^*)}{1-F(\phi^*)}} \tag{24}$$

Equilibrium in the Labor Market. Opening to trade modifies the labor market equilibrium as follows:

LEMMA 4. *Labor Market Equilibrium:*

- *In the open economy, the equilibrium on the labor market, defined as the pair (θ, u), is given by the intersection of the two locus:*

$$u = \frac{\delta}{\delta + \theta h(\theta)} \tag{BC-2}$$

$$1 - u = n^d(\phi_d^e)M_d + \gamma n^x(\phi_x^e)M_x \tag{JC-2}$$

where the second equation can be rewritten as:

$$u = 1 - \frac{C(\theta)^{\sigma-2}}{\rho^{\sigma-2}[1 - \rho H(\theta)]{\phi_T^e}^{\sigma-1}}\frac{[1 - F(\phi^*)](\pi^e + c) + \gamma[1 - F(\phi_x^*)]c_x}{1 - F(\phi^*) + \gamma[1 - F(\phi_x^*)]}$$

- *Under Assumption 1, the labor market equilibrium exists and is unique.*

Proof. See the Appendix.

When looking at the equilibrium on the labor market, it appears that an increase in trade exposure - e.g. higher γ - has an ambiguous effect on unemployment. Indeed, trade liberalization will make firms larger on average, since they will want to invest in new markets (higher profits π^e), but will destroy many small firms as well - i.e., the productivity cutoff will jump and from (24) it can be seen that the resulting mass of firms will be smaller. Thus, one might expect this second effect to overcompensate the first, which could be interpreted as a rise in unemployment. The aim of the next section is now to determine the net impact of trade on unemployment.

[29]See the Appendix.

[30]See the Appendix.

Figure 3: Trade Openness : Impact on the Goods Market

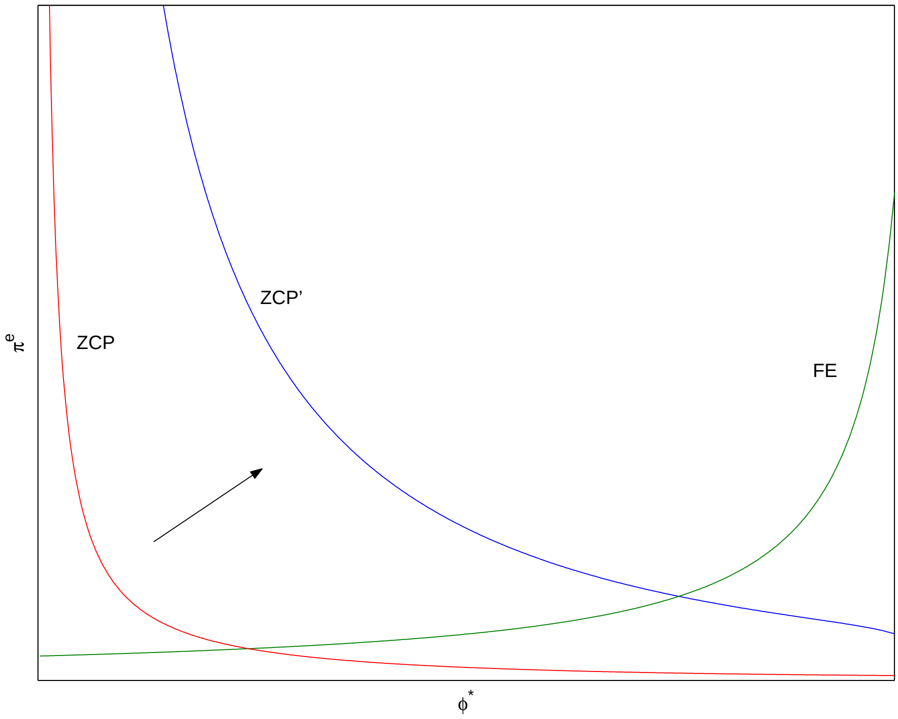
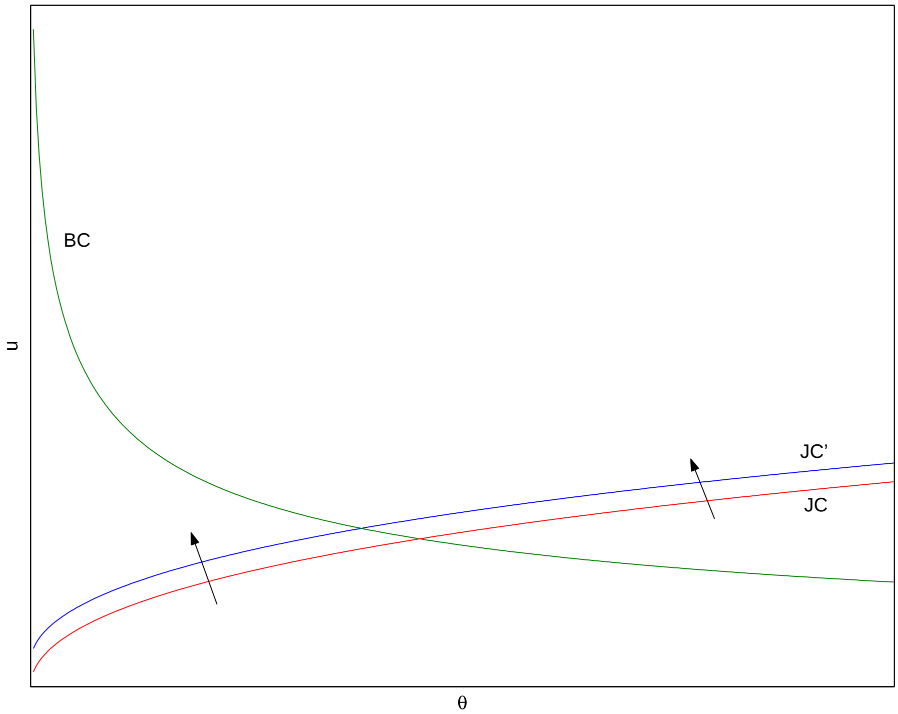


Figure 4: Trade Openness : Impact on the Labor Market



3 The Impact of Trade

3.1 Unemployment

The impact of trade on the goods market is twofold. Due to the existence of sunk costs c_x to export markets, trade leads to an increase in both the productivity cutoff ϕ^* and average profits π^e: large firms become larger and some small firms that do not engage in international trade shrink or die, labor is therefore reallocated from the latter firms to the former. This mechanism is displayed in Figure 3.

However, when labor markets are characterized by frictions, it is not known whether job creation and destruction are balanced. A contribution of the present paper is to understand how this analysis extends to labor market outcomes and, in particular, to assess the consequences in terms of unemployment. As we saw in the previous Section, those consequences are *a priori* ambiguous. On the one hand, new investment opportunities abroad make profits higher for the most productive firms, which is an incentive for them to hire more workers. And as profits are greater on average, more firms will try to enter into the industry.

On the other hand, as large firms produce more, the average price decreases and the real wage increases, which pushes ϕ^* upwards. Some small firms then exit the industry as they cannot face the increase in real wage. Further, with an increase in the number of trade partners γ, as the productivity cutoff ϕ^* increases, the reservation productivity that determines whether firms enter international markets or not, ϕ_x^*, increases as well. Some exporting firms will then return to pure domestic activities, which will lead them to dismiss workers.

Formally, in order to determine the net impact on unemployment, we need to know whether the job creation curve shifts up or down following trade liberalization. Below, a simpler formulation for the job creation curve precisely helps to determine the net impact of trade on unemployment, in that it omits average profits π^e:

$$u = 1 - \frac{C(\theta)^{\sigma-2}}{[1-\rho H(\theta)]\rho^{\sigma-2}} \frac{[1-F(\phi^*)]c(\frac{\phi_d^e}{\phi^*})^{\sigma-1} + \gamma[1-F(\phi_x^*)]c_x(\frac{\phi_x^e}{\phi_x^*})^{\sigma-1}}{[1-F(\phi^*)]{\phi_d^e}^{\sigma-1} + \gamma\tau^{1-\sigma}[1-F(\phi_x^*)]{\phi_x^e}^{\sigma-1}}$$

Proof. See the Appendix.

At this point, some comparative statics of the above (JC) formulation are necessary. Notice the following two extreme cases[31]:

$$u|_{\gamma=0}^{JC} = 1 - \frac{C(\theta)^{\sigma-2}}{[1-\rho H(\theta)]\rho^{\sigma-2}} \frac{c}{{\phi^*}^{\sigma-1}}$$

$$u|_{\gamma\to\infty}^{JC} = 1 - \frac{C(\theta)^{\sigma-2}}{[1-\rho H(\theta)]\rho^{\sigma-2}} \tau^{\sigma-1} \frac{c_x}{{\phi_x^*}^{\sigma-1}} = 1 - \frac{C(\theta)^{\sigma-2}}{[1-\rho H(\theta)]\rho^{\sigma-2}} \frac{c}{{\phi^*}^{\sigma-1}}$$

Those two values for unemployment given the labor market tightness are *not* equal. Indeed, as previously shown, following trade liberalization the productivity cutoff ϕ^* increases. This implies that $u|_{\gamma\to\infty}^{JC} > u|_{\gamma=0}^{JC}$, as the following Proposition states.

PROPOSITION 2. *Under Assumption 1, greater trade exposure increases unemployment. In particular,*

- *The first derivative of steady state unemployment with respect to the number of trade partners γ is positive.*

[31] To compute the value of unemployment given the market tightness when γ tends to infinity, use the expression $\phi_x^* = \tau \left(\frac{c_x}{c}\right)^{\frac{1}{\sigma-1}} \phi^*$.

- *The first derivative of steady state unemployment with respect to the variable trade cost τ is negative.*
- *The first derivative of steady state unemployment with respect to the fixed trade cost c_x is negative.*

Proof. See the Appendix.

It follows that more exposure to trade makes unemployment to rise. The excessive deaths of small firms are not compensated by sufficient new hirings. Figure 4 illustrates this impact: the job creation curve goes up and unemployment grows. The reason is due to the partitioning among firms and the complementarity between goods and labor markets imperfections described in Proposition 1. Gains from trade liberalization do not favor small firms, but are in fact biased toward large firms[32]. This mechanism can actually be seen as analogous to the introduction of higher barriers to entry[33]: workers fired by small firms are not all hired by the large because large firms want to profit from market power. They then restrain their hirings to increase their profits.

It follows that two frictions are the cause of this increase in unemployment. First, the fixed cost to export market generates the observed partitioning among firms between exporting and non-exporting. Absent the c_x cost, trade liberalization would not lead to an improvement in aggregate productivity and would not have any impact on unemployment.

Secondly, another rigidity which explains this rise in unemployment is the fixed distribution of productivity draws F. If these were not assumed in the model and firms could instead 'choose' their productivity level, unemployment would probably remain constant. However, this is clearly not the case, as argued by the empirical literature that states that firm-specific uncertainty dominates firm-level dynamics, justifying other approaches such as the Hopenhayn (1992) and Mortensen & Pissarides (1994) models. This is why my model is referred to as *short run* since the distribution of productivity draws remains unchanged. A *long run* approach would then make this distribution to evolve over time and to adapt to new market conditions[34].

3.2 Gains from Trade

The introduction of search frictions *à la* Pissarides (2000) into the Melitz (2003) model does not affect an important result: following trade liberalization, the intra-industry reallocations from small to large firms leads to an increase in aggregate productivity. This channel makes firms more performant on average and leads to welfare gains.

Moreover, in a framework where labor markets are frictional, this process has another positive effect, i.e. the fall in labor market tightness θ. As large firms do

[32] Baldwin (2005) sees this mechanism as a Stolper-Samuelson type of effect.

[33] High barriers to entry is a standard view explaining the high level of unemployment in Europe as they are breaks on job creation. See Blanchard and Giavazzi (2003) or Bertrand and Kramartz (2002).

[34] See for instance Sener (2001) or Rivera-Batiz and Romer (1991), where trade encourages the flow of ideas in the R&D sector.

not compete anymore for labor with the smallest firms, this reduces their turnover cost and is an incentive for them to produce larger quantities.

