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GOOD JOBS, BAD JOBS, AND TRADE LIBERALIZATION

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ABSTRACT

How do labor markets adjust to trade liberalization? Leading models of intraindustry trade (Krugman (1981), Melitz (2003)) assume homogeneous workers and full employment, and thus predict that all workers win from trade liberalization, a conclusion that is at odds with the public debate. Our paper develops a new model that merges Melitz (2003) with Shapiro and Stiglitz (1984), so also links product market churning to labor market churning. Workers care about their jobs because the model features aggregate unemployment and jobs that pay different wages to identical workers. Simulations show that for reasonable parameter values as many as one-fourth of "good jobs" (those with above average wage) may be destroyed in a liberalization. This is true even as the model shows minimal impact on aggregate unemployment and quite substantial aggregate gains from trade.

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I. Introduction

How do labor markets adjust to trade liberalization? Three points motivate our approach to this question. The first is empirical. Most of trade is intra-industry trade and recent experience of large liberalizations suggests that the greater part of adjustment is likewise reallocation within rather than between industries. The second is a point of analysis. Recent theoretical advances that emphasize the role of firm heterogeneity and product market churning also underscore the importance of considering labor market churning in trade liberalization episodes. The third motivation is again empirical. While job rents appear to be more modest than they appeared in some early studies, they remain substantial for some workers and this could be a source of resistance to trade reform.

We develop a model that integrates these elements. Building on Melitz (2003), the model is focused on within industry reallocation, and so is relevant for the bulk of trade and the nature of the most significant trade reforms. Linking this with Shapiro and Stiglitz (1984) efficiency wages at the firm level, there is equilibrium unemployment and jobs have firm specific rents attached, the latter implying that workers distinguish between good and bad jobs. Selection effects now depend both on firm physical productivities and firm wages. Since our model also features the product market churning of Melitz, it likewise features labor market churning. However, unlike in Melitz, job rents and the existence of unemployment mean that workers care about job loss, particularly the loss of good jobs.

We go on to develop a simulation of this economy, with key parameters chosen where possible to match existing empirical estimates, and study liberalization episodes that constitute transitions to Anderson and Van Wincoop's (2003) preferred estimate of actual level of trade integration as well as the case corresponding to the removal of all trade barriers. The substantive points are robust to the two exercises. Trade raises aggregate real income substantially, with essentially all of the gain coming from firm selection effects that raise productivity. The level of unemployment is at plausible magnitudes and is little affected by liberalization. However there is considerable product and labor market churning. With the removal of all border barriers, trade leads to the gross destruction of one-fourth of all "good" (above average wage) jobs.

The central message of our paper is simple. The new heterogeneous firm models place essentially all of the weight of gains from trade on the efficiency effects of firm selection. The consequent product market churning has a counterpart in labor market churning. If there is unemployment and if, in addition, some jobs carry empirically relevant rents, then the presence of aggregate gains does not preclude the existence of distributional conflicts between the employed and the unemployed and between workers with good and bad jobs. In contrast to the first generation models of intra-industry exchange, in the new models such distributional conflict is to be expected.

Background

It has long been recognized that most of world trade is exchange among rich countries and that most of this is intra-industry trade.[1] While tariffs among these countries are already low, technological and commercial advances continue to shift the balance of incentives to produce for global rather than only local markets, and so a model premised on intra-industry exchange and liberalization continues to be relevant.

Interestingly, the intra-industry model is also highly relevant to the experience in many of the developing countries with the most dramatic recent trade liberalizations. As Goldberg and Pavcnik (2007, p. 59) write in their *Journal of Economic Literature* review, ". . . a fundamental prediction of factor endowment based trade theories is that the adjustment process to trade reforms would involve labor reallocations from sectors that experience price declines, and hence contract, toward sectors that experience relative price increases and hence expand. However, most studies of trade liberalization in developing countries find little evidence in support of such reallocation across sectors."

This issue of the appropriate approach is also crucial to the analytics. Again, we concentrate on a contrast between two broad approaches to how labor markets adjust to trade liberalization. One focuses on the need for inter-industry reallocation of resources. This includes a class of models including Heckscher-Ohlin, Specific Factors, and others. These models emphasize a range of issues such as transition costs, redistribution across different classes of labor, and at times the possibility of exacerbating structural unemployment. The principal alternative approach focuses on trade liberalization as intra-industry exchange. In the most

[1] Grubel and Lloyd (1975).

prominent variant of this, due to Krugman (1981), the integration of two identical economies leads no firm to go out of business, no worker to lose or change jobs, and the real wages of all workers to rise as the price index falls due to the doubling of available varieties. In short, the analytic approach based on inter-industry exchange focuses on redistribution and transition costs while the alternative based on intra-industry exchange focuses on the easy transition to liberalization because of symmetry and mutual gains.

