The rise of the *maquiladoras*: Labor market consequences of offshoring in developing countries*

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Abstract

Conventional wisdom has it that the Mexican *maquiladora* program attracted much needed foreign capital and increased overall employment by offering new job opportunities especially for low-skilled workers and has thus increased overall welfare in Mexico. We present a simple heterogeneous firm model which captures the salient features of the Mexican economy. Specifically, we model the significant differences between manufacturing and *maquila* plants, their heavy reliance on intermediate inputs and unskilled labor, as well as the predominance of foreign ownership and the existence of an informal labor market for low-skilled workers. We calibrate the model to fit key stylized facts of the Mexican economy. In our simulations, we show that *maquila*-promoting policies like a reduction of exporting fixed costs for foreign firms lead to negative welfare effects. We also find that Mexican welfare is higher in the presence of an informal sector.

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1 Introduction

Beginning in the mid-1980s, all over Latin America governments began shying away from import-substitution as an industrialization policy and in turn tried to attract foreign direct investment and moved to export promoting policies for their manufacturing industries. One of the front runners of this policy change was Mexico. Beginning in 1984, it began reducing restrictions on foreign direct investment and, by the end of 1993, basically lifted all restrictions on foreign direct investment.[1] The creation of the North American Free Trade Agreement (NAFTA) in 1994 further strengthened this trend by a spectacular expansion of predominantly US-owned input-processing plants known as *maquiladoras* or *maquilas* which took advantage of low labor costs and low transportation costs to sell in the US market. From 1980 to 1998, more than 60% of all FDI flows into Mexico came from the US, see Graham and Wada (2000). In the same line, Waldkirch (2010) reports that investment in *maquilas* as percentage of total inbound FDI flows has risen from 8% in 1994 to 20% in 2005. Policy makers stressed the importance of the *maquila* sector for increasing exports, creating job opportunities for Mexican workers and ultimately promote growth and an increase in welfare. Further jobs were expected as *maquilas* would ultimately use inputs not only from US-suppliers but also from domestic manufacturing firms. This export-oriented growth model was also seen as a way for Mexico to get access to foreign currency, thus allowing imports of foreign consumer and capital goods. Finally, hopes were high that the increase in labor demand brought about by the influx of foreign capital would reduce the size of informal sector employment which represents a substantial fraction of the labor force in most Latin American countries, e.g. about 30% in Mexico.[2] Informal sector jobs are mainly characterized by low productivity and hence low wages, lack access to social security systems like e.g. the pension system and are less stable than formal sector employment. *Maquilas* were thus seen as a golden bullet to increase the overall productivity of the Mexican economy by replacing "bad" informal sector jobs by "good" formal sector jobs in the *maquila* sector driven by its export-led growth, see e.g. Martin (2000).

However, informal sector employment remained high. Irrespective of different definitions of informality, the hoped for general decline in informal jobs did not materialize in Mexico.

Understanding the determinants of informal sector employment, its link to foreign direct investment and the *maquila* phenomenon and its larger welfare implications are of major interest for policy makers in Mexico but also in other

[1] See **?** for an account of the Mexican *apertura*, i.e. its opening up to trade and foreign investments.

[2] For a survey on levels of informality throughout Latin America, see Gasparini and Tornarolli (2009).

developing and emerging economies in Latin America and beyond.[3] However, empirical studies evaluating the impact of the rise of the *maquila* sector are scarce. The few existing studies offer mixed results at best. Whereas Graham and Wada (2000) stress positive effects on wages, they also note that inequality between high-skilled and low-skilled workers may have increased due to trade liberalization and the increased importance of *maquila* production. Waldkirch, Nunnenkamp, and Bremont (2009) find only modest positive employment effects of FDI inflows in non-*maquila* manufacturing sectors for blue-collar workers but none for white-collar workers. Paus and Gallagher (2008) stress the fact that most of the potential of FDI could not translate into overall positive effects for Mexican employment as MNEs procured the necessary inputs from US and other international suppliers whereas input producers from the domestic manufacturing sector where forced out of business by increasing competition from abroad.

One reason for the mixed conclusions about the *maquila*-employment nexus is that most studies either focus on informal or formal sector employment or the expansion of foreign direct investment separately. The *maquila* phenomenon is mostly viewed in terms of the invested foreign capital in Mexico without taking into account its broader implications for Mexican imports and exports. To the best of our knowledge, the implications of *maquilas* for informal sector employment have not been investigated so far. Hence most studies are oblivious to the linkages between increased foreign activity, trade and the informal sector.

To evaluate these complex interrelations, a unifying theoretical framework is needed. So far, theoretical models of the informal sector tend to neglect the impact of the export-oriented policies implemented throughout Latin America.

This paper advances the literature by presenting a calibrated model which is specifically designed to capture the salient features Mexican economy like foreign ownership of low-skilled labor intensive *maquila* plants and the profit repatriation which is linked to it, the heavy reliance on US intermediates as well as US export markets and, most crucially, the presence of an informal sector. Our model allows to evaluate the welfare implications of an increase of the *maquila* sector. Our simulations indicate that a rise of the *maquila* sector may actually be detrimental to Mexican welfare, even though the informal sector may decrease. Counterfactually shutting down the informal sector, we find that welfare is lower than in the economy with the possibility of informal employment. The intuition for this result is that taking away the possibility for workers to work in the informal sector hurts their bargaining power. As workers cannot opt out from working in the formal sector, wages in the formal part of the economy will be lower. If workers can use informality as a threat in their wage bargaining process, less profits will get siphoned off to foreign owners and hence more income is retained in the home country for domestic consumption. This directly increases welfare.

[3]For a comparative world-wide survey of informality, see Jütting and de Laiglesia (2009).

To the best of our knowledge, this mechanism has not been discussed in the literature so far. This paper is the first in presenting a unified treatment of the *maquila* phenomenon and informality using a heterogeneous firm model in the vein of Melitz (2003). In a well-intentioned effort to focus on the implications of informal labor markets, most of the literature has modeled the production side of the economy as populated by homogeneous firms which operate on perfectly competitive markets. However, empirical studies using firm-level data have highlighted the vast differences which exist across firms in terms of productivity, see e.g. Bernard and Jensen (1999) and Bernard and Jensen (2004). Furthermore, resource reallocations induced by trade liberalization and *maquila* promoting policies occur not only across sectors as stressed by standard homogeneous firm trade models of the Heckscher-Ohlin type but also within industries from less productive firms to more productive ones, see Pavcnik (2002). Crucially, firm-level adjustment processes work through the labor market and hence are important determinants for evaluating the labor market implications of the rise of the *maquila* sector. Standard homogeneous firm models are also intimately linked to perfect competition and hence the absence of firm profits. In heterogeneous firm models, fixed costs of entering export markets naturally give rise to operating profits. Therefore, foreign ownership of *maquila* plants can be cast quite naturally as profit repatriation. Finally, heterogeneous firm models allow a wider evaluation of policy instruments like *maquila* promoting policies and reduction of red tape for foreign investment which are absent from standard trade models. We then rely on an amalgam of the models of Bernard, Redding, and Schott (2007) and Felbermayr, Prat, and Schmerer (2010) to include the informal sector in a search and matching framework into a heterogeneous firm model of international trade.

Informal sector jobs can be evaluated from two viewpoints: On the one side, they can be considered unequivocally to be "bad" jobs as workers only turn to the informal sector when they cannot find a formal sector job. In this view, informality is involuntary. On the other side, picking up a job in the informal sector can be the outcome of a rational choice when a formal sector job is not attractive enough. In this view, workers choose to become informal. Intuitively, one's evaluation of the impact of the rise of *maquilas* on informal sector employment and on general welfare will depend on one's view on informality. Our model will capture this Janus-faced nature of informality: Informal sector workers will earn lower wages than those in the formal sector but closing down the informal sector actually reduces welfare in Mexico and specifically hurts low-skilled workers.
The remainder of the paper is structured as follows: Section 2 reviews the literature, section 3 presents key stylized facts of the Mexican informal sector and the *maquila* industry. Section 4 presents our theoretical model. Comparative statics from model simulations are presented in section 5. Section 6 shows results from policy experiments under varying different assumptions on preferences and the

production structure to check the robustness of our results. Finally, section 8 concludes.

2 Literature review

There exists a body of theroretical literature which analyzes the conditions for detrimental effects of foreign direct investment, dating back in spirit at least to Bhagwhati's (1958) case of immiserizing growth for a small open economy in a perfectly competitive framework with no frictions on the labor market. Growth is assumed to happen exogenously by moving out the production possibility frontier.

Chandra and Khan (1993) analyze the welfare effects of foreign direct investment in a Harris and Todaro (1970) type economy. Workers have the choice between employment in the rural sector or in the urban center. There, they can either be employed in the formal or informal sector. Chandra and Khan (1993) endogenize the size of the informal sector using a variant of the Heckscher-Ohlin model where the output produced in the informal sector is internationally traded. They demonstrate that an influx of capital can be immiserizing for a small open economy in the presence of an informal sector. In their model, however, no explanation is offered as to why wages should not be equalized in the formal and informal sector by underbidding in the absence of any labor market rigidities as the informal sector is in essence just a label attributed to an otherwise standard sector.

Marjit, Ghosh, and Biswas (2007) present a theoretical model of homogeneous firms employing both formal and informal workers where firms have the possibility to bribe government officials to get away with employing informal workers. In this setup, trade liberalization leads to an increase in informality. The mechanisms in their model are complementary to ours as we abstract from the public sector.