The following summarizes the above:

Defining aggregate welfare as[35]

$$W = Q - (cM + \gamma c_x M_x) - c_v v$$

then,

PROPOSITION 3. *Trade liberalization leads to an increase in welfare. In particular,*

- *The first derivative of W with respect to the number of trade partners γ is positive.*
- *The first derivative of W with respect to the variable trade cost τ is negative.*
- *The first derivative of W with respect to the fixed trade cost c_x is negative.*

Proof. See the Appendix.

As a result, the mechanism that lies behind the gains from trade, i.e. labor reallocations from small to large firms, is the same as the one that depreciates employment. On the one hand, as trade benefits are biased towards the most productive firms, this leads to an improvement in aggregate productivity. But, on the other hand, the more concentrated those benefits, the sharper will be the decline in equilibrium employment. Hence,

PROPOSITION 4. *The more productivity-enhancing is trade liberalization, the sharper will the increase in equilibrium unemployment be.*

Proof. See the Appendix.

It follows from the above Proposition that opposition to trade should be amplified as gains from trade are larger, as the subsequent rise in equilibrium unemployment will be stronger. This is a possible explanation for the recent demonstrations against globalization. Indeed, in 2006, the 6th summit of the World Social Forum took place in Caracas (Venezuela), claiming that the way followed by globalization is harming part of the population. Moreover, as time goes by, those groups are getting stronger and more numerous. In Mar del Plata (Argentina) in November 2005, similar movements wanted to reject the American Free Trade Agreement, as this process was claimed to dampen job creation[36]. Another example of the political strength of those lobbyists is the recent authorization in December 2005 by Pascal Lamy, head of the World Trade Organization, to allow for the presence of some of those lobbies at the negotiations.

[35] Notice that the following definition only considers *equilibrium* welfare. Accounting for dynamics following trade liberalization would add a term comprising the building cost c_e.

[36] One could read in the French newspaper *Le Monde* on November 5th that “Argentina proposed as a slogan for the summit ‘creating *jobs* to face poverty’. (...) On the other hand, Washington rejects any active policy creating jobs, encouraging *free trade*”.

3.3 The Short Run

The model presented above aims at describing the impact of trade liberalization on equilibrium unemployment. The modeling approach could actually be referred to as 'medium-run' since no dynamics are taken into account. On the other hand, the analysis presented in Section 5 will show that the job flows following an increase in trade exposure occur within the year of this increase, which corresponds to a 'short run' adjustment. Now, I want to explain why the two approaches are not so disconnected.

The law of motion for u is

$$\dot{u} = \delta(1-u) - g(\theta)u + I\left[\dot{\phi}^{*} > 0\right]\left(n(\phi^{*})\mu(\phi^{*})M\dot{\phi}^{*}\right)$$

where I is an indicator function that takes value 1 if the expression between brackets is true and zero otherwise. The time subscripts t are suppressed for notational convenience and dots refer to derivatives with respect to time. From above, we see that the variation in unemployment is the sum of three types of flows. The first term refers to exogenous job separations, the second is total new hirings and the last is job destruction driven by the death of the least productive firms (due to the increase in real wages). Thus, both variations in θ and ϕ^{*} affect the variation in unemployment.

In the standard matching literature (Pissarides, 1985), following a negative shock, labor market tightness would drop immediately to its new steady-state value (the amount of vacancies posted by large firms will increase, but many small forward-looking firms will give up hiring workers as they anticipate to be forced out of the industry). The reason of this jump is because the job creation equation is essentially forward looking. In a Pissarides (1985) context the unemployment rate would then progressively grow to its steady-state value.

With the technology given in my paper, the adjustment in employment at the firm-level is actually instantaneous. The reason comes from the Euler equation of firms. In a companion paper, I describe labor markets dynamics in a Melitz context. In particular, this paper studies a discrete-time version of the model described in Section 2. In discrete time, the Euler equation for firms providing the domestic market is[37]:

$$\frac{1}{1+r}E_t\left\{Q_{t+1}^{1-\rho}\phi^{\rho}\rho n_{t+1}^{\rho-1} - w + (1-\delta)\frac{c_v}{h(\theta_{t+1})}\right\} = \frac{c_v}{h(\theta_t)} \tag{25}$$

Notice that if $\theta_t = \theta_{t+1}$, the equation above then becomes as in (16). From this equation, we see that, as marginal profits only depend on future firm-level employment, firms instantaneously adjust their employment level to any desired value (unless they are currently too large). This is not the case in Pissarides (1985) since his model considers that firms can only hire one unit of labor. This suggests that the way trade liberalization has been modeled before is appropriate to assess short-run impact[38].

[37]For firms providing the export market, the Euler equation is similar. One only needs to adjust marginal profits by introducing the τ parameter as in (17).

[38]At the aggregate level, the shock still displays persistence as we see from (25) that firms smooth hirings over time as they can trade-off between facing hiring costs at time t or at $t+1$.

4 Extension: Endogenous Wages

The Extended Framework. In the analysis from the preceding Section, wages were taking an exogenous value set to w. I now consider the possibility of endogenous labor compensation. To this end, I first need to model labor supply decisions.

The flow value of unemployment is normalized to zero and wages are assumed to be determined under a Nash-Bargaining rule as in Pissarides (2000)[39]. β denotes the workers' bargaining power.

The steady-state present-discounted value of being unemployed can then be written as:

$$rU = g(\theta) \int_{\phi^*}^{+\infty} \left[E(\phi') - U \right] \eta(\phi') d\phi' \tag{26}$$

with

$$rE(\phi) = w(\phi) + \delta \left[U - E(\phi) \right]$$

and where $E(\phi')$ is the value of being employed in a firm with productivity ϕ' and $\eta(\phi)$ denotes the distribution of employment over productivities.

One obtains the following formulation for wages, first order conditions and prices, in the case of firms providing the domestic market:

$$w(\phi) = (1-\beta) rU + \beta \rho \phi^{\rho} Q^{1-\rho} n(\phi)^{\rho-1} \tag{27}$$

$$(1-\beta) \frac{\rho \phi^{\rho} Q^{1-\rho} n(\phi)^{\rho-1} - rU}{r+\delta} = \frac{c_v}{h(\theta)} \tag{28}$$

$$p(\phi) = \frac{rU + (r+\delta)\frac{c_v}{h(\theta)}}{\rho \phi (1-\beta)} \tag{29}$$

In the case of exporting firms, one simply has to modify the marginal values in the above equations as in (17) and (20). Equation (27) merely states that wages are a linear combination of workers' threat point rU and the marginal revenue they bring to the firm.

Combining the first order condition for a firm with productivity ϕ with the Nash-bargaining rule and (26), one can show that:

$$rU = \frac{\beta}{1-\beta} \theta c_v$$

This implies the following formulation for wages, employment and prices:

$$w(\phi) = \beta \theta c_v + \beta \rho \phi^{\rho} Q^{1-\rho} n(\phi)^{\rho-1}$$

$$\frac{(1-\beta) \rho \phi^{\rho} Q^{1-\rho} n(\phi)^{\rho-1} - \beta \theta c_v}{r+\delta} = \frac{c_v}{h(\theta)}$$

$$p(\phi) = \frac{\frac{\beta}{1-\beta} \theta c_v + (r+\delta)\frac{c_v}{h(\theta)}}{\rho \phi (1-\beta)}$$

[39]See Chapter 3.

When aggregating, neither the zero-cutoff profit condition, nor the free-entry or the Beveridge curve are affected by the Nash bargaining rule. The Job Creation curve reads as follows:

$$u = 1 - \frac{\left(\frac{\beta}{1-\beta}\theta c_v + (r+\delta)\frac{c_v}{h(\theta)}\right)^{\sigma-2}}{\rho^{\sigma-2}\left[1-\rho\left(\frac{\frac{\beta}{1-\beta}\theta c_v+\delta\frac{c_v}{h(\theta)}}{\frac{\beta}{1-\beta}\theta c_v+(r+\delta)\frac{c_v}{h(\theta)}}\right)\right]{\phi_T^e}^{\sigma-1}} \frac{[1-F(\phi^*)](\pi^e+c)+\gamma[1-F(\phi_x^*)]c_x}{1-F(\phi^*)+\gamma[1-F(\phi_x^*)]}$$

At a fixed value for θ, the value of aggregate employment is then proportional to the one from the (JC-2) equation with exogenous wages. This means that the introduction of endogenous wages into the framework does not affect qualitatively the results.

Response of Wages to Trade Liberalization. Even if the extended framework does not change qualitatively the impact of trade on unemployment, it is a nevertheless interesting extension since it allows to assess the response of wages following an increase in trade exposure. Some empirical studies have already illustrated a negative impact of trade liberalization on wages. In particular, the study by Revenga (1997) suggests that trade liberalization has reduced the rent captured by workers in the Mexican manufacturing sector. The results displayed below show that the modeling strategy I have followed actually meet this literature.

In order to derive this comparative static, it is worth showing that, in spite of firm heterogeneity in productivity and labor market search frictions, the economy actually displays a unique wage. As previously described, wages are a linear combination of workers' threat point and the marginal revenue they bring to the firm (see equation (27)). The first component is constant across workers since they are all alike, while the second component may differ across firms since firms are heterogeneous. It can actually be proved that this second component does not differ and the reason is because hiring costs $\frac{c_v}{h(\theta)}$ do not depend on the firm's productivity. This implies that, if firms hire workers up to the point where the marginal revenue they generate is equal to the search cost (see equation (28)), this marginal value has to be equal across all firms. As a result, wages take a unique value whichever firm's productivity is. This is stated in the following Lemma.

LEMMA 5. *The economy is characterized by a unique wage: $\forall \phi > \phi^*, w(\phi) = w$. In particular, the wage takes the following value:*

$$w = \frac{\beta^3-\beta^2+\beta}{(1-\beta)^2}\theta c_v + \frac{\beta}{1-\beta}(r+\delta)\frac{c_v}{h(\theta)}$$

This value decreases following trade liberalization because of two effects, which in fact are complementary. Those two effects result from the interaction between goods and labor markets imperfections that is described in Proposition 1.

The first reason is the decrease in the workers' threat point. As unemployment increases, labor market tightness decreases. This implies that it becomes harder for a worker to find a new job, reducing her bargaining power when wages are negotiated.

The second effect is due to the concentration of the labor force in a smaller set of firms. Remember the goods market displays monopolistic competition implying that firms have some market power. As a consequence, the revenue firms earn is characterized by decreasing returns to scale in employment. A higher firm level employment then decrease the marginal revenue workers generate, reducing the wage they earn.

The complementarity between these two effects comes from the first-order condition (28). From this equation, we clearly see that labor market tightness and firms' marginal revenue are positively related, implying that if competition between workers in the labor market becomes more tight, hiring cost decreases for firms, which in turn is an incentive for them to increase employment at the firm level and decrease marginal revenue. On the other hand, following a reallocation shock, the concentration of workers in few firms, which leads to a decrease in the marginal revenue, has to be compensated by a decrease in the search cost.

The following Proposition summarizes these results:

PROPOSITION 5. *Trade liberalization leads to a decrease in wage, as*

- *Trade liberalization decreases the workers' threat point.*
- *Trade liberalization reduces the marginal value workers bring to the firm.*

Proof. See the Appendix.

Intrafirm Wage Bargaining. In a paper by Cahuc *et al.* (2005), it is argued that, in a large firm setting, when revenues generated by workers are characterized by decreasing returns to scale, firms actually increase their level of employment so that they can reduce the marginal value workers generate and so wages. This should be the case in my model of trade and unemployment.

The results that have been presented so far are in fact robust to a so-called framework with *intrafirm wage bargaining*. Indeed, from Cahuc *et al.* (2005), is can be shown in this setting that the first order condition becomes

$$(1-\beta)\frac{\frac{\rho\phi^{\rho}Q^{1-\rho}n(\phi)^{\rho-1}}{1-\beta+\beta\rho}-rU}{r+\delta}=\frac{c_v}{h(\theta)}.$$

When comparing this equation with (28), one can see that the only difference comes the left-hand side of the equation, where marginal revenue is multiplied by a factor $\frac{1}{1-\beta+\beta\rho}>1$. This means that the results that have been presented so far are not qualitatively affected by intrafirm wage bargaining.

5 Empirical Evidence

Existing empirical literature on firm heterogeneity in international economics shows that trade liberalization leads to the decline of small firms and the expansion of large firms. In a full-employment framework, these results suggest a reallocation of labor from small to large firms. In this Section, empirical evidence suggests that firm turnover generates more job destruction than creation.