Recently a third analytic approach to trade liberalization, due to Marc Melitz (2003), has achieved prominence. On its face, the Melitz approach seems squarely in the tradition of the Krugman-style model of intra-industry exchange. Countries are symmetric. Consumers value variety. And producers in the countries manufacture unique varieties which are exchanged via trade. To this, Melitz adds only that there are fixed costs to trade and heterogeneity in the productivity of firms. This gives rise to selection effects in which trade has the added benefit of raising average productivity. With frictionless, competitive factor markets, homogeneous labor, the possibility of gains via variety, lower cost, and greater productivity, all workers gain from free exchange. And this would appear to put the Melitz and Krugman approaches in the same camp as to the ease of transition with liberalization.

We believe, though, that the departures of the Melitz model, relative to that of Krugman, are more fundamental than has been generally appreciated. Melitz (2003) notes that integration could lead the number of varieties *consumed* in a country to rise or fall. But it is possible to go further than this to establish a benchmark. It has become common to work with the Melitz model by assuming a Pareto distribution for the productivities of firms, both for reasons of tractability, and because this reproduces the distribution of firm sizes one finds in the data. Let us take this as given and use as a benchmark the case in which firms' fixed costs in penetrating foreign markets are equal to those in penetrating the domestic market. As Baldwin (2005) has shown, in this case a move from autarky to trade leaves the variety available to consumers in each market entirely unchanged. That is, in this benchmark, the very source of gains from trade in the Krugman world disappears entirely. This remains true even when there are more than two countries integrating. Indeed, in the more plausible case in which the fixed costs of penetrating a foreign market exceed those of penetrating ones own market, equilibrium variety consumed declines with trade. Large foreign exporters crowd the local market, forcing the exit of small local firms and decreasing both local and total variety available to home consumers. This is less Paul Krugman and more José Bové.

The fact that in this benchmark version of the Melitz model, the now standard Krugman gains from variety wholly disappear does not at all diminish the fact that there are gains from trade. But the focus shifts. No longer are the gains coming from the simple exchange of varieties produced by the same workers at the same firms as prior to liberalization. Instead the gains are coming through the efficiency enhancements achieved through the sharp expansion at new exporters, the contraction of firms that still serve only the domestic market, and the exit of firms that cannot weather the new competition from abroad. In short, in this benchmark version of Melitz, *all* of the gains from trade come via efficiency-enhancing churning in the product market.

The fact that the very essence of gains from trade in the benchmark Melitz model comes from churning in the product market should have a natural counterpart in the labor market. While this remains purely a model of within industry exchange, it thus has reallocative properties that mimic the older interindustry models. Melitz (2003) abstracts from the labor market consequences of liberalization by assuming homogeneous labor and perfect factor markets. In spite of the fact that liberalization will occasion tremendous reallocation of labor resources across firms in his model, the fact that all jobs are alike, that there is no unemployment or transition costs between jobs, and that all workers share in the efficiency gains from trade suggests there should be universal support for liberalization.

Of course, this doesn't look like the actual public response to liberalization. Speaking in March 2007, Treasury Secretary Henry M. Paulson, Jr. noted that "more and more Americans seem to doubt that trade brings greater benefits than costs." This perspective finds strong support in an April 2008 Pew Research Center survey in which respondents replied by margins respectively of six- and seven-to-one that freer trade costs jobs and lowers wages.[2] Even an iconic internationalist, such as Larry Summers, recently wrote ". . . opposition to trade agreements, and economic internationalism more generally, reflect[s] a growing recognition by

[2] These numbers are up substantially even from the figures that Paulson cited in his remarks. Similarly, a March 2008 NBC News/Wall Street Journal poll found that the margin by which Americans view globalization as "bad because it has subjected American companies and employees to unfair competition and cheap labor", rather than "good because it has opened up new markets for American products and resulted in more jobs", rose in the last decade from 6 to 33 percentage points. That this is true even though in recent periods changes in net exports constitute an important source of macro strength suggests that the prime concern is the type of jobs at risk.

workers that what is good for the global economy and its business champions [is] not necessarily good for them, and that there [are] reasonable grounds for this belief."[3]

Paul Krugman (1993) famously argued that among the few things that undergraduates genuinely need to know about trade is that it is not about "jobs". Indeed, Krugman considered this crucial precisely because of the prominence of concerns about job loss in public discussion. His point was a macro one – that the Federal Reserve will expand or contract credit to target the natural rate of unemployment whatever the degree of trade openness. Of course, one reply is that structural elements of trade may affect the natural rate. This is not a direction we will go, since although unemployment exists in our model, it is affected only very modestly by trade openness.