Satchi and Temple (2009) present a calibrated model of the Mexican economy with search and matching frictions in the urban labor market where workers have the possibility of self-employment in the informal sector. However, the model does not include a foreign-owned *maquila* sector and no self-selection of more productive firms into exporting as our model does.

Ulyssea (2010) presents a model where an intermediate good can be used in the production of a final consumption good that can either be produced in the formal or informal sector. Homogeneous firms face vacancy costs to post both formal and informal jobs, where the latter jobs are less costly. The model completely abstracts from trade and hence the *maquila* sector is not accounted for.

A recent strand of the trade literature has incorporated labor market rigidities in heterogeneous trade models, see e.g. Helpman and Itskhoki (2010), Felbermayr

et al. (2010), Egger and Kreickemeier (2009) and Larch and Lechthaler (2009). Helpman and Itskhoki (2010) present a two country model with two sectors, a differentiated heterogeneous firm sector and a homogeneous firm sector and labor market frictions modeled in a search and matching framework. Felbermayr et al. (2010) analyse the implications of search and matching frictions in a single sector model of heterogeneous firms. Egger and Kreickemeier (2009) use fair wages to generate unemployment in a single sector Melitz-type model. Larch and Lechthaler (2009) analyse search and matching in a multi-sector model without an homogenous goods outside sector. However, all of these papers do not consider the specific structure of the *maquila* phenomenon with its heavy reliance on imported intermediate inputs and foreign ownership. Furthermore, none of the papers compares welfare differences when labor market rigidities are abolished.

Hence, our paper is the first to address the linkages between the informal sector and the export-processing plants phenomenon in a single theoretical framework, complementing the recent literature concerned with the impact of globalization on domestic labor markets.

A unifying theme in the theoretical literature is its non-uniform modeling of the informal sector. Similarly, in the empirical literature, different definitions of informality are used. This reflects at least partly the division over how to evaluate informality from a welfare standpoint. In the vein of Harris and Todaro (1970), the informal sector is a residual part of the economy where workers subsist on low wages, absence of social security benefits and general dire conditions while they are queing for "good" formal sector jobs. This involuntary view on informality argues that above-market clearing wages, too strict labor regulation and red tape force workers into informal work. In this view, the bigger the informal sector, the lower the general welfare of the society. The general thrust of this literature is therefore that reducing the informal sector is necessarily welfare-improving, and measures like extending social security benefits to informal workers will alleviate the poor conditions in which these workers live. Contrary to this view, Maloney (2004) stresses the fact that even though average wages in the informal sector are lower, very often workers voluntarily choose to become informal. Self-employment can be a utility-maximizing choice given the low productivity of formal sector jobs, the preference for being one's own boss instead of being a salaried factory worker, and the poor quality of the social security system. Especially entrepreneurial-minded workers may shun away from paying welfare contributions if they have the perception that future governments will default on future pension payments and will therefore tend to invest their assets themselves. The consequences of this view for policy recommendations are starkly different. If e.g. informal sector workers may gain access to the public health system, this works as a de facto subsidy for informal work and will induce even more workers to move into the informal sector, as the relative benefits of

picking up a formal sector job have decreased. These conflicting views on informality hint at the core question of how to model the informal sector. Modeling choice is crucial for policy conclusions to be drawn from the theoretical analysis. To the best of our knowledge, the literature on heterogeneous firms has so far neglected the question of the effects of foreign investment on the welfare effects of the host country in the presence of an informal sector and foreign ownership of plants using different views on informality. In section 4, we present a model with a search and matching framework where workers are matched with formal sector jobs. Unmatched workers gain income in the informal sector. This income directly influences the bargaining process between formal sector employers and employees where income generated in the informal sector props up wages by offering an exit option from the formal sector, stressing Maloney's view on the partly voluntary decision to become informal when formal jobs do not pay well enough.

3 Stylized facts on the Mexican economy

3.1 The rise of the *maquila* sector

The beginning of the *maquila* phenomenon dates back to the 1960ies when the *Programa de Industrialización de la Frontera Norte* (Industrialization Program for the Northern Border) was put into place to promote the creation of export-processing plants in the Northern part of Mexico. To create a *maquila* factory, US companies have to get a permission from the *Secretaría de Economía* (Secretary of Economy), see **??**. During the 1990s, *maquila* production experienced a major expansion, both in terms of output produced as well as in terms of employment. Figure 1 shows the increase of the value added in the *maquila* sector from 1990 to 2004.[4] During this period, value added has more than doubled. Accordingly, also the number of employees has increased substantially, from 450,000 to 1,115,000 persons in total. In 1990, this figure represented 1.5% of the labor force. In 2004, 3.7% of the economically active population worked at a *maquila* plant. This increase in employment figures is not due to the overall growth of the Mexican economy but reprents a genuine structural shift towards a larger reliance on export processing plants. Whereas *maquilas* were a relatively minor phenomenon at the beginning of the 1990s representing only about 6% of total manufacturing output, in 2004 more than a quarter of all manufacturing goods were produced in the export-processing sector, see figure 4. Likewise, the share of *maquila* workers

[4]More recent data are not available as the Mexican statistical office INEGI discontinued its survey of *maquila* plants, *Estadística de la Industria Maquiladora de exportación* (EIM) in 2006. Since 2007, *maquila* plants are incorporated in the survey *Industria Manufacturera, Maquiladora y de servicios de EXportación* (IMMEX), hence the data do not allow to discriminate between *maquila* and standard manufacturing plants after 2006.

as a percentage of total manufacturing employment increased from 15% in 1995 to 20% in 2004, see figure 3. At the same time, the overall contribution of the manufacturing sector to GDP remained fairly stable at around 18%, a figure literally unchanged over 26 years from 1980 onwards, see figure 5.

Another key feature of the *maquila* mode of production is that most plants are foreign owned. Hence, profits generated in the sector are moved abroad. Ramirez (2006) presents evidence that overall remittances of profits and dividends from Mexico more than doubled from 1990 to 2000 (from US$2.3 to $5.2 billion).

Finally, the relative wage of white collar workers compared to blue collar workers in Mexican *maquilas* rose during the 1990s which is commonly linked to skill-biased technological change in the presence of complementarities between skilled labor and capital, see Mollick (2008). With our model presented in section 4, we offer a distinct explanation for the rise in the skill-premium via the increase in the *maquila* sector.

3.2 Informality and the Mexican labor market

The literature on jobs in the informal sector uses heterogeneous definitions of which job characteristics constitute an informal job. This reflects partly that definitions of informality have evolved over the last decades. Earlier studies stress informality as a concept refering to a specific sector of the economy. This *productive* definition focuses on characteristics of the single establishment. Enterprises belong to the informal sector when they operate "with scarce or even no capital, using primitive technologies and unskilled labor, and then with low productivity" as in the ILO (1993) definition of the informal sector. More recently, emphasis has moved away from enterprise centered definitions towards informal employment, recognizing the fact that informal employment can arise both in formal as well as informal establishments. For example, formal businesses may subcontract informal workers to cut labor costs as a response to increasing competition.[5] This *legalistic* definition of informality[6] comprises employees and self-employed which do not have access to social security benefits like e.g. the pension system, but also workers who do not have a written work contract. As data on informality are often scarce, proxies like the share of self-employed in the labor force are also used to measure informality. Obviously, this measure includes freelancing professions like e.g. doctors which are normally not considered to be informal workers. Hence, depending on one's definition, informality can refer to very heterogeneous economic conditions.[7]

Recent studies on stylized features of the informal sector in Mexico are scarce.

[5]See Sanchez, Joo and Zappala (2001), as cited in Maloney (2004).

[6]For the terms *productive* and *legalistic* definition of informality, see Gasparini and Tornarolli (2009).

[7]For a detailed overview of informality definitions see Jütting and de Laiglesia (2009).

Martin (2000) presents evidence on trends in unemployment and informal employment rates for Mexico for the 1990s.

The hoped-for reduction in the informal sector employment rate by the increase of *maquila* activity did not materialize. As indicated by figure 7, there is no discernible trend in the informal sector employment rate, at least not for the last decade. Informal sector employment fluctuated around an average value of just below 28% of the economically active population. Gasparini and Tornarolli (2009) corroborate this finding using micro-level household data and using different definitions of informality.

Informal sector employment is mainly a phenomenon affecting unskilled workers. On average, 57% of all informal sector workers only have primary education or no formal education at all. Only 14% of informal sector employment represents individuals with an university degree, see figure 8. Finally, informal jobs tend to pay lower wages on average. As can be seen from comparing figures 9 and 10, whereas about 60% of informal sector workers earn less than three minimum wages (including those 10% who do not earn anything at all), workers in the formal private sector represent about 45% of the total in the same income bracket.

[Figure 1 about here.]

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[Figure 3 about here.]

[Figure 4 about here.]

[Figure 5 about here.]

[Figure 6 about here.]

[Figure 7 about here.]

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[Figure 10 about here.]

4 The model

In the following, we present a simple model of the Mexican economy with two sectors, a standard manufacturing sector and a *maquila* sector. Utility of Mexican consumers only depends on consumption of the standard manufacturing good.