5.1 Data

The data is a panel dataset of annual frequency. Gross job flows are taken from the Davis *et al.* (1996) database, which provides us with data on job creation and job destruction rates for the period 1973-1988 over 447 4-digit manufacturing sectors (1972 SIC definition). Since the SIC sectors was revised in 1987, I use the methodology of Bartelsman and Gray (1996) to allow the correspondence between the 1987 and 1988 sample to the previous subsample.

I calculate penetration ratios by using data on sectoral imports and exports from the NBER International Trade database as:[40]

$$P_{i,t}^{imp} = \frac{M_{i,t}}{Y_{i,t}+M_{i,t}}$$

$$P_{i,t}^{exp} = \frac{X_{i,t}}{Y_{i,t}+M_{i,t}}$$

$M_{i,t}$ denotes sectoral imports for sector i at time t, $X_{i,t}$ sectoral exports and $Y_{i,t}$ industry shipments. Data on industry shipments are taken from the NBER Manufacturing Productivity database[41].

Aggregate variables are constructed using employment shares as provided by Davis *et al.* (1996) database.

Sectors with missing data are dropped, I chose to remove them. Those represent a total of 29 sectors, or 6.5% of the total 447 sectors available. The list of the dropped sectors is provided in Table 6 in the Appendix.

We end up with a balanced panel of 15 years over the period 1974-1988 and a total of 418 sectors for the US.

It would certainly be interesting to also use data on tariffs in order to assess the impact of trade liberalization. This data is available on the NBER web site. However, the time period doe not match with my data on job flows.

On the other hand, one could argue that my measures of trade exposure are actually better suited to assess the impact of globalization. First, these are *effective* measures of trade exposure. They account for phenomena such as trade diversion that are not necessarily considered when using tariff data. Second, they also should account for other trade costs like non-tariff barriers to trade. In particular, a report from the Swedish National Board of Trade show that when a country experiences a decrease in tariffs, it usually switch to other forms of trade barriers[42]. My measure of trade exposure accounts for those effects.

5.2 Descriptive Statistics

Estimating the impact of a greater exposure to international trade on job flows is a difficult task. Indeed, both international and domestic markets are characterized by several types of shocks that always interact. The work by Davis *et al.* (1996) did not find any significant relation in the long run: sectors that are more open did not appear to be characterized by a different evolution of job flows. However,

[40]See Feenstra (1996, 1997) for more details.

[41]See Bartelsman and Gray (1996).

[42]See Kommerskollegium (2006).

the calibration by Bernard *et al.* (2003) on the short-run effects reveals some more significant results. They suggest that a 5% fall in geographic barriers would increase job creation by 1.5% and job destruction by 2.8% in the manufacturing sector, making employment to drop by 1.3%. But their model is based on Eaton and Kortum (2002) which, despite of fitting the data very well, considers a frictionless labor market.

This section describes the evolution of our aggregate variables of interest, i.e. gross job flows and trade exposure ratios in order to motivate why we need to take care of several factors in order to assess the effect of trade liberalization. This will motivate the approach I will consider for my estimations: the use of panel data techniques.

The well known behavior of aggregate job destruction and creation[43] is displayed in Figure 5. One can notice that the two variables are negatively correlated, mainly reflecting the impact of aggregate shocks. As will be explained further, those *a priori* totally closed economy considerations need to be accounted for in an open economy framework as well.

Figure 6 shows the evolution of aggregate import and export ratios, calculated as in Section 5.1. Two features can be observed. Firstly, both variables display an upward trend, reflecting a growing exposure of the US to international trade. Secondly, a negative correlation around this trend illustrates the impact of exchange rate fluctuations on the trade balance.

Those facts imply we should be careful when analyzing the link between trade exposure and employment: other variables are affecting our two variables, meaning that we will have to distinguish between the effect we are interested in (a greater exposure to international trade) and other shocks such as aggregate and exchange rate fluctuations.

Indeed, in the empirical literature, it has been largely shown that aggregate shocks extensively affect job flows. See for instance Abraham and Katz (1986), Blanchard and Diamond (1989) and Davis and Haltiwanger (1999). But, there has also been a debate regarding the effect of real exchange rate fluctuations on intra-sectoral job reallocation. In particular, this debate has focused on the nature of such shocks, i.e. whether they are allocative or aggregate[44]. The first paper on this issue is Gourinchas (1998) who claims that the existing matching models aimed at fitting the behaviors of job creation and destruction, such as Mortensen and Pissarides (1994), cannot account for the effects of real exchange rate fluctuations on job reallocations. He finds with US data that such a type of shock has an allocative effect, i.e. it induces a positive correlation between job creation and destruction, whereas traditional matching models would instead show that it induces a negative correlation between the two variables. Surprisingly, he then finds in French data[45] that an aggregate interpretation better fits the observed behavior and justifies this finding by asserting that the real exchange rate fluctuations of the French Franc cannot be anticipated. Actually, Klein *et al.* (2003) investigate the same issue on US data and find the shock to be aggregate in nature. They argue that the

[43]See Davis *et al.* (1996) for a comprehensive study.

[44]That is whether they induce a positive or a negative correlation between job flows.

[45]See Gourinchas 1999.

results in Gourinchas (1998) are due to sample selection bias. In my estimations below, I will rely on Klein *et al.* (2003) as a benchmark model (i.e. exchange rate shocks are not allocative but aggregate). Thus, controlling for aggregate shocks is important since those shocks are affecting trade and labor market variables at the same time. An estimation procedure using panel data is thus appropriate since panel data techniques allow the econometrician to disentangle between aggregate and sector-specific shocks.

Finally, Figure 7 shows the importance of aggregate shocks. This picture depicts the evolution of net employment and changes in trade exposure ratio[46]. Both variables are standardized. Basically a positive correlation between the two variables can be noticed, suggesting a positive impact of trade exposure on employment. Indeed, the overall correlation coefficient is around 0.37. But, if one pays more attention to these evolutions, it can be seen that there is a strong positive correlation essentially over three periods: the oil shock in 1975, the crisis at the beginning of the 1980's and the large fluctuations in the dollar in the late 1980's. Outside those periods a negative correlation can instead be observed. Even though this negative correlation seems smaller in magnitude, the effect is present, suggesting that, after controlling for exchange rate and other aggregate effects, an increasing exposure to international trade might induce a drop in employment.

The empirical strategy I propose is to use panel data techniques since it is otherwise hard to identify all the relevant effects at the aggregate level and because such techniques help to control for aggregate shocks. Indeed, although we observe an increasing exposure to international trade at the aggregate level, data at the sectoral level will be more informative: some sectors become less connected to the rest of world, whereas others experience an increase in their exposure[47]. Further, we will be able to disentangle between the effect of an increase in trade exposure and other aggregate effects. Finally, when the time span is short, panel data techniques allow to exploit all the cross section dimension. The next Subsection explains our methodology more in details.

5.3 Estimation and Results

I propose to estimate the following set of dynamic equations:

$$JC_{i,t} = \alpha_1(L)\Delta P^{imp}_{i,t} + \alpha_2(L)\Delta P^{exp}_{i,t} + \alpha_3(L)JC_{agg,t} + \alpha_4(L)JC_{i,t-1} + \eta_{jc,i} + \epsilon_{jc,i,t} \quad (30)$$

$$JD_{i,t} = \beta_1(L)\Delta P^{imp}_{i,t} + \beta_2(L)\Delta P^{exp}_{i,t} + \beta_3(L)JD_{agg,t} + \beta_4(L)JD_{i,t-1} + \eta_{jd,i} + \epsilon_{jd,i,t} \quad (31)$$

where $JC_{i,t}$ and $JD_{i,t}$ are respectively job creation and destruction rates in sector i at time t. From the theoretical part of the present paper, trade liberalization induces an increase in both $P^{exp}_{i,t}$ and $P^{imp}_{i,t}$ ratios. The coefficients of interest are then α_1, α_2, β_1 and β_2 which give the impact of a one-point increase in import and export shares on job creation and destruction rates respectively. Recall that a balanced increase in job flows following an increase in trade exposure should imply $\alpha_1 = \beta_1$ and $\alpha_2 = \beta_2$. Aggregate variables are included in order to control for

[46] This last variable refers to the sum of import and export penetration ratios.

[47] See Gourinchas (1998).

Table 1: *Job Creation: Regression Results.*

		GMM		FE		GMM2	
Dep. Var.	**Exp. Var.**	**Coef.**	**t-value**	**Coef.**	**t-value**	**Coef.**	**t-value**
$JC_{i,t}$	$\Delta P_{i,t}^{imp}$	3.1370	1.0054	3.0722	1.1855	3.2348	0.1654
		(3.1203)		*(2.5915)*		*(19.5615)*	
	$\Delta P_{i,t}^{exp}$	-2.1985	-0.8010	-2.0605	-0.9197	-0.4654	-0.0347
		(2.7446)		*(2.2404)*		*(13.4192)*	
	$JC_{agg,t}$	0.9925	10.7663***	0.9983	36.6474***	0.9873	4.0167***
		(0.0922)		*(0.0272)*		*(0.2458)*	
	$JC_{i,t-1}$	0.0230	0.8486			0.0232	0.2877
		(0.0270)				*(0.0805)*	
m_1			-8.7543				-5.1645
m_2			-0.1727				-0.0959
SS			414.9244†				353.7832†
NR			735				497

†no overidentification at the 5% level, * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

SS is the Sargan Statistic and NR the number of restrictions used for the GMM estimation. Standard-error are in parentheses.

Table 2: *Job Destruction: Regression Results.*

		GMM		FE		GMM2	
Dep. Var.	**Exp. Var.**	**Coef.**	**t-value**	**Coef.**	**t-value**	**Coef.**	**t-value**
$JD_{i,t}$	$\Delta P_{i,t}^{imp}$	14.6645	2.7885***	15.4614	4.3132***	22.9811	0.9715
		(5.2590)		*(3.5847)*		*(23.6558)*	
	$\Delta P_{i,t}^{exp}$	6.3000	2.0624**	5.6092	1.7914*	4.2445	0.2120
		(3.0546)		*(3.1311)*		*(20.0233)*	
	$JD_{agg,t}$	1.0615	16.3466***	1.0697	41.8252***	1.0674	4.9189***
		(0.0649)		*(0.0256)*		*(0.2170)*	
	$JD_{i,t-1}$	0.0376	1.5303			0.0204	0.2939
		(0.0245)				*(0.0693)*	
m_1			-9.0792				-5.4791
m_2			-0.7580				-0.7590
SS			417.3722†				368.6686†
NR			735				497

†no overidentification at the 5% level, * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

SS is the Sargan Statistic and NR the number of restrictions used for the GMM estimation. Standard-error are in parentheses.

macroeconomic shocks, e.g., productivity, oil prices or exchange rate shocks. This enables us to control for shocks that have an impact on the trade balance, rather than not taking into account a proper increase in trade exposure. In addition, the aggregate shock also controls for the well-known shift from manufacturing to services. The $\eta_{\bullet,i}$ are fixed effects and $\epsilon_{\bullet,i,t}$ sectoral shocks in sector i at time t. The introduction of fixed effects is important in our framework: remember that we want to assess the *short-run* impact on employment. Fixed effects then control for sector-specific characteristics omitted by the model. For instance our results are insensitive to whether the sector is a booming or a declining one. Time dummies could also have been introduced, but as previously argued another strategy was followed in order to control for aggregate effects. Results are however not very different if one includes or not time dummies. Moreover, as all variables are stationary, we don't need to control for any trend.

As the panel has a small number of time periods T and a large number of sectors I, I choose to use Generalized Method of Moments (GMM) techniques applied to panel data in a two-step robust procedure[48] to estimate equations (30) and (31). The asymptotic properties of this estimator have been derived in Alvarez and Arellano (2003).

Regarding moment conditions, differences in import and export share and aggregate variables are considered to be strictly exogenous and the dependent variables as predetermined. Note that the strict exogeneity of trade exposure could be criticized. But, an incremental Sargan test below will not reject the hypothesis.