However, the public concern about jobs is not necessarily the same thing as concern about the unemployment rate. There is also a concern that trade may put pressure on good jobs. In our work, these good jobs will be jobs that come with a rent attached. For our work, it is not crucial that the magnitudes be enormous, only large enough that some fraction of workers cares to maintain these rents. Hence we need some discussion of the status of the literature on wage rents.

In an early contribution to the literature, Krueger and Summers (1988) argued that large measured industry wage differentials were evidence of labor rents. Murphy and Topel (1987), among others, were skeptical, arguing that industry wage differentials were perfectly consistent with unobserved (to the economist) heterogeneity in workers' marginal products, and that it is entirely unsurprising that some industries or firms might wish to systematically hire more productive workers. To resolve this dispute requires information on worker and firm characteristics, as well as enough "job switchers" to be able to reliably identify what component of a worker's wage is due to her inherent productivity and what component is due to the firm where she works. To our knowledge, only Abowd, Kramarz and Margolis (1999) have assembled data (a panel of French workers and firms from 1976 to 1987) that can answer this question. Their conclusion is that the "person" effect is much more important than the "firm effect.

While this result can reasonably be interpreted as vindication for the view that labor rents are smaller than Krueger and Summers may have thought, their estimates do not eliminate wage rents: the Abowd *et al* estimate of the standard deviation of the firm effect on log French wages

[3] "A Strategy to Promote Healthy Globalization," Financial Times, May 4, 2008.

as 0.06. This estimate justifies our theoretical approach to job rents as well as providing the measure of dispersion of firm-specific wage rents for our simulations.

There are several recent papers that also consider unemployment and job loss in a Melitz-type model of heterogeneous firms. Egger and Kreickemeier (2006) integrate Melitz (2003) with the fair wage model of Akerlof and Yellen (1990). Firm-level wages in their model are a weighted average of firm productivity and an unemployment-adjusted average wage. Unemployment arises because the fair wage constraint prevents wages from fully adjusting to insure full employment. While trade liberalization may cost jobs in their model, it does so only at the least productive firms offering the lowest wages. Hence their model does not offer a sense in which trade may threaten good jobs at good wages. Helpman and Itskhoki (2007), Felbermayr, et al. (2008) and Janiak (2006) each integrate Melitz (2003) with Pissarides-type (2000) search models and show conditions under which trade integration may raise or lower equilibrium unemployment. An earlier literature, including Copeland (1989), Brecher (1992) and Hoon (2001), considers the implications of efficiency wages in trade models. None of these papers considers the channels we consider in the current paper, and in particular they rule out the sort of intra-industry reallocations that seem to be important in practice and that are the focus of Melitz (2003). The paper by Matusz (1996), which analyzes efficiency wages in a Krugman-style model of intraindustry trade, is the most relevant to our project, and we discuss Matusz' model further below.

Section II of our paper lays out our labor market model of efficiency wages when monitoring costs differ across firms. This labor market is merged with the Melitz (2003) model of heterogeneous firms in Section III and IV. Our results about the effects of trade liberalization on wages, jobs, unemployment, and economy-wide efficiency are presented in Section V and VI.

II. Unemployment, Efficiency Wages, and the Firm

A. Shapiro-Stiglitz with Heterogeneous Firm Level Monitoring and Iceberg Effort Costs

In considering employment relations, we follow the efficiency wage model of Shapiro and Stiglitz (1984), amending this as needed to mesh with the firm-based model of Melitz (2003).

In the Shapiro and Stiglitz model, firms can monitor worker effort only imperfectly. Workers' distaste for effort tempts them to shirk, and they are deterred in equilibrium by the possibility that their shirking will be discovered and they will be fired. Unemployment persists in equilibrium because the wage that firms offer is too high to clear the labor market. Unemployment is bad news for workers, and truly involuntary, in the sense that employed workers are *ex ante* identical to the unemployed yet have higher utility. The market failure is that workers cannot credibly commit to effort at less than the going wage. Our model has all these features, with the crucial difference that firms differ in their ability to detect shirking.