Hence, *maquila* production is destined for exports only. Plants in the *maquila* sector are foreign owned. In model parlance, this implies that all fixed costs related to production are paid from abroad, and in turn any profits arising from production leave the country. We treat the standard manufacturing sector as completely owned domestically, in turn implying that fixed costs are paid at home as well as profits stay in the home economy. We treat Mexico as a small open economy, and think of the US as the rest of world, abstracting from all other trade partners. This is not unduly restrictive, as 80% of all Mexican exports are shipped to the US.[8] Thus, we only model Mexico explicitly and take the prices of final goods as well as of the imported intermediate goods as given. In the following, we refer to Mexico as the home economy (H) and the US as the rest of the world or the foreign economy (F). In all models, the home economy consists of two sectors, the *maquila* sector ($j = 1$) and the standard manufacturing sector ($j = 2$). Consumers at home only care about the standard manufacturing good. This implies that the *maquila* good is only produced for export purposes only. Hence,

$$U^H = C_2, \tag{4.1}$$

$$C_2 = \left((\bar{M}^H)^{-1/\sigma} \int_{\omega \in \Omega} [q_2^H(\omega)]^{\frac{\sigma-1}{\sigma}} d\omega + (\bar{M}^H)^{-1/\sigma} \int_{\omega' \in \Omega'} [q_2^F(\omega')]^{\frac{\sigma-1}{\sigma}} d\omega' \right)^{\frac{\sigma}{\sigma-1}}. \tag{4.2}$$

C_2 is a composite good from all different varieties ω from the set Ω of varieties produced in sector 2 in the home economy and varieties produced abroad ($\omega' \in \Omega'$). σ is the elasticity of substitution. We follow Blanchard and Giavazzi (2003), Felbermayr et al. (2010) and Larch and Lechthaler (2009) and normalize by $(\bar{M}_2^H)^{-1/\sigma}$ where $\bar{M}_2^H$ is the mass of varieties available in the domestic economy, including varieties supplied from domestic producers as well as imported varieties. This ensures that utility and hence the size of the informal sector does not depend on the size of the economy as the number of varieties does not increase output as in the standard Dixit-Stiglitz model.

Utility maximization of Mexican consumers implies that firms face a demand curve with constant elasticity of substitution in the domestic market:

$$q_j^H(\omega) = \frac{\alpha_j^H Y^H}{\bar{M}_j^H} (P_j^H)^{\sigma-1} p_j^H(\omega)^{-\sigma} \tag{4.3}$$

where Y^H is total income of the home economy and α_j^H is the expenditure share on sector j. $\bar{M}^H$ is the mass of varieties available in the domestic economy (i.e. $\bar{M}_j^H = M_j^H + \chi_j^F M_j^F$). Without loss of generality, we normalize $\chi_j^F M_j^F = 1$. As we assume that the home economy only consumes the goods produced in the

[8] In 1991, 79.4% of all exports were shipped to the US; in 2009, 80.5%, see INEGI (2010).

manufacturing sector, $\alpha_1^H = 0$ and $\alpha_2^H = 1$.

Foreign demand is given by

$$q_j^F(\omega) = A^F p_j^F(\omega)^{-\sigma} \tag{4.4}$$

Let us now turn to the producer side of the economy. Production in standard manufacturing uses low-skilled and high-skilled labor, L and K. In addition, to capture offshore production nature of *maquila* plants, sector 2 uses intermediate inputs I which are exclusively supplied from abroad:

$$q_1(\varphi) = \varphi K_1^{\beta_1^K} L_1^{\beta_1^L} I_1^{1-\beta_1^K-\beta_1^L} \tag{4.5}$$

$$q_2(\varphi) = \varphi K_2^{\beta_2^K} L_2^{1-\beta_2^K} \tag{4.6}$$

Firms differ in their productivity φ which can be used as a firm index as in Melitz (2003).

We assume that intermediates as well as high-skilled labor is traded on perfectly competitive markets. Hence, in equilibrium, all high-skilled workers will be employed. To the contrary, we model the existence of the informal sector by introducing search and matching type frictions in the labor market for low skilled workers as in Felbermayr et al. (2010).[9] Specifically, firms have to post a certain amount of vacancies v for low-skilled workers. This posting implies costs of c per vacancy which is paid in terms of the standard manufacturing good. In every period, only a fraction of $m(\theta)$ vacancies is actually filled with a worker. $m(\theta)$ is a function of the labor market tightness, i.e. the ratio of the total amount of vacancies to the number of informal sector workers in the economy, V/U.

Every period, a match between a formal sector employer and a low-skilled worker is destroyed with probability d due to exogenous factors. Hence, the stock of low-skilled workers at a firm evolves according to

$$L_{j,t+1}(\varphi) = (1-d)L_{j,t}(\varphi) + m(\theta)v_{j,t}(\varphi) \tag{4.7}$$

where the dependence of θ on the stock of workers at time t is understood.

Taking into account the cost of posting a vacancy c, the interest rate r, and

[9] A variant version of this model which abstracts from the specific nature of the *maquila* sector was used in Larch and Lechthaler (2009) with sectoral unemployment rates for two skill groups.

the exogenous firm death rate δ, the value of a firm can be written as:

$$J_{j,t}(\varphi) = \frac{1}{1+r}\Bigg(r_j(\varphi) - w_L L(\varphi) - w_K K(\varphi) - \tau_I w_I I - f_j P_{j,t}^H - v_{j,t} c P_{j,t}^H - \mathbf{1}(\varphi) f_{jx} P_{j,t}^H + (1-\delta) J_{j,t+1}\Bigg) \tag{4.8}$$

where $\mathbf{1}(\cdot)$ is a function which indicates whether a firm exports or not. The firm maximizes its net present value by choosing the number of vacancies given the demand conditions, its production function, and the evolution of employment. Maximization yields the following first order conditions

$$c P_{j,t}^H = m(\theta)(1-\delta)\vartheta_{L,t} \tag{4.9}$$

where $\vartheta_{L,t}$ is the shadow value of employing a low-skilled worker in $t+1$ which implies that the firm posts new vacancies as long as its marginal profit covers the additional cost of an additional vacancy. Imposing the steady state condition $J_{j,t+1}(\varphi) = J_{j,t}(\varphi)$, we can write equation (4.9) as

$$\frac{\partial R_j(\varphi)}{\partial L} = \frac{c P_{j,t}^H}{m(\theta)} \frac{s+r}{1-\delta} + w_L + \frac{\partial w_L}{\partial L} L \tag{4.10}$$

where $s = d + \delta - d\delta$ is the overall probability of job destruction when the probability of the destruction of a match is independent of the probability of firm death.

Once a successful match is established, workers bargain with their employer individually, i.e. every worker is treated as the marginal worker as in Stole and Zwiebel (1996). The result of the bargaing is given by the following surplus-splitting rule

$$(1-\mu)(E_L(\varphi) - U_L) = \mu \frac{\partial J_j(\varphi)}{\partial L_j} \tag{4.11}$$

where $E_L(\varphi)$ denotes the asset value of a low-skilled worker employed at a firm with productivity φ. U_L denotes the value of a low-skilled worker in the informal sector which depends on the income generated from informal sector work b which is a constant fraction of the going wage rate for low-skilled workers. μ is the bargaining power of workers and lies in the interval $[0; 1]$.

Following the same procedure as Felbermayr et al. (2010), we get the job-creation conditions:

$$
\begin{aligned}
w_L^H &= (1-\beta_1^H)\tilde{\varphi}_1^H p_1^H \left(\frac{K_{1d}^H}{L_{1d}^H}\right)^{\beta_1^H} \left(\frac{\sigma-1}{\sigma+\beta_1^H\mu-\mu-\beta_1^H\sigma\mu}\right) - \left(c^H \frac{s+r}{m(1-\delta)}\right) \\
w_K^H &= \left(\frac{\sigma-1}{\sigma}\right)\beta_1^H \tilde{\varphi}_1^H p_1^H \left(\frac{K_{1d}^H}{L_{1d}^H}\right)^{\beta_1^H-1}
\end{aligned} \tag{4.12}
$$

There is an unbounded number of potential entrants in every sector. These firms can enter the market after having incurred the fixed and sunk entry costs f_{je}. We assume that all manufacturing firms are domestically owned, hence f_{2e} are paid in the home economy, whereas all *maquila* plants are foreign-owned, hence their entry fixed costs are paid from abroad. After entering, firms draw a productivity φ from a Pareto distribution given by

$$
g_j(\varphi) = g(\varphi) = ak^a\varphi^{-(a+1)} \tag{4.13}
$$

which is the same across all sectors. k is the minimum value of productivity, i.e. $\varphi > k$, and $a > 0$ is a shape parameter which governs the skewness of the distribution. Productivity remains constant and can be used as a firm identifier. Hence, only firms which get a high enough productivity draw start production.

When a firm wants to export, it has to incur additional fixed costs f_{jx}, where $f_{jx} > f_j$. This fixed cost ranking implies a sorting of firms into exporting. As *maquila* plants are set up specifically to reexport their produced varieties, only firms enter the market which can profitably serve the export market. All fixed costs, i.e., per period production fixed costs, f_j^H, per period exporting fixed costs f_{jx}^H, and up-front entry fixed costs f_{1e}^H, are in terms of the final good of the respective industry. Note that this implies that not all output produced can be used for consumption.[10] Note also that this is contrary to Melitz (2003) where fixed costs are paid in terms of units of labor. This is not a viable option in our case. When plant setup costs are effectively created by labor input, the bargaining power of low-skilled workers would increase as they could prevent production from taking place altogether. Therefore, we could not resort to wage bargaining where every worker is treated as the marginal worker.[11]

The entry decision defines two cut off values for productivity. Firstly, φ_{jd}^* is the productivity where a firm breaks even with its sales on the domestic market. Per-period domestic profit of the firm which is given by

$$
\pi_d(\varphi^H) = p_j(\varphi^H)q_d(\varphi^H) - w_K K(\varphi^H) - w_L L(\varphi^H) - w_I I(\varphi^H) - f_j P_j^H - cP_j^H \frac{dL(\varphi^H)}{m(\theta)}
$$

[10] See Egger and Kreickemeier (2009) for a similar assumption.