Results. The results are presented in Tables 1 and 2 (GMM column). The optimal length of the lag polynomial is determined by removing the lags that are not significant but at the same time keeping at least the first element of the polynomial. For the sake of comparison, results using a fixed effects procedure (FE column), as well as a GMM procedure where trade exposure ratios are considered as predetermined (GMM2 column), are reported. In the FE case, the lagged dependent variable is omitted as it would bias the results. The m_1, m_2 and *Sargan Stat.* rows respectively indicate the autocorrelation and overidentification tests from Arellano and Bond (1991).

From Tables 1 and 2, one can first notice that the results are very similar across specifications. This is because the coefficient on the lagged dependent variable is not significant and overall small in magnitude, which tends to reduce the bias (if it exists).

Secondly, as well known, job flows variables are highly correlated with aggregate shocks[49]. For both job creation and destruction rates, the coefficient relative to aggregate flows is indeed very close to one and very significant, and across all specifications.

Thirdly, all tests specific to GMM estimation, i.e., m_1 and m_2 tests and the Sargan overidentification test are satisfactory. m_1 is negative and large, m_2 is close to zero and the Sargan tests do not seem to indicate any type of overidentification

[48]See Arellano (2003) or Arellano and Honoré (2001) for more details.

[49]See Abraham and Katz (1986), Blanchard and Diamond (1989) and Davis and Haltiwanger (1999).

in the moment conditions.

All of the above elements allow us to interpret the coefficients on trade exposure ratios, having controlled for aggregate shocks. The results are the following. A greater trade exposure does not affect job creation (for both imports and exports shares). The coefficient is not significant even in the fixed effects specification which is expected to yield more precise coefficients. But, in contrast, it does have an effect on job destruction. The coefficients relative to imports and exports shares are indeed highly significant and tell us that a 1 point increase in import share increases job destruction rate by 14.7 points, while an increase in export share in the same proportion increases job destruction by 6.3 points.

It is not surprising to observe that an increase in import penetration destroys more jobs as compared to an increase in the export ratio as the former leads to a decline in the respective domestic sectors and to dismissals in those same sectors in the short run[50]. But, we need to pay more attention to the shrinkage in employment even in the sectors that are exporting more. Even though it is smaller in magnitude, it remains negative. This findings confirm the theoretical results from Section 3, i.e. following in increase in trade exposure, the subsequent labor reallocation process within sector is characterized by higher job destruction than creation.

Robustness. As the strict exogeneity of trade exposure ratios can be criticized,[51] I performed an incremental Sargan test, to test the null hypothesis of strict exogeneity against the alternative according to which variations in trade exposure ratios are correlated only with current and past shocks. The χ^2 statistics are respectively 61.14 for the job creation and 48.70 for the job destruction equations, which does not reject the null hypothesis and suggests no overidentification.

Another critique to the use of our measures of exposure to trade is that they are sensitive to the business cycle. As long as international and business cycles are not aligned, a drop in Y does not *a fortiori* imply the same decrease in X. Suppose then that there is a domestic recession in a specific sector with no impact on X nor M. This would imply an increase in our index of openness to trade and an increase in job destruction, but those variations would actually be due to domestic shocks rather than a *proper* change in exposure to trade.

I partly control for this as I included aggregate shocks and fixed effects into the regression, but it is certainly interesting to check the sensitivity of the results when using a measure of openness to trade that is not subject to this critique. I then filter my series for Y, X and M by using a low-pass filter in order to remove frequencies that are lower than 6 years. Table 3 displays the results when considering measures of trade exposure that are constructed from the filtered series. As one can see, there is no much change with respect to the results presented in Tables 1 and 2, which indicates our measures of exposure to trade are in fact not very sensitive to sectoral cycles.

[50] See Revenga (1992) or Baldwin *et al.* (1980).

[51] As the estimations were not precise enough (see GMM2), further moment conditions were required in order to indentify the model and get significant coefficients. This is the well-known trade-off between a consistent and an efficient estimator. The incremental Sargan test show that the bias is not strong, establishing us to maintain the assumption of exogeneity.

Table 3: *Job Flows: Regression Results with the Filtered Series.*

		GMM				**GMM**	
Dep. Var.	**Exp. Var.**	**Coef.**	**t-value**	**Dep. Var.**	**Exp. Var.**	**Coef.**	**t-value**
$JC_{i,t}$	$\Delta P_{i,t}^{imp}$	-2.4608	-0.6325	$JD_{i,t}$	$\Delta P_{i,t}^{imp}$	12.4733	2.5427***
		(3.8906)				*(4.9055)*	
	$\Delta P_{i,t}^{exp}$	0.1907	0.2813		$\Delta P_{i,t}^{exp}$	3.3864	4.3613***
		(0.6778)				*(0.7765)*	
	$JC_{agg,t}$	1.0039	13.5825***		$JD_{agg,t}$	1.0530	19.8063***
		(0.0739)				*(0.0532)*	
	$JC_{i,t-1}$	0.0166	0.7417		$JD_{i,t-1}$	0.0337	1.7616*
		(0.0223)				*(0.0191)*	
m_1			-9.9671				-9.1181
m_2			-0.2773				-0.9828
SS			412.2596†				413.1572†
NR			735				497

†no overidentification at the 5% level, * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level. Standard-error are in parentheses.

SS is the Sargan Statistic and NR the number of restrictions used for the GMM estimation.

Table 4: *Robustness: Job Flows regressed on future variations in exposure ratios.*

		FE				**FE**	
Dep. Var.	**Exp. Var.**	**Coef.**	**t-value**	**Dep. Var.**	**Exp. Var.**	**Coef.**	**t-value**
$JC_{i,t}$	$\Delta P^{imp}_{i,t+1}$	-6.8388	-2.5690***	$JD_{i,t}$	$\Delta P^{imp}_{i,t+1}$	3.3408	0.8789
		(2.6620)				*(3.8010)*	
	$\Delta P^{exp}_{i,t+1}$	1.1503	0.4973		$\Delta P^{exp}_{i,t+1}$	-2.7789	-0.8418
		(2.3130)				*(3.3013)*	
	$JC_{agg,t}$	1.0069	37.0112***		$JD_{agg,t}$	1.0444	38.8889***
		(0.0272)				*(0.0269)*	

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level. Standard-error are in parentheses.

As a further robustness check, I regressed job flows at time t on the variation in trade penetration ratios at time $t+1$ in a simple fixed effect framework. One might indeed think that firms hire their workers today in order to sell their products abroad in a year. The results are reported in Table 4 and enable us not to reject that trade implies massive job destruction: no coefficient is significant, except for the impact of an increase in import ratio on job creation, which is highly significant and negative.

In addition (not reported) I also added to the regression monetary growth as an explanatory variable as Davis *et al.* (1996) suggest that the aggressive monetary policy in the 70's could explain the observed high rate in job reallocation. I also included real effective exchange rate growth and government expenditure growth. Results remain robust.

The only case where I found that more exposure significantly increases job creation is when squared terms are included (see Table 5)[52]. The reason for introducing squared terms is because, according to my model, job reallocation should occur for both an increase and a decrease in trade exposure. This means that we should observe job creation by large firms when trade exposure increases and job creation by small firms when it decreases. But, even in this case creations do not compensate destructions: a one-point increase in export share generates an increase in job creation by 4.5 points and an increase in job destruction by 6.5 points[53]; and a one-point increase in import ratio does not seem to generate any significant increase in job creation while job destruction is increased by 13.8 points.

To summarize our previous results: higher exposure to international trade increases job destruction since small firms are thrown out from the market, but at the same

[52] Care should be given when reading this Table. A one-point increase in penetration ratio corresponds to a value of 0.01, meaning that when one wants to take the square, one has to consider a value of 0.0001.

[53] It could be argued that the two coefficients might not be significantly different. Therefore I regressed the sectoral net employment growth on increases in sectoral penetration ratios. The results indicate a decrease in employment when opening to trade.

Table 5: *Job Flows: Regressions when adding squared terms.*

		GMM				GMM	
Dep. Var.	**Exp. Var.**	**Coef.**	**t-value**	**Dep. Var.**	**Exp. Var.**	**Coef.**	**t-value**
$JC_{i,t}$	$\Delta P_{i,t}^{imp}$	2.8381	0.7172	$JD_{i,t}$	$\Delta P_{i,t}^{imp}$	12.1548	1.9337**
		(3.9571)				*(6.2859)*	
	$\Delta P_{i,t}^{imp2}$	-1.5475	-0.0288		$\Delta P_{i,t}^{imp2}$	164.1163	2.0158**
		(53.7570)				*(81.4140)*	
	$\Delta P_{i,t}^{exp}$	-2.2456	-0.8312		$\Delta P_{i,t}^{exp}$	6.2524	1.8291**
		(2.7015)				*(3.4182)*	
	$\Delta P_{i,t}^{exp2}$	45.0710	3.7212***		$\Delta P_{i,t}^{exp2}$	-2.8575	-0.1580
		(12.1119)				*(18.0897)*	
	$JC_{agg,t}$	0.9913	10.2356***		$JD_{agg,t}$	1.0629	14.2701***
		(0.0969)				*(0.0745)*	
	$JC_{i,t-1}$	0.0161	0.5556		$JD_{i,t-1}$	0.0301	0.9695
		(0.0290)				*(0.0311)*	
m_1			-8.6197				-8.5764
m_2			-0.3587				-0.7971
SS			410.8†				417.4†
NR			1155				1155

†no overidentification at the 5% level, * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

SS is the Sargan Statistic and NR the number of restrictions used for the GMM estimation. Standard-error are in parentheses.

time job creations are not large enough to compensate the fall in employment.

6 Conclusion

While nations gain from international trade, international trade hurts particular groups of agents. Thus gains from trade are unequally distributed. Some groups win, others lose.

This was already known of models of inter-industry trade. This paper illustrates that also intra-industry trade hurts some agents. When trade is liberalized, workers relocate from the least to the most productive firms, leading to an increase in aggregate productivity and welfare gains. But, when labor markets are characterized with search frictions, job destruction due to small firms exit exceeds job creation by large firms. The reason why all displaced workers are not absorbed by the remaining firms is because those firms want to benefit from market power on the goods market, which allows them to extract higher rents. The mechanism is due to a complementarity property between goods and labor markets imperfections and in fact is analogous to the introduction of higher barriers to entry in the goods market, which causes equilibrium unemployment to increase.

This trade-off between aggregate welfare and employment leads to the following caveat: the greater the gains from trade, the steeper the opposition to globalization will be as the rise in equilibrium unemployment will be sharper. An example are the recent demonstrations against the American Free Trade Agreement during the 4th American Summit in November 2005 at Mar del Plata in Argentina. The protesters were curiously opposing free trade against employment. This paper gives an explanation of why such a statement can be made.

An interesting implication of this result is that we should not see opposition to trade only in import-competing industries, but also in expanding industries. According to my model and the results from the empirical part of the paper, even the growth of large multinationals gives rise to a short-run decrease in employment in those sectors. This gives a rationale for the presence of labor unions or groups of protesters in those sectors.

As claimed by Kletzer (2002), it is then necessary to think carefully about possible redistribution mechanisms and other economic policies that should accompany trade liberalization. In this way, in addition of being welfare-improving, such policies would make globalization Pareto-improving.

References

[1] Abraham, K. and Katz, L.F. (1986) 'Cyclical Unemployment: Sectoral Shifts or Aggregate Disturbances?' *Journal of Political Economy*, 94(3), 507-22.

[2] Acemoglu, D. (2001) 'Good Jobs versus Bad Jobs,' *Journal of Labor Economics*, 19(1), 1-21.

[3] Alvarez, J. and Arellano, M. (2003), 'The Time Series and Cross-Section Asymptotics of Dynamic Panel Data Estimator,' *Econometrica*, 71(4), 1121-59.

[4] Arellano, M. and Bond, S. (1991) 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations,' *The Review of Economic Studies*, 58(2), 277-297.

[5] Arellano, M. and Honoré, B. (2001), 'Panel Data Models: Some Recent Developments,' in Heckman, J.J. and E. Leamer (Eds), *Handbook of Econometrics*, vol. 5, chapter 53, North-Holland.

[6] Arellano, M. (2003) *Panel Data Econometrics*, Advanced Texts in Econometrics, Oxford University Press, New York.

[7] Aw, B.Y., Chung, S. and Roberts, M.J. (2000), 'Productivity and Turnover in the Export Market: Micro-level Evidence from the Republic of Korea and Taiwan (China),' *World Bank Economic Review*, 14, 65-90.