There is a large literature that tests various aspects of the Shapiro-Stiglitz and other efficiency wage models, but there is no paper that directly tests the prediction that monitoring ability and high wages are substitute means to elicit effort. There are a number of papers, including Groshen and Krueger (1990), Rebitzer (1995), and Nagin, Rebitzer, Sanders and Taylor (2002) that use exogenous variation in monitoring intensity to confirm that effort does indeed increase in monitoring intensity[5]. There is also a literature that documents industry wage differentials (for example, Krueger and Summers (1988)). Such differentials have no direct connection to efficiency wage theory, but they are consistent with labor rents of the sort that obtain in the equilibrium of the Shapiro-Stiglitz model.

Workers are infinitely lived, risk neutral, and discount the future at rate r. Subject to an intertemporal budget constraint, they maximize the expectation:

(1) $$E\left[\int_0^\infty U\left(w_t, e_t\right)\exp\left[-rt\right]dt\right]$$

The real wage for a worker at firm i is $w_i = \frac{W_i}{P}$, where W_i is the nominal wage at firm i and P is the aggregate price index (developed below).

Depending on the employment and effort status of a worker, the utility takes the following forms:

$U\left(w,e\right) = w$ if the worker shirks

$U\left(w,e\right) = \frac{w}{e}, \quad e > 1$ if the worker exerts effort.

[5] We have also observed a positive relationship between monitoring intensity and homework effort by resident adolescents. We believe that such an effect is well-known to other parents.

$U = 0$ if the worker is unemployed

Here the cost of effort e is modeled as an "iceberg" cost that shrinks the perceived real wage of the worker, although of course not shrinking the nominal wage paid by firms and received by workers (both of which treat the aggregate price index P as given).[6]

Workers lose their job only if the firm dies or they are caught shirking. Firm death happens at an exogenous rate δ. If workers at firm i were to shirk, they would face a probability $m_i \in (0,1]$ of detection, with a penalty of being fired and spending a period in unemployment before finding a new job.

Workers at firm i have fundamental asset equations that reflect their status as shirkers or non-shirkers. Let V_{Ei}^S and V_{Ei}^N be the expected lifetime utility respectively of shirkers and non-shirkers currently employed at firm i. Let V_U be the expected lifetime utility of a worker currently unemployed (noting that this is independent of any firm because unemployed workers are unattached).

Then the fundamental asset equations for employed non-shirkers and shirkers respectively are:

$$(2) \qquad rV_{Ei}^N = \frac{w_i}{e} + \delta\left(V_U - V_{Ei}^N\right)$$

$$(3) \qquad rV_{Ei}^S = w_i + \left(\delta + m_i\right)\left(V_U - V_{Ei}^S\right)$$

These consist of the flow real wage benefits, (w_i / e) or w_i respectively, plus an expected capital loss in case of a shift to unemployment, where the instantaneous probabilities differ because shirkers face a higher likelihood of a move to unemployment due to firm i's monitoring m_i for shirking. This departs from the conventional Shapiro-Stiglitz framework in allowing for firm specificity in monitoring ability, the wage, and the value of employment at a particular firm.

[6] The iceberg cost of effort, *U=w/e*, departs from the traditional Shapiro-Stiglitz formulation of the cost of effort as *U=w-e*. This responds to the critique by David Romer (2006) that the conventional formulation would give rise to a secular trend in unemployment. A consequence is that the aggregate price index *P* is simply a scale variable in Equation (1). Moreover, changes in *P*, for example due to trade liberalization, will not *directly* affect the balance of incentives to work or shirk, since it affects them proportionately (cf. Steven Matusz (1996)). The new formulation also has the important consequence for us, developed below, that the *ranking* of firms by marginal cost is a function only of firm-specific parameters, hence invariant to the liberalization episodes we consider.