[11] For wage bargaining when workers are complements, see e.g. Horn and Wolinsky (1988).

where profit of a domestic firm is equal to revenue at home minus factor cost payments to the two types of labor, the intermediate costs, fixed production costs f_j as well as the vacancy posting costs. The last term follows from equation (4.7) and the fact that in steady state $v = dL(\varphi)/m(\theta)$. Note at this point that profits in the manufacturing sector remain in the home economy, whereas profits from *maquila* sales are sent abroad to their foreign owners. Hence φ^*_{jd} is the productivity level where the expected net present value of per-period profits is given by

$$(1-\delta)\frac{\pi_d(\varphi^*_{jd})}{r+\delta} = w_K K(\varphi^*_{jd}) - w_L L(\varphi^*_{jd}) - w_I I(\varphi^*_{jd}) - f_j P_j^H - cP_j^H \frac{dL(\varphi^*_{jd})}{m(\theta)}.$$

Similarly, we can define an exporting cutoff productivity φ^*_{jx} which is given by zero expected profits from exporting:

$$(1-\delta)\frac{\pi_d(\varphi^*_{jx})}{r+\delta} = w_K K(\varphi^*_{jx}) - w_L L(\varphi^*_{jx}) - w_I I(\varphi^*_{jx}) - f_{jx} P_j^H - cP_j^H \frac{dL(\varphi^*_{jx})}{m(\theta)}.$$

Given this sorting into exporting, one can express the share of firms exporting in industry j by

$$\chi_j^H = \frac{1-G(\varphi^*_{jx})}{1-G(\varphi^*_{jd})} = \left(\frac{\varphi^*_{jd}}{\varphi^*_{jx}}\right)^a. \tag{4.14}$$

where G is the cumulative distribution function of the productivity distribution g. Note that by construction, $\chi_1^H = 1$ as *maquila* plants only serve the foreign market.

We follow Melitz (2003) and define the average productivity of all domestically active firms:

$$\tilde{\varphi}_j = \left(\frac{1}{1-G(\varphi^*_{jd})}\int_{\varphi^*_{jd}}^{\infty} \varphi^\sigma g(\varphi)d\varphi\right)^{1/(\sigma-1)} \tag{4.15}$$

Similarly, we define the average productivity of all exporting firms as

$$\tilde{\varphi}_{jx} = \left(\frac{1}{1-G(\varphi^*_{jx})}\int_{\varphi^*_{jx}}^{\infty} \varphi^\sigma g(\varphi)d\varphi\right)^{1/(\sigma-1)} \tag{4.16}$$

where φ^*_{jd} and φ^*_{jx} are the cut-off productivities for being active on the domestic market and on the export market respectively.

Given the optimal number of vacancies posted by firm, it chooses profit-

maximizing prices at home and abroad as

$$p_j^H(\varphi) = \frac{w_K^{\beta_j^K} w_L^{\beta_j^L} (\tau_I w_I)^{1-\beta_j^K-\beta_j^L}}{\rho\varphi} \tag{4.17}$$

$$p_j^F = \tau_j p_j^H \tag{4.18}$$

where $\rho = (\sigma - 1)/\sigma$. We follow Demidova and Rodríguez-Clare (2009) in assuming that domestic firms neither affect the expenditure level in the foreign economy nor the foreign price level.[12] Still, domestic producers of varieties set prices facing an exogenously given downward sloping demand curve in the foreign economy. Trade costs for final goods τ_j are symmetric but can differ across both sectors. τ_I are the trade costs for the intermediate good.

The price level in the manufacturing sector in the home economy is given by:

$$P_{2H}^{1-\sigma} = \frac{1}{M_2^H + \chi_2^F M_2^F} \left[\left(M_2^H p_2^H(\tilde{\varphi}_{2H}^d) \right)^{1-\sigma} + \chi_2^F M_2^F \left(\tau_2 \frac{\tilde{\varphi}_{2F}^d}{\tilde{\varphi}_{2F}^x} p_2^F(\tilde{\varphi}_{2F}^x) \right)^{1-\sigma} \right]$$

Note that this is equal to the overall price level in the domestic economy as varieties from sector 1 are not consumed.

To close the model, we need to specify the matching function as well as the labor market clearing conditions. The matching process between informal workers and formal sector employers is described by a Cobb-Douglas matching function:

$$m(\theta) = \bar{m}\theta^{-\gamma_m} \tag{4.19}$$

where $\bar{m}$ measures the overall efficiency of the labor market.

The economy is endowed with L^H low-skilled workers. In steady state, the number of low-skilled workers entering the informal sector in a given period of time, $s(1-u)L^H \partial t$, has to equal the number of newly hired workers in the formal sector of the economy, $mL^H \partial t$. This implies that the equilibrium informal sector employment share is given by

$$u^H = \frac{s}{s + \theta m}. \tag{4.20}$$

Denoting the number of workers in the formal sectors of the economy by L_f, labor market clearing can be expressed as:

$$L_f = (1 - u^H)L^H \tag{4.21}$$

$$L_{1f} = L_e - L_{2f} \tag{4.22}$$

[12] Specifically, we differ from Flam and Helpman (1987) in assuming that domestic firms do not have an impact on the overall price level in the foreign economy.

where L_{jf} gives the number of formal sector workers in sector j. The mass of firms is also pinned down by the labor market equilibirum:

$$M_1^H = \frac{L_{1e}^H}{L_{1d}^H(\tilde{\varphi}_{1d}) + \chi_1^H L_{1x}^H(\tilde{\varphi}_{1x})} \tag{4.23}$$

$$M_2^H = \frac{L_{2e}^H}{L_{2d}^H(\tilde{\varphi}_{2d}) + \chi_2^H L_{2x}^H(\tilde{\varphi}_{2x})} \tag{4.24}$$

The balance of payments is defined as:

$$\underbrace{(\tau_1 p_1^F)^{1-\sigma} R_1^F}_{\text{revenue of Mexican } \textit{maquila} \text{ exports}} + \underbrace{\left(P_2^F\right)^{\sigma-1} \tau_2^{1-\sigma} \left(\frac{\tilde{\varphi}_2^H}{B_2^H} p_2^H\right)^{1-\sigma} R_2^F \chi_2^H M_2^H}_{\text{revenue of Mexican manufacturing exports}} =$$

$$= \underbrace{\left(P_2^H\right)^{\sigma-1} \tau_2^{1-\sigma} \left(\frac{\tilde{\varphi}_2^F}{B_2^F} p_2^F\right)^{1-\sigma} \frac{R_1^H}{M_2^H + \chi_2^F M_2^F} \chi_2^F M_2^F}_{\text{Mexican manufacturing imports for consumption}}$$

$$+ \underbrace{\tau_I P_2^F I_1^H(\tilde{\varphi}_1^H) \chi_1^H M_1^H}_{\text{intermediate input imports from US}} + \underbrace{\eta P_2^F M_1^H f_{1e}^H / [(k/\phi_1^H)^a] + \chi_1^H f_{1x}^H + \eta_v c/mL_{e1}}_{\textit{maquila} \text{ profits transferred to US}}$$

where R denotes the revenue of the average domestically active firm in the respective industry and $\phi_1^S = (f_{1x}^S(\lambda_1^S)^{-a})^{1/a}(1/f_{1e}^S)^{1/a}(a/(a-\sigma)k^a)^{1/a}$ and $\lambda_1^S = 1$ by assumption. Note that a share of η of the profits in the *maquila* sector are transferred to the foreign owners of *maquila* plants. We use the overall price level in the *maquila* sector as numéraire. Finally, without loss of generality we normalize $M_2^F + \chi_2^H M_2^H = M_1^F + \chi_1^H M_1^H = 1$.

5 Calibration and policy experiments

Having set up the model, we solve it numerically to get comparative static results. In order to obtain analytical results, we would have to simplify our model considerably which would preclude any comparison with the actual Mexican experience. Numerical solutions have gained importance for the analysis of international trade models in recent years, see e.g. Anderson and van Wincoop (2003), Bernard, Eaton, Jensen, and Kortum (2004), Bernard et al. (2007), and Helpman and Itskhoki (2010).