[8] Baldwin, R.E., Mutti, J.H. and Richardson, J.D. (1980) 'Welfare Effects on the United States of a Significant Multilateral Tariff Reduction,' *Journal of International Economics*, 10(3), 405-423.

[9] Baldwin, R. (2005) 'Heterogeneous Firms and Trade: Testable and Untestable Properties of the Melitz Model,' NBER working paper 11471.

[10] Baldwin, R. and Robert-Nicoud, F. (2004) 'The Impact of Trade on Intraindustry Reallocations and Aggregate Industry Productivity: A Comment,' NBER working paper 10718.

[11] Baldwin, R. and Robert-Nicoud, F. (2006) 'Trade and Growth with Heterogeneous Firms,' NBER working paper 12326.

[12] Bartelsman, E.J. and Gray, W. (1996), 'The NBER Manufacturing Productivity Database,' NBER technical working paper 205.

[13] Bernard, A.B. and Jensen, J.B. (1995), 'Exporters, Jobs, and Wages in US Manufacturing: 1976-1987,' *Brooking Papers on Economic Activity. Microeconomics*, 67-119.

[14] Bernard, A.B. and Jensen, J.B. (1999), 'Exceptional Exporter Performance: Cause, Effect, or Both?' *Journal of International Economics*, 47, 1-25.

[15] Bernard, A.B., Eaton, J., Jensen, J.B. and Kortum, S. (2003) 'Plants and Productivity in International Trade,' *American Economic Review*, 93(4), 1268-90.

[16] Bertrand, M. and Kramartz, F. (2002) 'Does Entry Regulation Hinder Job Creation? Evidence from the French Retail Industry,' *Quarterly Journal of Economics*, 117, 1369-1413.

[17] Blanchard, O.J. and Diamond, P. (1989) 'The Beveridge Curve,' *Brooking Papers on Economic Activity*, 1, 1-76.

[18] Blanchard, O.J. and Giavazzi, F. (2003) 'Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets, *Quarterly Journal of Economics*, 118(3), 879-909.

[19] Caballero, R. and Hammour, M. (1996) 'On the Ills of Adjustment,' *Journal of Development Economics*, 51, 161-92.

[20] Cahuc, P. and Wasmer, E. (2001) 'Does Intrafirm Bargaining Matter in the Large Firm's Matching Model?' *Macroeconomic Dynamics*, 5, 742-47.

[21] Cahuc, P., Marque, F. and Wasmer, E. (2005) 'A Theory of Wages and Labor Demand with Intrafirm Bargaining and Matching Frictions, CEPR discussion paper 4605.

[22] Clerides, S.K., Lach, S. and Tybout, J.R. (1998), 'Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico and Morocco,' *Quarterly Journal of Economics*, 113, 903-47.

[23] Cox, D. and Harris, R. (1985) 'Trade Liberalization and Industrial Organization: Some Estimates for Canada,' *Journal of Political Economy*, 93(1), 115-45.

[24] Cuñat, A. and Melitz, M.J. (2006) 'Volatility, Labor Market Flexibility, and the Pattern of Comparative Advantage,' *mimeo.*

[25] Davidson, C., Martin, M. and Matusz, S.J. (1999) 'Trade and Search Generated Unemployment,' *Journal of International Economics*, 48(2), 271-99.

[26] Davidson, C. and Matusz, S.J. (2004) *International Trade and Labor Markets. Theory, Evidence and Policy Implications.*, W.E. Upjohn Institute for Employment Research, Kalamazoo, Michigan.

[27] Davidson, C. and Matusz, S.J. (2006) 'Long-Run Lunacy, Short-Run Sanity: A Simple Model of Trade with Labor Market Turnover,' *Review of International Economics*, 2(5), 261-76.

[28] Davidson, C., Matusz, S.J. and Schevchenko, A. (2005) 'Globalization and Firm Level Adjustment with Imperfect Labor Markets,' University of Nottingham working paper.

[29] Davis, S.J., Haltiwanger, J. and Schuh, S. (1996), *Job Creation and Destruction*, The MIT Press, Cambridge, Massachusetts.

[30] Davis, J.D. and Haltiwanger, J. (1999) 'On the Driving Forces Behind Cyclical Movements in Employment and Job Reallocation,' *American Economic Review*, 89(5), 1234-58.

[31] Dixit, A. and Stiglitz, J. (1977) 'Monopolistic Competition and Optimum Product Diversity,' *American Economic Review*, 67, 297-308.

[32] Eaton, J. and Kortum, S. (2002) 'Technology, Geography and Trade,' *Econometrica*, 70(5), 1741-79.

[33] Eaton, J., Kortum, S. and Kramarz, F. (2004) 'Dissecting Trade: Firms, Industries, and Export Destinations,' *American Economic Review. Papers and Proceeding*, forthcoming.

[34] Feenstra, R.C. (1996) 'U.S. Imports, 1972-1994: Data and Concordances,' NBER working paper 5515.

[35] Feenstra, R.C. (1997) 'U.S. Exports, 1972-1994: With State Exports and Other U.S. Data,' NBER working paper 5990.

[36] Flam, H. (1992) 'Product Markets and 1992: Full Integration, Large Gains?' *Journal of Economic Perspectives*, 6(4), 7-30.

[37] Ghironi, F. and Melitz, M.J. (2005) 'International Trade and Macroeconomic Dynamics with Heterogeneous Firms,' *Quarterly Journal of Economics*, 120, 865-915.

[38] Gourinchas, P.O. (1998) 'Exchange Rates and Jobs: What Do We Learn from Job Flows?' *NBER Macroeconomics Annual.*

[39] Gourinchas, P.O. (1999) 'Exchange Rates Do Matter: French Job Reallocation and Exchange Rate Turbulence, 1984-1992,' *European Economic Review*, 43, 1279-1316.

[40] Head, K. and Ries, J. (1999) 'Rationalization Effects of Tariff Reductions,' *Journal of International Economics*, 47, 295-320.

[41] Hopenhayn, H.A. (1992) 'Entry, Exit and Firm Dynamics in Long Run Equilibrium,' *Econometrica*, 60(5), 1127-50.

[42] Janiak, A. (2005) 'Labor Mobility and Education Policy: The Tradeoff Between Specialization and Reallocation Cost,' Ecares *mimeo.*

[43] Klein, M.W., Schuh, S. and Triest, R.K. (2003) 'Job Creation, Job Destruction, and the Real Exchange Rate,' *Journal of International Economics*, 59, 239-65.

[44] Kletzer, L.G. (2002) *Imports, Exports, and Jobs: What does trade mean for employment and job loss?*, W.E. Upjohn Institute for Employment Research.

[45] Kommerskollegium (2006) *Open for Business? A Comparative Analysis of the Trade Policies of the European Union, the United States, Canada and Japan*, Stockholm: Swedish National Board of Trade.

[46] Krugman, P. (1980) 'Scale Economies, Product Differentiation, and the Pattern of Trade,' *American Economic Review*, 70(5), 950-59.

[47] Lamo, A., Messina, J. and Wasmer, E. (2006) 'Are Specific Skills an Obstacle to Labour Market Adjustment? Theory and an Application to the EU Enlargement,' CEPR discussion paper 5503.

[48] Levinsohn, J. (1999) 'Employment Responses to International Liberalization in Chile,' *Journal of International Economics*, 47, 321-44.

[49] Magee, C.S.P., Davidson, C. and Matusz, S.J. (2005) 'Trade, Turnover and Tithing,' *Journal of International Economics*, 66, 157-76.

[50] Melitz, M.J. (2003) 'The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,' *Econometrica*, 71(6), 1695-1725.

[51] Mortensen, D. and Pissarides, C.A. (1994) 'Job Creation and Destruction in the Theory of Unemployment,' *Review of Economic Studies*, 61(3), 397-416.

[52] Pavcnik, N. (2002), 'Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants,' *Review of Economic Studies*, 69, 245-76.

[53] Petrongolo, B. and Pissarides, C.A. (2001) 'Looking into the Black Box: A Survey of the Matching Function,' *Journal of Economic Literature,* 38, 390-431.

[54] Pissarides, C.A (1985) 'Short run Dynamics of Unemployment, Vacancies, and Real Wages,' *American Economic Review*, 75(4), 676-90.

[55] Pissarides, C.A (2000) *Equilibrium Unemployment Theory*, The MIT Press, Cambridge, Massachusetts.

[56] Revenga, A. (1992) 'Exporting Jobs? The Impact of Import Competition on Employment and Wages in US Manufacturing,' *Quarterly Journal of Economics*, 107(1), 255-84.

[57] Revenga, A. (1997) 'Employment and Wages Effects of Trade Liberalization: The Case of Mexican Manufacturing,' *Journal of Labor Economics*, 15(3), S20-43.

[58] Rivera-Batiz, L. and Romer, P. (1991) 'Economic Integration and Economic Growth,' *Quarterly Journal of Economics*, 106(2), 531-556.

[59] Roberts, M.J. and Tybout, J.R. (1997) 'The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs,' *American Economic Review*, 87(4), 545-64.

[60] Saint-Paul, G. (2005) 'Making Sense of Bolkenstein-Bashing: Trade Liberalization under Segmented Labor Markets,' IZA discussion paper 1618.

[61] Sener, F. (2001) 'Schumpeterian Unemployment, Trade and Wages,' *Journal of International Economics*, 54, 119-48.

[62] Trefler, D. (2004) 'The Long and Short of the Canada-US Free Trade Agreement,' *American Economic Review*, 94(4), 870-95.

[63] Tybout, J. (2002) 'Plant and Firm-Level Evidence on New Trade Theories. In *Handbook of International Economics*,' J. Harrigan (ed.), Vol. 38, Basil-Blackwell.

[64] Yeaple, S.R. (2005) 'A Simple Model of Firm Heterogeneity, International Trade, and Wages,' *Journal of International Economics*, 65, 1-20.

[65] Wacziarg, R. and Wallack, J.S. (2004) 'Trade Liberalization and Intersectoral Labor Movements,' *Journal of International Economics*, 64, 411-39.

A Proofs

A.1 Closed Economy

A.1.1 Inter-temporal maximization program of the firm.

Proof. The Hamiltonian H for the maximization program is:

$$H = e^{-rt}\left\{p(\phi)q(\phi) - wn(\phi) - c_v v(\phi) - c\right\} + \Xi_t\left\{h(\theta)v(\phi) - \delta n(\phi)\right\}$$

Where Ξ_t is the Lagrange multiplier evaluated at time t. We set $\xi_t = e^{-rt}\Xi_t$.

When plugging the production function and the demand equation (7) into the above expression, we have:

$$H = e^{-rt}\left\{Q^{1-\rho}\phi^{\rho}n(\phi)^{\rho} - wn(\phi) - c_v v(\phi) - c\right\} + \Xi_t\left\{h(\theta)v(\phi) - \delta(\phi)\right\}$$

The first order conditions are:

$$\begin{cases} -c_v e^{-rt} + \Xi_t h(\theta) = 0 \\ e^{-rt}\left\{\rho Q^{1-\rho}\phi^{\rho}n(\phi)^{\rho-1} - w\right\} - \delta\Xi_t = -\dot{\Xi}_t \end{cases}$$

By noticing $\dot{\Xi}_t = -re^{-rt}\xi_t + e^{-rt}\dot{\xi}_t$ and setting $\dot{\xi}_t = 0$, we then get in steady state:

$$\begin{cases} \xi_t = \frac{c_v}{h(\theta)} \\ \xi_t = \frac{\rho Q^{1-\rho}\phi^{\rho}n(\phi)^{\rho-1} - w}{r+\delta} \end{cases}$$

which leads to equation (8).

Equation (9) is the steady state formulation of (5).

Finally, (10) is obtained by substituting (8) and the production function into (7). ■

A.1.2 Lemma 6: Value of a firm.

Before understanding how operate firm entry into the industry, it is necessary to analyze steady-state profits. Thus the following Lemma:

LEMMA 6. *In steady state, the value of a firm with productivity parameter ϕ is:*

$$V(\phi) = \begin{cases} \frac{(1-\rho H(\theta))R(\phi) - c}{r} & \text{if } \phi \geq \phi^* \\ 0 & \text{otherwise} \end{cases} \tag{32}$$

where $R(\phi) = p(\phi)q(\phi)$ is the revenue earned by a firm with productivity ϕ and $H(\theta) = \frac{w + \frac{\delta}{h(\theta)}c_v}{w + \frac{r+\delta}{h(\theta)}c_v}$.