5.1 Parameter values

We assume that the *maquila* sector is low-skilled labor intensive ($\beta_1^L = 0.3$, $\beta_1^K = 0.1$), whereas the standard manufacturing sector is high-skilled intensive ($\beta_2^K = 0.6$). We closely follow Felbermayr et al. (2010) and set the parameters of the Pareto distribution as in their paper ($k = 0.2$, $a = 3.4$). The probability of firm death is set to $\delta = 0.11$. The interest rate is set to $r = 0.04$. Following

Bernard et al. (2007), we set the elasticity of substitution $\sigma = 3.8$. In our baseline scenario, all profits may be shifted abroad ($\eta = 1$). The entry fixed costs are set equal to $f_{ie} = 0.1$ in both sectors. Per period production fixed costs are equal to $f_i = 2$ in both sectors. The ratio of entry fixed costs to exporting fixed costs is 1.93. This implies that approximately 22% of all manufacturing firms export, which is in line with Bernard et al. (2004). Trade costs of the final *maquila* good are set to $\tau_1 = 1.5$, for the final manufacturing good $\tau_2 = 1.2$, and for the intermediate good $\tau_I = 1.5$. The price for the intermediate good is set to $w_I = 1$, the relative price of the *maquila* good vs. the manufacturing good is set equal to 5. We set the informal sector income to 50% of the formal sector wage of unskilled workers. The elasticity of the matching function is set to $\gamma = 0.5$ as in Petrongolo and Pissarides (2001). The productivity of the matching function is set to $\bar{m} = 7.6$, the exogenous rate of job destruction is set to $d = 0.3$. The bargaining power of the worker is set to $\mu = 0.5$.

Further details can be found in the appendix.

We analyze the effect of different policy changes on welfare:

1. rise in the relative price of the *maquila* good
2. fall in the profit tax in the *maquila* sector
3. reduction in the fixed exporting costs in the *maquila* sector
4. reduction of *maquila*/intermediate trade costs

Note that in our model, quantities consumed are strictly lower than quantities produced as fixed costs are paid in terms of the final manufacturing good. This implies that only wage income can be used for purchase of final consumption. Hence, the appropriate welfare measure for Mexico in our model is given by

$$W = \frac{w_L L + w_K K}{P_2^H}. \tag{5.1}$$

5.2 A rise in the final *maquila* good price

Result 1. *A rise in the final* maquila *good price will decrease the informal sector and increase welfare in the home economy. Welfare will be unambiguously higher in an economy with an informal sector than in an economy where the informal sector is shut down.*

[Figure 11 about here.]

As can be seen in figure 11, an exogenous rise in the price of the final *maquila* good will decrease the informal sector and increase domestic welfare, a result in line with standard trade models. We resimulate the model without any labor market rigidities, i.e. we shut down the informal sector. All other parameter

settings remain equal. For all prices of the final *maquila* good, welfare will be higher in the economy with an informal sector. Also the gradient of the increase in welfare is higher in the economy with the informal sector. A higher price of the *maquila* good increases relative demand for low-skilled workers as the *maquila* sector is low-skilled intensive. This props up wages for low-skilled workers. What is more, low-skilled workers have to be offered a higher wage. If the wage paid in the formal sector is too low, workers will opt out of the bargaining and start a business in the informal sector. This threat of the exit option forces employers to pay more to their employees. This reduces profits. As the increase in the *maquila* sector will also increase profits transferred abroad, the threat of the exit option will leave more income in the domestic economy and directly increase welfare. When the informal sector is shut down, workers cannot use informal sector employment. In a perfectly competitive labor market, workers have no bargaining power and are simply paid as their marginal productivity implies. This implies higher profits for the foreign owned companies. Hence, workers do not profit as much from the increase in the final *maquila* good price as in the model economy with an informal sector.

5.3 A reduction in the profit tax in the *maquila* sector

to be added

5.4 A fall in exporting fixed costs in the *maquila* sector

Result 2. *A fall in the exporting fixed costs in the* maquila *sector will increase the informal sector and decrease welfare in the home economy. Welfare will be unambiguously higher in an economy with an informal sector than in an economy where the informal sector is shut down.*

The domestic government may create programs which specifically reduce the exporting fixed costs in the *maquila* sector to attract multinational enterprises. Programs may include simplified customs procedures, a general cut in red tape or efforts to reduce corruption or increase general efficiency of government agencies. As can be seen in figure 12, a reduction in exporting fixed costs in the *maquila* sector decreases welfare. Shutting down the possibility of employment in the informal sector, we again resimulate the model. Comparing both model economies with the same parameter values, again welfare is higher across all considered values of exporting fixed costs in the economy with the informal sector. A reduction in exporting fixed costs in the *maquila* sector increases the size of the *maquila* sector and increases profits for multinational enterprises operating there. As profits are going abroad, less income remains in the home economy,

overall consumption is lower and hence domestic welfare. Again the possibility of employment in the informal sector is a credible threat of low-skilled workers and therefore preps up their wage. This keeps more profits in the domestic economy and directly leaves more income for domestic consumption directly increasing domestic welfare.

[Figure 12 about here.]

5.5 A differential fall in trade costs in the *maquila* sector

Result 3. *A differential fall in trade costs for the final* maquila *good will decrease the informal sector and decrease welfare in the home economy. Welfare will be unambiguously higher in an economy with an informal sector than in an economy where the informal sector is shut down.*

As can be seen in the left panel of figure 13, a differential fall in trade costs for shipping the final *maquila* good abroad decreases welfare in the home economy. A fall in iceberg trade costs implies that less output has to be produced to ship one unit to consumers in the foreign economy. At the same time, demand for the *maquila* good increases as its goods are cheaper for foreign consumers and the *maquila* sector expands. However, Mexican consumers do not profit from the fall in trade costs as they do not consume the good. What is more, the increase of the *maquila* sector comes at the expense of the standard manufacturing sector. The latter sector is domestically owned, whereas the *maquila* sector is foreign-owned. Hence, the expansion of the *maquila* sector increases the overall amount of profits sent out of the home economy directly decreasing available income for domestic consumption and hence decreasing overall welfare. Thus the home country over-specializes in the production of the *maquila* good. Note also that the fall in trade costs is accompanied by a decrease in the informal sector. Hence, two obvious measures of political success as an increase of multinationals in the *maquila* sector as well as the reduced informal sector would indicate an improvement of domestic welfare. Resimulating the model without the informal sector, we again find that welfare is lower across all considered trade cost values in the economy without the possibility of informal sector employment. The mechanism at work is again the exit option of low-skilled workers which retains more income for consumption in the home economy. The counter factual fall in informal sector employment in our model simulations compared to the actual experience of Mexico can be rationalized by recognizing countervailing effects of trade liberalization on informality as indicated by Marjit et al. (2007). Their channel of higher corruption due to trade liberalization increases informal employment is not present in our model. Empirically, it may well be that both effects exactly

set off each other leading to the observed pattern of informality. Furthermore, the fall in the informal sector size is very small, contradicting the expected bigger effect of the expansion of *maquilas* on informal sector employment.

[Figure 13 about here.]

Result 4. *Comparing two model economies with and without an informal sector, welfare will be higher in the economy with the informal sector across all comparative static exercises.*

6 Robustness checks

6.1 Simulation of two country model

In order to check whether our results crucially hinge to the small open economy assumption, we simulate a two-country model. We stick to the assumption that Mexican low-skilled workers can end up in the informal sector whereas labor markets in the US are perfectly competitive and hence low-skilled workers in the US do not have the option of working in the informal sector. As in the small country case, welfare is higher if Mexican low-skilled workers may find a job in the informal sector.[13]

6.2 Consumption of *maquila* good

In order to check the robustness of our results, we also simulate our models by allowing consumption of the *maquila* good also in the home economy. Hence, preferences are given by

$$U^H = (C_1^H)^{\alpha_1}(C_2^H)^{\alpha_2} \tag{6.1}$$

with $\alpha_1 + \alpha_2 = 1$.

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to be added...

To see whether our results crucially hinge on the specific form of small country assumption we use, we simulate a two country version of our model where the small economy is characterized by an informal labor market whereas in the large economy, labor markets are perfectly competitive. RESULTS TO BE ADDED

[13] Simulation code and results are available from the authors upon request.

7 Conclusion

This paper has investigated the relationship between the rise of the *maquila* sector in Mexico, its linkages to informal sector employment as well as its broader implications for Mexican welfare. Our simulations of a small open economy with heterogeneous firms and labor market rigidities for low-skilled workers indicate that a reduction in plant set up costs in the *maquila* sector like a reduction of red tape and other non-tariff barriers to trade and foreign direct investment lead to a decrease in general welfare. Most of the newly created jobs in the intermediate input processing plants sector replace standard manufacturing jobs without inducing a major decrease in informal sector employment. The decline in informality is accompanied by a general decline of welfare. Even though standard measures of political achievement like an increase in overall formal sector employment as well as an increase of foreign-owned plants seem to indicate a positive development of the model economy, welfare actually declines. This is due to XXX, WHAT HAPPENS TO RELATIVE WAGES (W/, W/O informal sector?). Hence, there arises a distributional conflict between high-skilled workers who prefer a stricter stance on informality whereas low-skilled workers prefer a two-tier labor market. Our results suggest that the presence of a large informal sector is not necessarily detrimental to general welfare in an economy, at least given the level of development and its general production and consumption structure. What is more, the reduction of informality creates a new distributional conflict between high-skilled and low-skilled workers which has been overlooked both in the theoretical literature as well as in policy discussions so far. The results also indicate that labor market rigidities may create intricate choices for policy makers as increasing formal sector employment and restricting access to informal jobs in order to increase tax revenues and payments to pension systems may well be detrimental to voters' welfare. This highlights the importance of future research on informality to uncover its Janus-faced nature in order to enlighten policy choices faced by emerging economies.

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A Parameter settings for model simulations

The calibration closely follows Bernard et al. (2007) and on the labor market side Felbermayr et al. (2010).

Parameters for exogenous large foreign country F:

- $M_1^F = 10.$
- $M_2^F = 10.$
- $X_1^F = 0.3.$
- $X_2^F = 0.3.$
- $A_1^F = 0.5.$
- $A_2^F = 0.5.$
- $B_1^F = 0.8.$
- $B_2^F = 0.8.$
- $p_1^F = 1.$
- $p_2^F = 1.$

General parameters:

- $N = 1$, denoted in the subsequent with superscript H (for home country).
- $f_1^H = 0.1.$
- $f_2^H = 0.1.$
- $f_{1e}^H = 2.$
- $f_{2e}^H = 2.$
- $f_{1x}^H = f_1 \times 1.93.$
- $f_{2x}^H = f_2 \times 1.93.$
- $\delta = 0.11.$
- $\tau_1 = [1...0.05...1.6].$
- $\tau_2 = [1...0.05...1.6].$
- $\alpha = 0.5.$
- $\sigma = 3.8.$
- $\varsigma = 1 - 1/\sigma.$

Technological assumptions:

- Good 1 capital-intensive: $\beta_1 = 0.6.$
- Good 2 labor-intensive: $\beta_2 = 0.4.$

Assumption about the Pareto distribution:

- $\bar{k} = 0.2$.
- $c = 3.4$.
- $\gamma = c - \sigma + 1$.
- $\xi = c(k^{c-\gamma})/\gamma$.

Job Market parameter assumptions:

- $\bar{c}_l = 0.134$.
- $r = 0.04$.
- $\rho = 0.3$.
- $s = \rho + \delta - \rho\delta$.
- $\mu = 0.5$.
- $\bar{m} = 7.6$.
- $\gamma_m = 0.5$.
- $b = 0.4$.

Factor endowments are assumed as follows:

- $L^H = 1000$.
- $K^H = 1200$.

B Equations used for simulation/estimation

Productivity cutoffs, entry and exit:

$$\lambda_1^H = 1 \tag{B.1}$$

- $\lambda_2^H = \tau_2 \left(\frac{P_2^H}{P_2^F}\right) \left(\frac{\frac{(1-\alpha)R^H}{M_2^H + \chi_2^F M_2^F}}{\frac{(1-\alpha)R^F}{M_2(j) + \chi_2^H M_2^H}} \frac{f_{2x}^H}{f_2^H}\right)^{\frac{1}{\sigma-1}}$.
- $\varphi_{1d}^* = \left(f_1^H + f_{1x}^H \left(\lambda_1^H\right)^{-c}\right)^{\frac{1}{c}} \left(\frac{1}{f_{1e}^H}\right)^{\frac{1}{c}} \left(\left(\frac{1+r}{r+\delta}\right)\left(\frac{c}{\gamma} - 1\right)k^c\right)^{\frac{1}{c}}$.
- $\varphi_{2d}^* = \left(f_2^H + f_{2x}^H \left(\lambda_1^H\right)^{-c}\right)^{\frac{1}{c}} \left(\frac{1}{f_{2e}^H}\right)^{\frac{1}{c}} \left(\left(\frac{1+r}{r+\delta}\right)\left(\frac{c}{\gamma} - 1\right)k^c\right)^{\frac{1}{c}}$.
- $\varphi_{1x}^* = \lambda_1^H \varphi_{1d}^*$.
- $\varphi_{2x}^* = \lambda_2^H \varphi_{2d}^*$.
- $\tilde{\varphi}_{1d} = \left(\frac{a}{\gamma}\right)^{\frac{1}{\sigma-1}} \varphi_1^H$.
- $\tilde{\varphi}_2^H = \left(\frac{a}{\gamma}\right)^{\frac{1}{\sigma-1}} \varphi_2^H$.
- $B_1^H = \left(\frac{a}{\gamma}\right)^{\frac{1}{\sigma-1}} \varphi_{1x}^H$.

- $B_2^H = \left(\frac{a}{\gamma}\right)^{\frac{1}{\sigma-1}} \varphi_{2x}^H$.

Prices and expenditure:

- $\left(\frac{1-\delta}{r+\delta}\right) p_1^H \tilde{\varphi}_1^H \left(L_{1d}^H\right)^{1-\beta_1} \left(K_{1d}^H\right)^{\beta_1} \left(1-\beta_1\left(\frac{\sigma-1}{\sigma}\right)-(1-\beta_1)\left(\frac{\sigma-1}{\sigma+\beta_1\mu-\mu-\beta_1\sigma\mu}\right)\right) = \left(\frac{\tilde{\varphi}_1^H}{\varphi_1^H}\right)^{\sigma-1}\left(\frac{1+r}{r+\delta}\right) f_1^H P_1^H$.
- $\left(\frac{1-\delta}{r+\delta}\right) p_2^H \tilde{\varphi}_2^H \left(L_{2d}^H\right)^{1-\beta_2} \left(K_{2d}^H\right)^{\beta_2} \left(1-\beta_2\left(\frac{\sigma-1}{\sigma}\right)-(1-\beta_2)\left(\frac{\sigma-1}{\sigma+\beta_2\mu-\mu-\beta_2\sigma\mu}\right)\right) = \left(\frac{\tilde{\varphi}_2^H}{\varphi_2^H}\right)^{\sigma-1}\left(\frac{1+r}{r+\delta}\right) f_2^H P_2^H$.
- $L_{1x}^H = L_{1d}^H$.
- $L_{2x}^H = \left(\frac{\tilde{\varphi}_2^H}{B_2^H}\right)^{1-\sigma} \tau_2^{1-\sigma} \frac{\left(\frac{(1-\alpha)R^F}{M_2^F+\chi_2^H M_2^H}\right)}{\left(\frac{(1-\alpha)R^H}{M_2^H+\chi_2^F M_2^F}\right)} \left(\frac{P_2^F}{P_2^H}\right)^{\sigma-1} L_{2d}^H$.
- $K_{1x}^H = \left(\frac{\tilde{\varphi}_1^H}{B_1^H}\right)^{1-\sigma} \tau_1^{1-\sigma} \frac{\left(\frac{\alpha R^F}{M_1^F+\chi_1^H M_1^H}\right)}{\left(\frac{\alpha R^H}{M_1^H+\chi_1^F M_1^F}\right)} \left(\frac{P_1^F}{P_1^H}\right)^{\sigma-1} K_{1d}^H$.
- $K_{2x}^H = \left(\frac{\tilde{\varphi}_2^H}{B_2^H}\right)^{1-\sigma} \tau_2^{1-\sigma} \frac{\left(\frac{(1-\alpha)R^F}{M_2^F+\chi_2^H M_2^H}\right)}{\left(\frac{(1-\alpha)R^H}{M_2^H+\chi_2^F M_2^F}\right)} \left(\frac{P_2^F}{P_2^H}\right)^{\sigma-1} K_{2d}^H$.
- $M_1^H = \frac{L_{1e}^H}{L_{1d}^H+\chi_1^H L_{1x}^H}$.
- $M_2^H = \frac{L_{1e}^H}{L_{1d}^H+\chi_2^H L_{1x}^H}$.

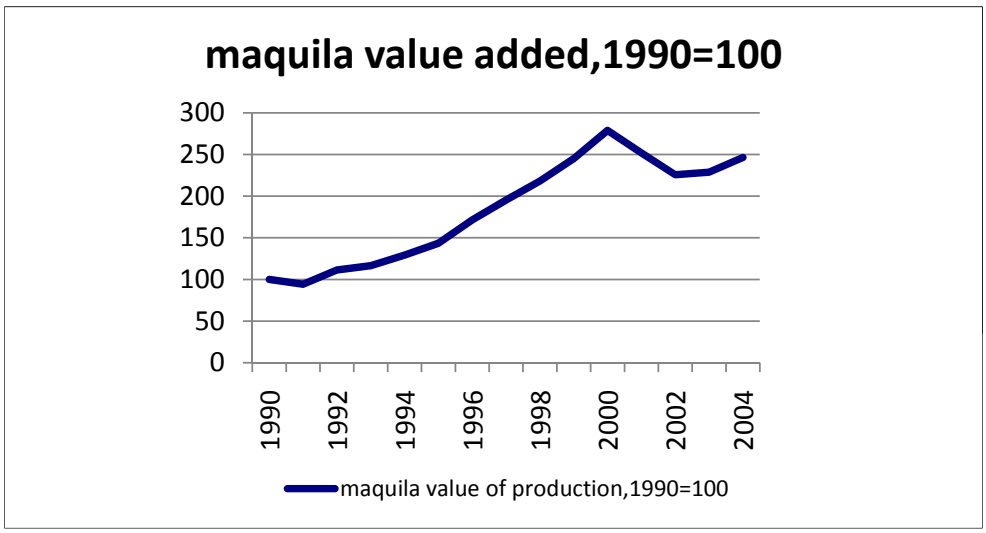
Trade balance:

$$
\begin{aligned}
0 \;=\; & \left(P_1^H\right)^{\sigma-1} \tau_1^{1-\sigma} \left(\frac{\tilde{\varphi}_1^F}{B_1^F} p_1^F\right)^{1-\sigma} \alpha \frac{R^H}{M_1^H+\chi_1^F M_1^F} \chi_1^F M_1^F \\
& + \left(P_2^H\right)^{\sigma-1} \tau_2^{1-\sigma} \left(\frac{\tilde{\varphi}_2^F}{B_2^F} p_2^F\right)^{1-\sigma} (1-\alpha) \frac{R^H}{M_2^H+\chi_2^F M_2^F} \chi_2^F M_2^F \\
& - \left(P_1^F\right)^{\sigma-1} \tau_1^{1-\sigma} \left(\frac{\tilde{\varphi}_1^H}{B_1^H} p_1^H\right)^{1-\sigma} \alpha \frac{R^F}{M_1^F+\chi_1^H M_1^H} \chi_1^H M_1^H \\
& - \left(P_2^F\right)^{\sigma-1} \tau_2^{1-\sigma} \left(\frac{\tilde{\varphi}_2^H}{B_2^H} p_2^H\right)^{1-\sigma} (1-\alpha) \frac{R^F}{M_2^F+\chi_2^H M_2^H} \chi_2^H M_2^H \\
& + \eta \Pi^1 + \tau_I w_I (I_1^H + I_2^H)
\end{aligned}
$$

Hence, in the trade balance, entry fixed costs of *maquilas* enter the domestic economy and are balanced by the outflow of profits.