Proof. The value of a firm with productivity parameter ϕ is:

$$V(\phi) = \begin{cases} lim_{t\to\infty}\int_0^t e^{-ry}\pi(\phi)dy & \text{if } \phi \geq \phi^* \\ 0 & \text{otherwise} \end{cases}$$

where $\pi(\phi)$ are the steady state profits for a given firm with productivity ϕ.

This leads to:

$$V(\phi) = \begin{cases} \frac{\pi(\phi)}{r} & \text{if } \phi \geq \phi^* \\ 0 & \text{otherwise} \end{cases}$$

Steady state profits are equal to:

$$\pi(\phi) = R(\phi) - wn(\phi) - c_v v(\phi) - c$$

Since the number of vacancies has to be chosen such that hirings equate separations, the turnover cost per employee is $w + \delta \frac{c}{h(\theta)}$, which yields:

$$\pi(\phi) = R(\phi) - \left(w + \frac{\delta}{h(\theta)} c_v \right) n(\phi) - c$$

Note that $R(\phi) = p(\phi)q(\phi) = p(\phi)\phi n(\phi)$ and recall the pricing equation (10). One gets:

$$\pi(\phi) = (1 - \rho H(\theta))R(\phi) - c$$

This leads to the result. ■

A.1.3 Lemma 1: Equilibrium on the goods market.

Proof. Before making the investment to enter the industry, the expected value of a firm is:

$$\bar{V} = F(\phi^*).O + [1 - F(\phi^*)] \, E[V(\phi)|\phi \geq \phi^*] - c_e$$

In equilibrium, this expected value has to be zero, i.e. $\bar{V} = 0$: firms will enter the market until expected profits cover entry costs, which gives the free entry condition (FE-1).

To determine the zero cutoff profit condition, we need the following lemma:

$$\frac{R(\phi_1)}{R(\phi_2)} = \left(\frac{\phi_1}{\phi_2} \right)^{\sigma - 1} \tag{33}$$

which follows from (7) and (10). Indeed:

$$\frac{R(\phi_1)}{R(\phi_2)} = \frac{p(\phi_1)q(\phi_1)}{p(\phi_2)q(\phi_2)} = \frac{p(\phi_1)Qp(\phi_1)^{-\sigma}}{p(\phi_2)Qp(\phi_2)^{-\sigma}} = \frac{\left(\frac{w + (r+\delta)\frac{c_v}{h(\theta)}}{\rho\phi_1} \right)^{1-\sigma}}{\left(\frac{w + (r+\delta)\frac{c_v}{h(\theta)}}{\rho\phi_2} \right)^{1-\sigma}}$$

which leads to (33).

The zero cutoff profit condition determines when a firm exits the market once entered, i.e. when steady state profits are negative. That is:

$$\pi(\phi^*) = 0$$

From Lemma 6, we have:

$$\pi(\phi^*) = (1 - \rho H(\theta))R(\phi^*) - c = 0 \Leftrightarrow R(\phi^*) = \frac{c}{1 - \rho H(\theta)} \tag{34}$$

From (33):

$$R(\phi^e) = \left(\frac{\phi^e(\phi^*)}{\phi^*}\right)^{\sigma-1} R(\phi^*) \tag{35}$$

We substitute (34) in (35):

$$R(\phi^e) = \left(\frac{\phi^e(\phi^*)}{\phi^*}\right)^{\sigma-1} \frac{c}{1-\rho H(\theta)}$$

Finally, using Lemma 6 applied to this last expression, the zero cutoff profit condition follows.■

A.1.4 Lemma 2: Equilibrium mass of firms.

Proof. From (6) and (7), we have:

$$Q = \int_{\phi^*}^{\infty} Qp(\phi)^{1-\sigma} M\mu(\phi)d\phi$$

Then, from (10):

$$M = \left[\int_{\phi^*}^{\infty} \left(\frac{C(\theta)}{\rho\phi}\right)^{1-\sigma} \mu(\phi)d\phi\right]^{-1}$$

And from the definition of ϕ^e, we finally have:

$$M = \left(\frac{C(\theta)}{\rho\phi^e}\right)^{\sigma\rho} = p(\phi^e)^{\sigma-1}$$

■

A.1.5 Lemma 3: Equilibrium on the labor market.

Proof. At time t, with a fixed ϕ^*, the variation in unemployment is equal to:

$$\dot{u}_t = \delta(1-u) - \theta h(\theta)u$$

The first term corresponds to job separations and the second to total hirings in the economy.

Setting $\dot{u}_t = 0$ gives the Beveridge curve, i.e. the steady state level of unemployment, given labor market tightness.

The job creation curve is obtained by aggregation of equation (8):

$$1-u = \int_0^{\infty} n(\phi)M\mu(\phi)d\phi$$

$$1-u = \int_0^{\infty} \left\{\frac{\rho\phi^\rho Q^{1-\rho}}{C(\theta)}\right\}^{\sigma} M\mu(\phi)d\phi$$

with $C(\theta) = w + (r+\delta)\frac{c_v}{h(\theta)}$.

$$1-u=\left\{\frac{\rho Q^{1-\rho}}{C(\theta)}\right\}^{\sigma} M \int_0^{\infty} \phi^{\sigma-1}\mu(\phi)d\phi$$

$$1-u=\left\{\frac{\rho Q^{1-\rho}}{C(\theta)}\right\}^{\sigma} M\phi^{e\sigma-1}$$

From (8), one notices that $n(\phi^e)=\left\{\frac{\rho Q^{1-\rho}}{C(\theta)}\right\}^{\sigma}\phi^{e\sigma-1}$. Hence:

$$1-u=n(\phi^e)M$$

From this expression, we need to determine the steady state values of $n(\phi^e)$ and M. To determine $n(\phi^e)$, we use the production function:

$$n(\phi^e)=\frac{q(\phi^e)}{\phi^e}=\frac{R(\phi^e)}{\phi^e p(\phi^e)}=\frac{\pi^e+c}{C(\theta)}\frac{\rho}{1-H(\theta)\rho}$$

Finally, by use of Lemma 2, we replace the steady-state value for M and complete the proof. ■

A.1.6 Existence and Uniqueness of the Labor Market Equilibrium.

Proof. The Beveridge curve is decreasing from infinity to zero as

$$\left.\frac{d\theta}{du}\right|_{BC}=-\frac{\theta}{u(1-u)\eta(\theta)}<0 \quad , lim_{\theta\to 0}\tfrac{\delta}{\delta+\theta h(\theta)}=\infty \quad \text{and } lim_{\theta\to\infty}\frac{\delta}{\delta+\theta h(\theta)}=0$$

Rewrite the Job Creation curve as

$$u=1-AB(\theta) \quad \text{with } A=\tfrac{\pi^e+c}{\rho^{\sigma-2}\phi^{e\sigma-1}}>0 \quad \text{and } B(\theta)=\frac{C(\theta)^{\sigma-2}}{1-\rho H(\theta)}$$

Notice that for $\theta\to 0$ the Job Creation curve is below the Beveridge curve as

$$u|_{JC,\theta\to 0}=1-A\frac{w^{\sigma-2}}{1-\rho}<1$$

Thus, a sufficient condition for the labor market equilibrium to exist and to be unique requires the Job Creation curve to be increasing.

We have

$$\left.\frac{du}{d\theta}\right|_{JC}=-AB'(\theta)=-A\frac{(\sigma-2)C(\theta)^{\sigma-3}C'(\theta)[1-\rho H(\theta)]+\rho H'(\theta)C(\theta)^{\sigma-2}}{[1-\rho H(\theta)]^2}$$

Notice

$$C'(\theta)=-(r+\delta)c_v\frac{h(\theta)^2}{h'(\theta)} \quad \text{and } H'(\theta)=\frac{rwc_v\frac{h(\theta)^2}{h'(\theta)}}{C(\theta)^2}$$

Hence, after some algebra

$$B'(\theta) = \frac{C(\theta^{\sigma-4})c_v h'(\theta)}{[1-\rho H(\theta)]^2 h(\theta)^2}\left[-(\sigma-2)(r+\delta)\{1-\rho H(\theta)\}C(\theta)+\rho r w\right]$$

From above, we see that when $\sigma \leq 2$, i.e. $\rho \leq \frac{1}{2}$, $\frac{du}{d\theta}\big|_{JC} \geq 0$, implying that the equilibrium exists and is unique in this case. When $\sigma > 2$, then the Job Creation is either increasing and then decreasing or decreasing over the whole range of possible values for θ. Then, as $lim_{\theta\to\infty}\, u|_{JC} = -\infty$ when $\sigma > 2$, the number of labor market equilibria is either zero or two. ■

A.2 Open Economy

A.2.1 Inter-temporal maximization program of the firm.

Proof. The Hamiltonian $\widetilde{H}$ for the maximization program is:

$$\widetilde{H} = e^{-rt}\left\{p^d(\phi)q^d(\phi)+\gamma p^x(\phi)q^x(\phi) - w\left(n^d(\phi)+\gamma n^x(\phi)\right) - c_v\left(v^d(\phi)+\gamma v^x(\phi)\right) - c - \gamma c_x\right\}$$
$$+\Sigma_t^d\left\{h(\theta)v^d(\phi)-\delta n^d(\phi)\right\} + \Sigma_t^x\left\{h(\theta)v^x(\phi)-\delta n^x(\phi)\right\}$$

Where Σ_t^d and Σ_t^x are the so-called Lagrange multipliers evaluated at time t.

We set $\varsigma_t^d = e^{-rt}\Sigma_t^d$ and $\varsigma_t^x = \gamma e^{-rt}\Sigma_t^x$, i.e. their respective discounted value.

When plugging the production function and (7) and (**??**) into the above expression, we have:

$$\widetilde{H} = e^{-rt}\{Q^{1-\rho}\phi^\rho n^d(\phi)^\rho + Q^{1-\rho}\left(\frac{\phi}{\tau}\right)^\rho n^x(\phi)^\rho - w\left(n^d(\phi)+\gamma n^x(\phi)\right) - c_v\left(v^d(\phi)+\gamma v^x(\phi)\right)$$
$$-c-\gamma c_x\} + \Sigma_t^d\left\{h(\theta)v^d(\phi)-\delta n^d(\phi)\right\} + \Sigma_t^x\left\{h(\theta)v^x(\phi)-\delta n^x(\phi)\right\}$$

The first order conditions are:

$$\begin{cases} -c_v e^{-rt} + \Sigma_t^d h(\theta) = 0 \\ -\gamma c_v e^{-rt} + \Sigma_t^x h(\theta) = 0 \\ e^{-rt}\left\{\rho Q^{1-\rho}\phi^\rho n^d(\phi)^{\rho-1} - w\right\} - \delta\Sigma_t^d = -\dot{\Sigma}_t^d \\ \gamma e^{-rt}\left\{\rho Q^{1-\rho}\phi^\rho \tau^{-\rho} n^x(\phi)^{\rho-1} - w\right\} - \delta\Sigma_t^x = -\dot{\Sigma}_t^x \end{cases}$$

Given $\dot{\Sigma}_t^i = -re^{-rt}\varsigma_t^i + e^{-rt}\dot{\varsigma}_t^i$, $\forall i \in \{d,x\}$ and setting $\dot{\varsigma}_t^d = 0$ and $\dot{\varsigma}_t^x = 0$, we then get in steady state:

$$\begin{cases} \varsigma_t^i = \frac{c_v}{h(\theta)}, \forall i \in \{d,x\} \\ \varsigma_t^d = \frac{\rho Q^{1-\rho}\phi^\rho n^d(\phi)^{\rho-1} - w}{r+\delta} \\ \varsigma_t^x = \frac{\rho Q^{1-\rho}\phi^\rho \tau^{-\rho} n^x(\phi)^{\rho-1} - w}{r+\delta} \end{cases}$$

which leads to equations (16) and (17).

Equation (18) is the steady state formulation of the law of motion that drives firm-level employment.

Finally, (19) and (20) are obtained by substituting (16), (17) and the production function into (7). ■

A.2.2 Lemma 7: Value of a firm.