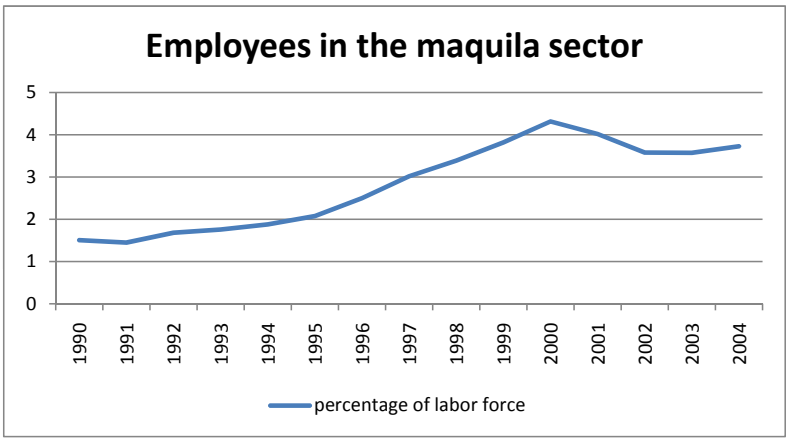
- $\theta = \frac{1-\delta}{c}\left[\frac{(1-b)(1-\mu)}{\mu} w_L^H - \left(\frac{r+s}{1-\delta}\right)\frac{c}{m}\right]$.

Figure 1: Value of *maquila* production, 1990-2004



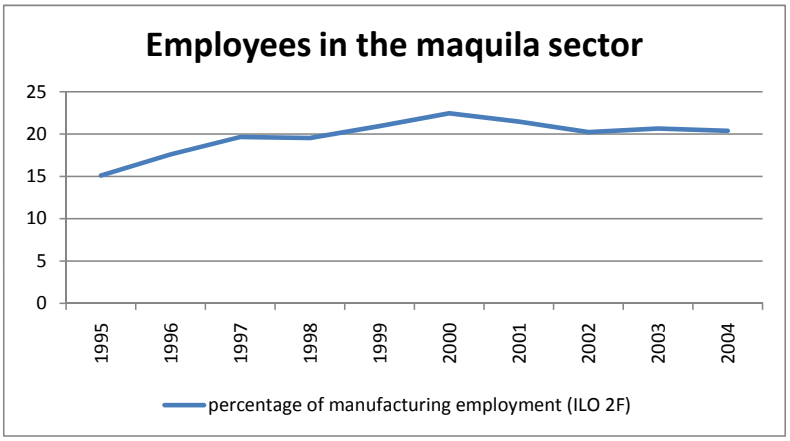
source: INEGI

Figure 2: Employees in the *maquila* sector, percentage of the labor force, 1990-2004



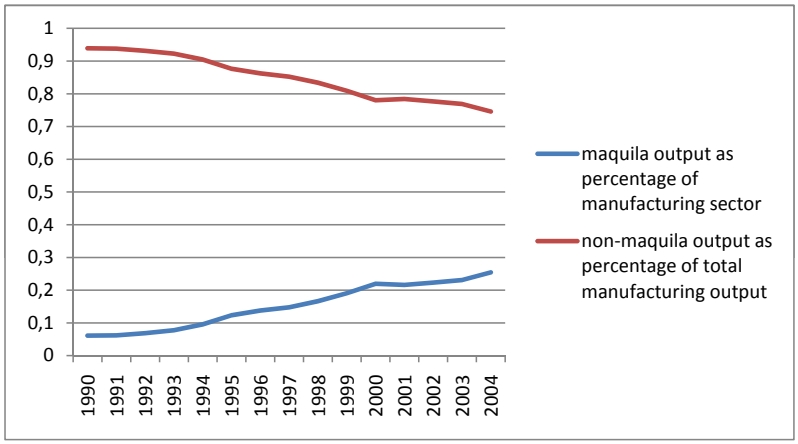
source: INEGI, labor force data from WDI

Figure 3: Employees in the *maquila* sector, percentage of total manufacturing employment, 1995-2004



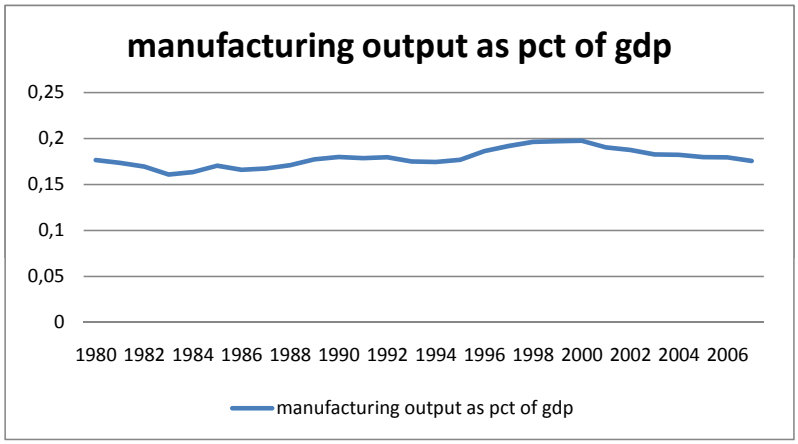
source: INEGI, manufacturing labor force data from ILO

Figure 4: Relative share of *maquila* output of total manufacturing output, 1990-2004



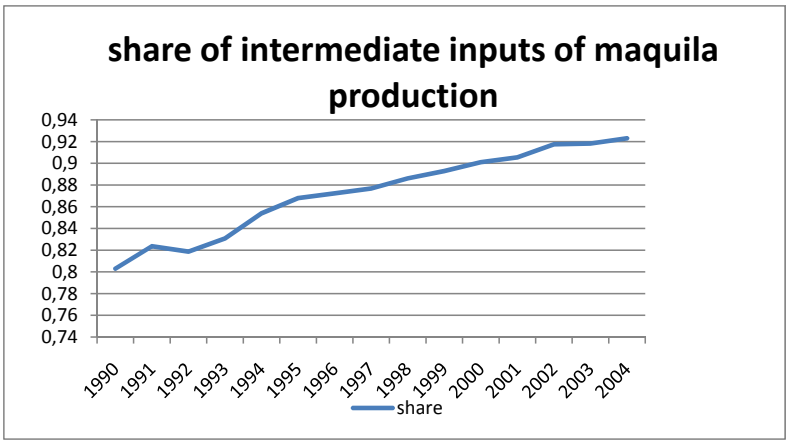
source: INEGI

Figure 5: Share of manufacturing output of total GDP, 1980-2006



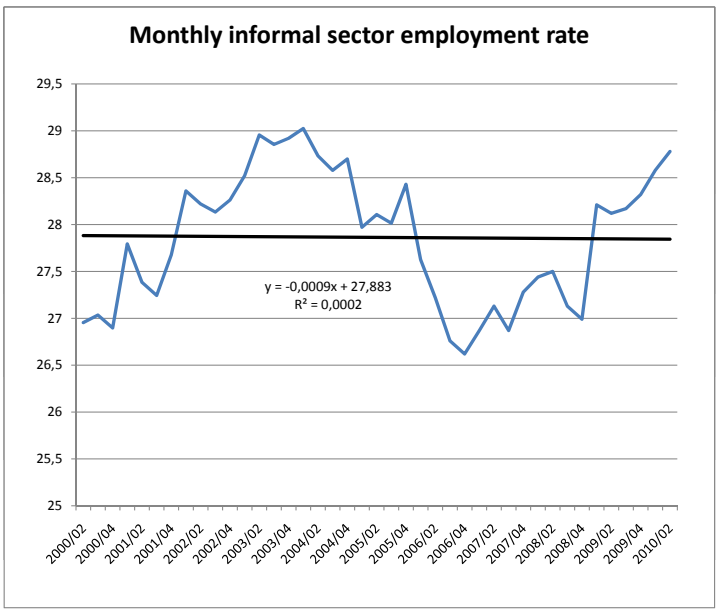
source: INEGI

Figure 6: Share of intermediate input use in the *maquila* industry, 1990-2004



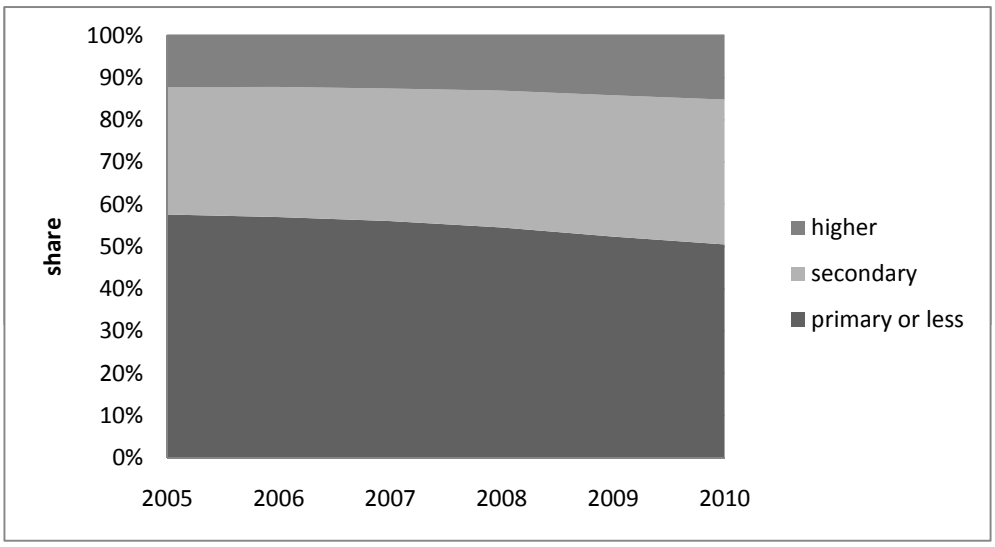
source: INEGI

Figure 7: Informal sector employment share, 2000-2010



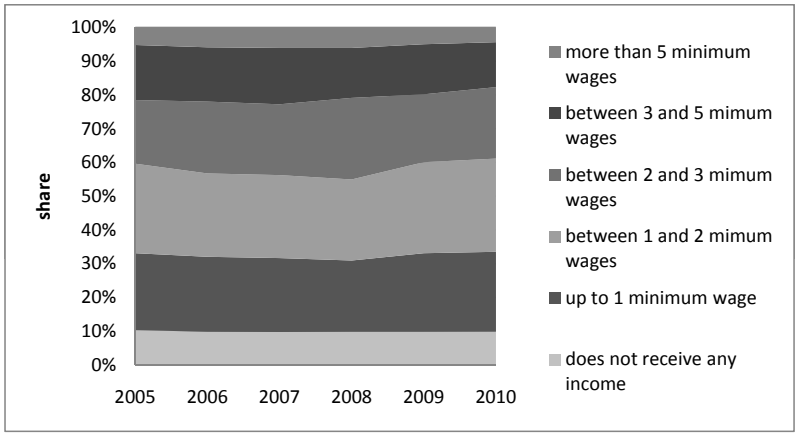
source: INEGI

Figure 8: Educational attainment shares of informal sector workers, 2005-2010



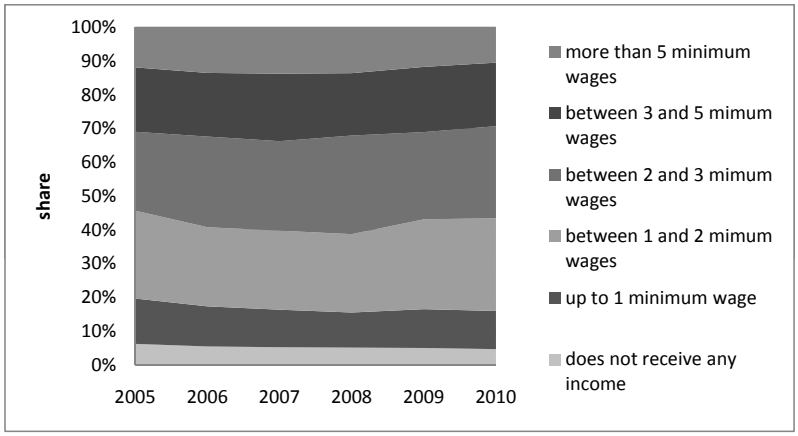
Graph shows the relative shares of educational attainment of workers in the informal sector. Primary refers to workers with *Primaria* as their highest degree, secondary refers to *Secundaria*, and higher refers to education at the level *Medio superior y superior*. Yearly averages of quarterly data. Average for 2010 is based on the first three quarterly data. Individuals who did not report any educational level were subtracted from the total. Those represent 0.07% of the individuals included in the survey.
source: INEGI, *Encuesta Nacional de Ocupación y Empleo*. Data can be accessed on INEGI's website in the section *Estadística>Consulta interactiva de datos* at `http://www.inegi.mx/est/contenidos/espanol/cubos/default.asp?c=1413`.

Figure 9: Income distribution of informal sector workers, 2005-2010



Graph shows the relative shares of different income brackets in terms of multiples of the minimum wage for workers in the informal sector (*sector informal*). Yearly averages of quarterly data. Average for 2010 is based on the first three quarterly data. Individuals who did not report their income level were subtracted from the total. Those represent 4.99% of the individuals included in the survey.
Source: INEGI, *Encuesta Nacional de Ocupación y Empleo*. Data can be accessed on INEGI's website in the section *Estadística>Consulta interactiva de datos* at `http://www.inegi.mx/est/contenidos/espanol/cubos/default.asp?c=1413`.

Figure 10: Income distribution of workers in the private sector, 2005-2010



Graph shows the relative shares of different income brackets in terms of multiples of the minimum wage for workers in the private sector (*empresas y negocios*). Yearly averages of quarterly data. Average for 2010 is based on the first three quarterly data. Individuals who did not report their income level were subtracted from the total. Those represent 7.46% of the individuals included in the survey.
Source: INEGI, *Encuesta Nacional de Ocupación y Empleo*. Data can be accessed on INEGI's website in the section *Estadística>Consulta interactiva de datos* at `http://www.inegi.mx/est/contenidos/espanol/cubos/default.asp?c=1413`.

Figure 11: Comparative statics of the final good price in the *maquila* sector

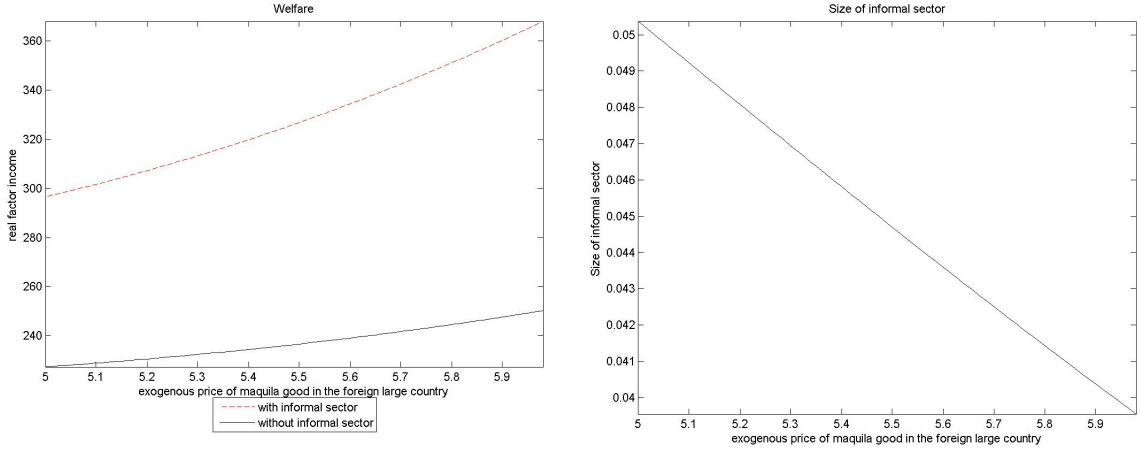


Figure 12: Comparative statics of exporting fixed costs in the *maquila* sector

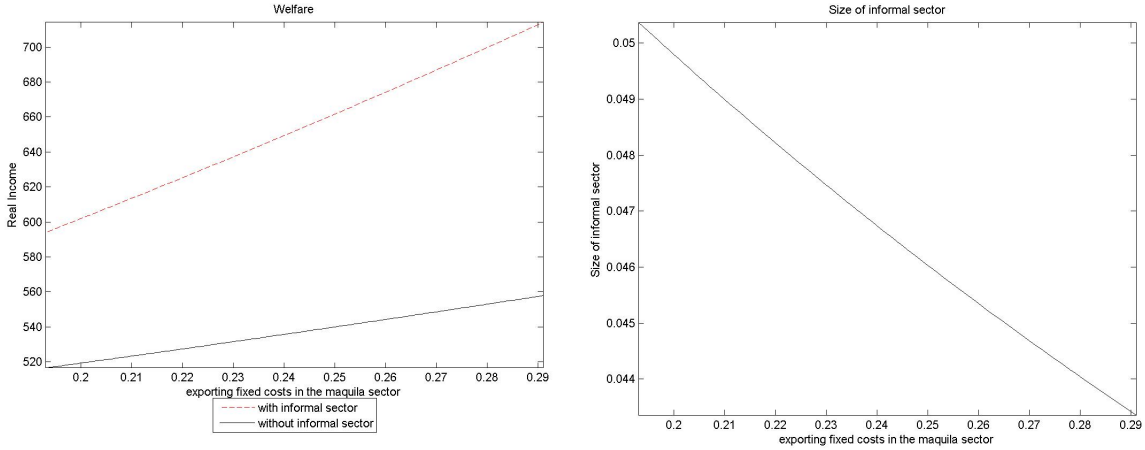


Figure 13: Comparative statics of trade costs for the final *maquila* good