In the open economy framework, the counterpart of Lemma 6 is:

LEMMA 7. *In steady state, the value of a firm with productivity parameter ϕ is:*

$$V(\phi) = \begin{cases} \frac{(1-\rho H(\theta))[\gamma R^x(\phi)+R^d(\phi)]-c-\gamma c_x}{r} & \text{if } \phi_x^* \leq \phi \\ \frac{(1-\rho H(\theta))R^d(\phi)-c}{r} & \text{if } \phi^* \leq \phi < \phi_x^* \\ 0 & \text{otherwise} \end{cases} \tag{36}$$

where $R^i(\phi) = p^i(\phi)q^i(\phi)$, $i = d, x$, is the revenue earned from each specific market by a firm with productivity ϕ.

Proof. The result follows directly from the proof of Lemma 6. ■

This allows us to determine the relation (22) linking ϕ^* and ϕ_x^*:

Proof. Let us denote by $\pi^d(\phi)$ and $\pi^x(\phi)$ the amount of profits a firm with productivity ϕ earns from domestic and export sales respectively.

By definition of ϕ^* and ϕ_x^*: $\pi^d(\phi^*) = 0$ and $\pi^x(\phi_x^*) = 0$.

From Lemma 7 and the fact that $R^x(\phi) = \tau^{1-\sigma}R^d(\phi^*)$, this yields:

$$\frac{R^x(\phi_x^*)}{R^d(\phi^*)} = \tau^{1-\sigma}\left(\frac{\phi_x^*}{\phi^*}\right)^{\sigma-1} = \frac{c_x}{c} \tag{37}$$

which leads to the result. ■

A.2.3 Goods Market Equilibrium.

Proof. The free entry condition is obtained in the same way as the one used for the proof of Lemma 1.

To determine the zero cutoff profit condition in the open economy benchmark, we use the following two definitions:

$$\pi^d(\phi^*) = 0 \quad \Leftrightarrow \quad \pi^d(\phi^e) = c\left\{\left(\frac{\phi^e(\phi^*)}{\phi^*}\right)^{\sigma-1} - 1\right\}$$
$$\pi^x(\phi_x^*) = 0 \quad \Leftrightarrow \quad \pi^x(\phi_e^*) = c_x\left\{\left(\frac{\phi_x^e(\phi_x^*)}{\phi_x^*}\right)^{\sigma-1} - 1\right\}$$

Given (22) and the definition of π^e in the open economy framework,

$$\pi^e = \pi^d(\phi^e) + \frac{1-F(\phi_x^*)}{1-F(\phi^*)}\gamma\pi^x(\phi_x^e),$$

the result follows. ■

A.2.4 Equilibrium Mass of Firms.

Proof. From (15) and (7), we have:

$$Q = \int_{\phi^*}^{\infty} Qp^d(\phi)^{1-\sigma} M\mu(\phi)d\phi + \gamma \int_{\phi^*}^{\infty} Qp^x(\phi)^{1-\sigma} M_x\mu(\phi)d\phi$$

Then, from (19):

$$M = \left[\int_{\phi^*}^{\infty} \left(\frac{C(\theta)}{\rho\phi} \right)^{1-\sigma} \mu(\phi)d\phi \ + \gamma\tau^{1-\sigma} \frac{1 - F(\phi_x^*)}{1 - F(\phi^*)} \int_{\phi_x^*}^{\infty} \left(\frac{C(\theta)}{\rho\phi} \right)^{1-\sigma} \mu(\phi)d\phi \right]^{-1}$$

And from the definitions of ϕ_T^e and M_T, we finally have:

$$M_T = \left(\frac{C(\theta)}{\rho\phi_T^e} \right)^{\sigma-1} = p^d(\phi_T^e)^{\sigma-1}$$

■

A.2.5 Lemma 4: Labor Market Equilibrium.

Proof. The Beveridge curve is derived as in the closed economy framework.

For the job creation curve to be derived, one needs to aggregate equations (16) and (17)

$$1 - u = \int_{\phi^*}^{\infty} n^d(\phi)M\mu(\phi)d\phi + \gamma \int_{\phi_x^*}^{\infty} n^x(\phi)M_x\mu_x(\phi)d\phi$$

$$1 - u = \int_{\phi^*}^{\infty} \left(\frac{\rho\phi^\rho Q^{\frac{1}{\sigma}}}{C(\theta)} \right)^{\sigma} M\mu(\phi)d\phi + \gamma \int_{\phi_x^*}^{\infty} \left(\frac{\rho\phi^\rho\tau^{-\rho} Q^{\frac{1}{\sigma}}}{C(\theta)} \right)^{\sigma} M_x\mu_x(\phi)d\phi$$

$$1 - u = \frac{\rho^\sigma QM}{C(\theta)^\sigma} \int_{\phi^*}^{\infty} \phi^{\sigma-1}\mu(\phi)d\phi + \frac{\rho^\sigma Q\gamma\tau^{1-\sigma}M_x}{C(\theta)^\sigma} \int_{\phi_x^*}^{\infty} \phi^{\sigma-1}\mu_x(\phi)d\phi$$

$$1 - u = \frac{\rho^\sigma QM}{C(\theta)^\sigma} \phi_d^{e\,\sigma-1} + \frac{\rho^\sigma Q\tau^{1-\sigma}\gamma M_x}{C(\theta)^\sigma} \phi_x^{e\,\sigma-1}$$

which leads to (JC-2).

Then, the steady state values of $n^d(\phi_d^e)$ and $n^x(\phi_x^e)$ are determined through the production function and the results from Lemma 7:

$$n^d(\phi_d^e) = \frac{q(\phi_d^e)}{\phi_d^e} = \frac{R(\phi_d^e)}{\phi^e p(\phi_d^e)} = \frac{\pi_d^e + c}{C(\theta)} \frac{\rho}{1 - \rho H(\theta)}$$

$$n^x(\phi_x^e) = \frac{q(\phi_x^e)}{\phi_x^e} = \frac{R(\phi_x^e)}{\phi_x^e p(\phi_x^e)} = \frac{\pi_x^e + c_x}{C(\theta)} \frac{\rho}{1 - \rho H(\theta)}$$

Substituting those values into (JC-2) and using the definition of π^e and the steady state value for M gives rise to the result. ■

A.3 Trade Impact

A.3.1 Job Creation Equation.

Proof. By use of its definition, one can rewrite ϕ_T^e as:

$$\phi_T^{e\,\sigma\rho} = \frac{[1-F(\phi^*)]\phi_d^e + \gamma\tau^{1-\sigma}[1-F(\phi_x^*)]\phi_x^e}{1-F(\phi^*)+\gamma[1-F(\phi_x^*)]}$$

When replacing this value into (JC), one gets:

$$u = 1 - \frac{C(\theta)^{\sigma-2}}{[1-\rho H(\theta)]\rho^{\sigma-2}} \frac{[1-F(\phi^*)](\pi^e + c) + \gamma[1-F(\phi_x^*)]c_x}{[1-F(\phi^*)]\phi_d^e + \gamma\tau^{1-\sigma}[1-F(\phi_x^*)]\phi_x^e}$$

Finally, by replacing π^e by its value in (ZCP), we get the above formulation. ■

A.3.2 Proposition 2: Unemployment

Proof. The derivative of steady state unemployment with respect to the number of trade partners is:

$$\begin{aligned}\frac{du}{d\gamma} = -A(\theta)c\Bigg\{&[1-F(\phi^*)]^2\phi^{e\sigma-1}\frac{d(\frac{\phi^e}{\phi^*})^{\sigma-1}}{d\gamma} + [1-F(\phi_x^*)]^2(\frac{\phi_x^e}{\phi^*})^{\sigma-1}\frac{d\phi_x^{e\,\sigma-1}}{d\gamma}\\
&+\gamma[1-F(\phi^*)][1-F(\phi_x^*)]\tau^{1-\sigma}\left(\phi_x^{e\,\sigma-1}\frac{d(\frac{\phi^e}{\phi^*})^{\sigma-1}}{d\gamma} + \phi^{e\sigma-1}\frac{d(\frac{\phi_x^e}{\phi^*})^{\sigma-1}}{d\gamma}\right)\\
&-\gamma\tau^{1-\sigma}(\sigma-1)[1-F(\phi^*)][1-F(\phi_x^*)]\left(\phi^{e\sigma-2}(\frac{\phi_x^e}{\phi^*})^{\sigma-1}\frac{d\phi^e}{d\gamma} + \phi_x^{e\,\sigma-2}(\frac{\phi^e}{\phi^*})^{\sigma-1}\frac{d\phi_x^e}{d\gamma}\right)\\
&+\gamma^2[1-F(\phi_x^*)]^2\tau^{2(1-\sigma)}\left(\phi_x^{e\,\sigma-1}\frac{d(\frac{\phi_x^e}{\phi^*})^{\sigma-1}}{d\gamma} - (\frac{\phi_x^e}{\phi^*})^{\sigma-1}\frac{d\phi_x^{e\,\sigma-1}}{d\gamma}\right)\Bigg\}\end{aligned}$$

with $A(\theta) > 0$.

Since $\frac{d\phi_d^e}{d\gamma} > 0$, $\frac{d\phi_x^e}{d\gamma} > 0$, $\frac{d(\frac{\phi_d^e}{\phi^*})^{\sigma-1}}{d\gamma} < 0$ and $\frac{d(\frac{\phi_x^e}{\phi_x^*})^{\sigma-1}}{d\gamma} < 0$ we have $\frac{du}{d\gamma} > 0$.

The derivative of steady state unemployment with respect to variable trade cost is:

$$\begin{aligned}\frac{du}{d\tau} = -B(\theta)c\Bigg\{&[1-F(\phi^*)]^2\phi^{e\sigma-1}\frac{d(\frac{\phi^e}{\phi^*})^{\sigma-1}}{d\tau} + \gamma^2[1-F(\phi_x^*)]^2\tau^{2(1-\sigma)}\phi_x^{e\,\sigma-1}\frac{d(\frac{\phi_x^e}{\phi^*})^{\sigma-1}}{d\tau}\\
&+\gamma[1-F(\phi^*)][1-F(\phi_x^*)]\tau^{1-\sigma}\left(\phi_x^{e\,\sigma-1}\frac{d(\frac{\phi^e}{\phi^*})^{\sigma-1}}{d\tau} + \phi^{e\sigma-1}\frac{d(\frac{\phi_x^e}{\phi^*})^{\sigma-1}}{d\tau}\right)\\
&-\gamma\tau^{1-\sigma}(\sigma-1)[1-F(\phi^*)][1-F(\phi_x^*)]\left(\phi^{e\sigma-2}(\frac{\phi_x^e}{\phi^*})^{\sigma-1}\frac{d\phi^e}{d\tau} + \phi_x^{e\,\sigma-2}(\frac{\phi^e}{\phi^*})^{\sigma-1}\frac{d\phi_x^e}{d\tau}\right)\\
&+\gamma^2[1-F(\phi_x^*)]^2\tau^{2(1-\sigma)}\left(\phi_x^{e\,\sigma-1}\frac{d(\frac{\phi_x^e}{\phi^*})^{\sigma-1}}{d\tau} - (\frac{\phi_x^e}{\phi^*})^{\sigma-1}\frac{d\phi_x^{e\,\sigma-1}}{d\tau}\right)\Bigg\}\end{aligned}$$

with $B(\theta) > 0$.

Since $\frac{d\phi_d^e}{d\tau} < 0$, $\frac{d\phi_x^e}{d\tau} < 0$, $\frac{d(\frac{\phi_d^e}{\phi^*})^{\sigma-1}}{d\tau} > 0$ and $\frac{d(\frac{\phi_x^e}{\phi_x^*})^{\sigma-1}}{d\tau} > 0$ we have $\frac{du}{d\tau} < 0$.

The derivative of steady state unemployment with respect to fixed trade cost is:

$$\frac{du}{dc_x} = -D(\theta)c\Bigg\{[1-F(\phi^*)]^2\phi^{e\sigma-1}\frac{d(\frac{\phi^e}{\phi^*})^{\sigma-1}}{dc_x} - [1-F(\phi_x^*)]^2(\frac{\phi^e}{\phi^*})^{\sigma-1}\frac{d\phi_d^{e\sigma-1}}{dc_x}$$
$$+\gamma[1-F(\phi^*)][1-F(\phi_x^*)]\tau^{1-\sigma}\left(\phi_x^{e\sigma-1}\frac{d(\frac{\phi^e}{\phi^*})^{\sigma-1}}{dc_x} + \phi^{e\sigma-1}\frac{d(\frac{\phi_x^e}{\phi^*})^{\sigma-1}}{dc_x}\right)$$
$$-\gamma\tau^{1-\sigma}(\sigma-1)[1-F(\phi^*)][1-F(\phi_x^*)]\left(\phi^{e\sigma-2}(\frac{\phi_x^e}{\phi^*})^{\sigma-1}\frac{d\phi^e}{dc_x} + \phi_x^{e\sigma-2}(\frac{\phi^e}{\phi^*})^{\sigma-1}\frac{d\phi_x^e}{dc_x}\right)$$
$$+\gamma^2[1-F(\phi_x^*)]^2\tau^{2(1-\sigma)}\left(\phi_x^{e\sigma-1}\frac{d(\frac{\phi_x^e}{\phi^*})^{\sigma-1}}{dc_x} - (\frac{\phi_x^e}{\phi^*})^{\sigma-1}\frac{d\phi_x^{e\sigma-1}}{dc_x}\right)\Bigg\}$$

with $D(\theta) > 0$.

Since $\frac{d\phi_d^e}{dc_x} < 0$, $\frac{d\phi_x^e}{dc_x} < 0$, $\frac{d(\frac{\phi_d^e}{\phi^*})^{\sigma-1}}{dc_x} > 0$ and $\frac{d(\frac{\phi_x^e}{\phi_x^*})^{\sigma-1}}{dc_x} > 0$ we have $\frac{du}{dc_x} < 0$. ■
From the above, the results from Proposition 4 directly follow.

A.3.3 Aggregate Consumption Good

The amount of consumption good produced is equal to

$$Q = M_T^{\frac{1}{\rho}}q(\phi_T^e)$$
$$Q = p^d(\phi_T^e)^\sigma q(\phi_T^e)$$
$$Q = p^d(\phi_T^e)^\sigma n(\phi_T^e)\phi_T^e$$
$$Q = p^d(\phi_T^e)^\sigma \frac{\rho\phi_T^{e\,\rho}Q^{\frac{1}{\rho}}}{C(\theta)}\phi_T^e$$
$$Q = p^d(\phi_T^e)^{\sigma-1}\phi_T^{e\,\rho}Q^{\frac{1}{\rho}}$$
$$Q = \left(\frac{C(\theta)}{\rho}\right)^{-(\sigma-1)^2}\phi_T^{e\,\sigma\rho^3}$$

Since more trade exposure reduces θ and increases ϕ_T^e, then $\frac{dQ}{d\gamma} > 0$, $\frac{dQ}{dc_x} < 0$ and $\frac{dQ}{d\tau} < 0$.

Second, since M_T decreases, $cM + \gamma c_x M_x$ has to decrease, and as employment drops, $c_v v$ has to decrease as well from (18). Hence, following trade liberalization, aggregate welfare increases.

A.3.4 Wages

Remember from Lemma 5 that wages take a unique value. This implies that $\forall\phi > \phi^*$:

$$w(\phi) = \beta\theta c_v + \beta\rho Q^{1-\rho}n^d(\phi_T^e)^{\rho-1}\phi_T^{e\,\rho}$$

Replacing Q gives:

$$w(\phi) = \beta\theta c_v + \beta\rho p^d(\phi_T^e)n^d(\phi_T^e)^{1-\rho}\phi_T^{e\,1-\rho}n^d(\phi_T^e)^{\rho-1}\phi_T^{e\,\rho}$$

which can be simplified:

$$w(\phi) = \beta\theta c_v + \beta\rho p^d(\phi_T^e)\phi_T^e$$

and gives:

$$w(\phi) = \frac{\beta^3 - \beta^2 + \beta}{(1-\beta)^2}\theta c_v + \frac{\beta}{1-\beta}(r+\delta)\frac{c_v}{h(\theta)}$$

As trade liberalization decrease labor market tightness, it also reduce wages.

B Graphs and Remarks about the Data

Figure 5: US Aggregate Job Creation and Destruction Rates, 1972-1986, quarterly data. Source: Bureau of Census

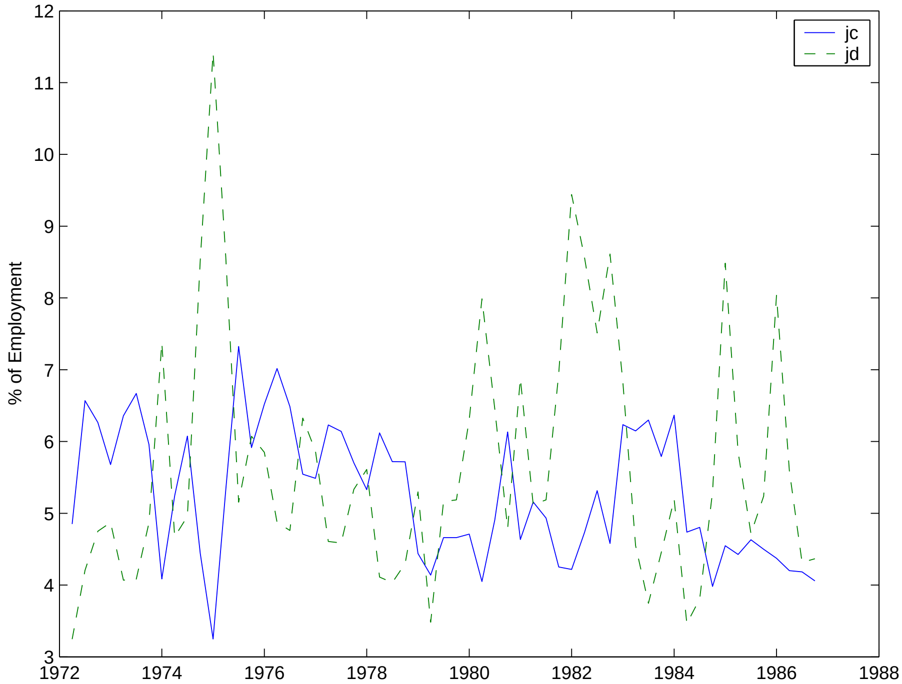


Figure 6: US Aggregate Export and Import Shares, 1972-1986, quarterly data. Source: OECD Main Economic Indicators.

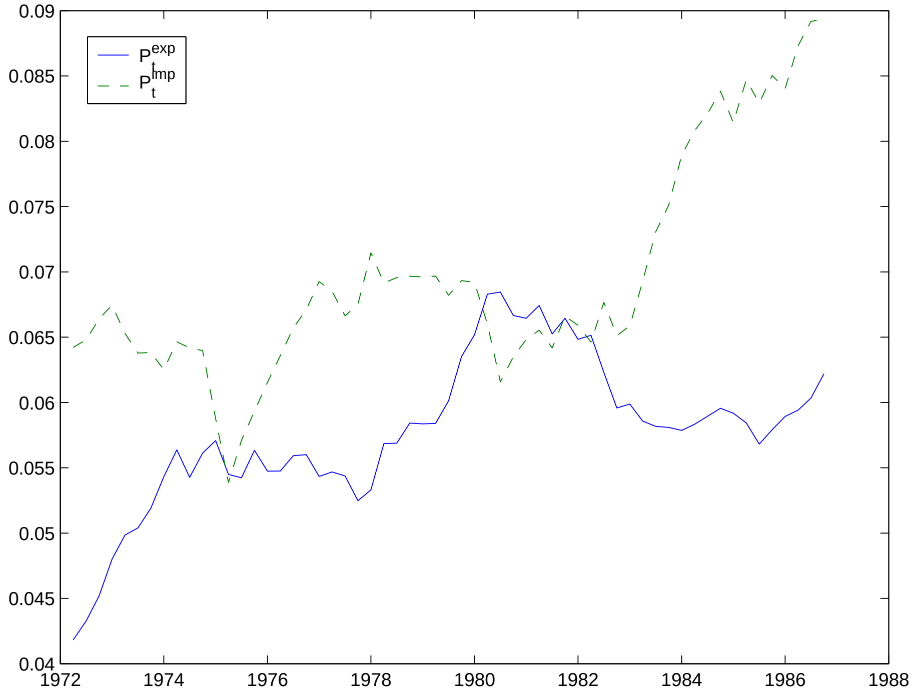


Figure 7: US Net Employment and Trade Exposure Ratio Changes, 1972-1986, quarterly data, standardized aggregate variables. Source: Bureau of Census and OECD Main Economic Indicators.

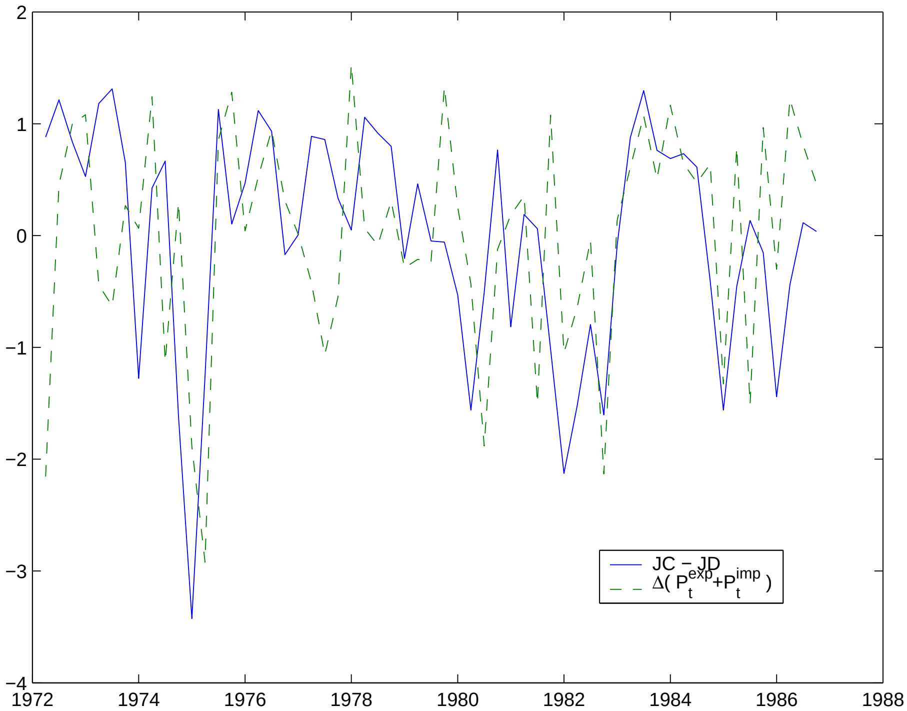


Table 6: *Missing Sectors in the Data*

Missing Trade Exposure Ratios	
SIC Codes	**Label**
2024	ICE CREAM AND FROZEN DESSERTS
2075	SOYBEAN OIL MILLS
2079	SHORTENING AND COOKING OILS
2092	FRESH OR FROZEN PACKAGED FISH
2097	MANUFACTURED ICE
2141	TOBACCO STEMMING AND REDRYING
2259	KNITTING MILLS, NEC
2269	FINISHING PLANTS, NEC
2517	WOOD TV AND RADIO CABINETS
2732	BOOK PRINTING
2789	BOOKBINDING AND RELATED WORK
2791	TYPESETTING
3273	READY-MIXED CONCRETE
3398	METAL HEAT TREATING
3451	SCREW MACHINE PRODUCTS
3471	PLATING AND POLISHING
3479	METAL COATING AND ALLIED SERVICES
3498	FABRICATED PIPE AND FITTINGS
3731	SHIP BUILDING AND REPAIRING
3761	GUIDED MISSILES AND SPACE VEHICLES
3953	MARKING DEVICES
3995	BURIAL CASKETS
Missing Job Creation Rates	
SIC Codes	**Label**
2076	VEGETABLE OIL MILLS, NEC
2271	WOVEN CARPETS AND RUGS
2351	MILLINERY
2823	CELLULOSIC MAN-MADE FIBERS
3263	FINE EARTHENWARE FOOD UTENSILS
3333	PRIMARY ZINC
Missing Job Destruction Rates	
SIC Codes	**Label**
3031	RECLAIMED RUBBER