Firm i recognizes the incentive to shirk. Hence in light of these incentives and its own monitoring ability, it chooses a wage sufficient to induce employees to work rather than shirk. This requires:

(4) $V_{Ei}^{N} \geq V_{Ei}^{S}$

The firm chooses to meet this non-shirking constraint with equality (so $V_{Ei}^{N} = V_{Ei}^{S} = V_{Ei}$). We can solve this for the firm-level equivalent of the Shapiro-Stiglitz no-shirking constraint:

(5) $$w_i = \frac{rV_U}{\hat{m}_i} \qquad \text{where} \qquad \hat{m}_i = \frac{m_i - (e-1)(r+\delta)}{em_i} \quad \text{and} \quad \frac{\partial \hat{m}_i}{\partial m_i} > 0.$$

Since V_U is independent of firm identity, wages will vary across firms only due to monitoring ability and equilibrium wages decline with improvements in monitoring. Note as well that this is a *notional* wage. That is, this is the wage required of a firm with monitoring ability m_i if it is to elicit effort, and is well defined although in equilibrium not all firms will survive.[7]

These allow us to have a precise definition of the utility cost of job loss for a worker at firm i:

(6) $$V_{Ei} - V_U = \frac{(W_i / m_i)}{P}\left[\frac{e-1}{e}\right]$$

This is always positive, which means job loss is costly to workers and that unemployment here is truly involuntary. Moreover, the utility cost of job loss varies across firms, being high where the wage distortion (W_i / m_i) is high.

We can also return to the firm-specific real wages in Equation (5) and consider it for firms A and B. Taking ratios, we find that:

(7) $$\frac{w_A}{w_B} = \frac{\hat{m}_B}{\hat{m}_A} = \frac{W_A}{W_B}$$

That is, the firm-specific real and nominal wages are in a constant ratio that depends inversely on the firm-level relative monitoring abilities as well as common parameters. With firm level physical marginal productivities also constant (as developed below), we finally arrive at the conclusion that relative marginal costs across firms will be constant. That is, firms can be

[7] Equation (1.5) requires the parameter restriction: $m_i / (r+\delta) > (e-1)$. The left-hand side is the probability of detection relative to the discounted probability of losing your job anyway. This must exceed the utility penalty of

ordered according to their marginal costs even before we have developed other elements of the equilibrium.

Assume that there is some firm that monitors effort perfectly, hence that $m_1 = 1$. We will choose the wage paid at such a perfect monitoring firm as our numéraire, so that the nominal wage $W_1 \equiv 1$. Using Equation (7), this gives rise to a notional nominal wage schedule

(8) $$W_i = \frac{m_i\left(1-\left(e-1\right)(r+\delta)\right)}{m_i-\left(e-1\right)(r+\delta)}$$

which is a constant greater than unity for $m_i \in \left(0,1\right)$ and decreasing in m_i. Firms pay a wage premium when their monitoring is less than perfect and that premium decreases as their monitoring improves. Although the nominal wage schedule is fixed, real wages of course are free to move with changes in the aggregate price index P. This nominal wage schedule will play a central role when we turn to the Melitz side of our model.

B. Aggregation

The next step is to connect wages to unemployment. For this we need an equilibrium density of the wages paid by active firms $f(W)$, to be derived later, and which of course will be common knowledge in the economy. Given this equilibrium density, we can calculate

$$E\left(V_{Ei}\right) = \left[\frac{e-1}{e}\right]P^{-1}E\left(\frac{W_i}{m_i}\right)+V_U$$

or, establishing notation,

(9) $$V_E - V_U = \left[\frac{e-1}{e}\right]P^{-1}\left(\frac{W}{m}\right)^{*}, \quad \text{where} \quad V_E \equiv E\left(V_{Ei}\right), \quad \left(\frac{W}{m}\right)^{*} \equiv E\left(\frac{W_i}{m_i}\right)$$

The average wage distortion $\left(\frac{W}{m}\right)^{*}$ will play a crucial role in what follows.

We are now ready to consider the flow benefits of being unemployed. Since unemployed workers here receive a zero wage, the flow benefits consist entirely of the expected capital gain from re-employment. Let a be the instantaneous probability of re-employment of an unemployed worker. Then the fundamental asset equation for an unemployed worker is:

effort. As long as workers are patient, exogenous job loss isn't too likely, or effort isn't too costly, this restriction will be satisfied.

(10) $$rV_U = a\left(V_E - V_U\right)$$

We can substitute (9) into (10) to get

(11) $$rV_U = a\left(\left[\frac{e-1}{e}\right]P^{-1}\left(\frac{W}{m}\right)^*\right)$$

The instantaneous probability of re-employment of an unemployed worker, a, can be examined in terms of the steady state, which requires that flows into and out of unemployment be equal. Let L be the total size of the labor force and let U be the total number of unemployed. In equilibrium separations happen at rate δ. Then the steady state imposes that:

$$aU = \delta\left(L - U\right)$$

or, defining the unemployment rate to be $u \equiv U / L$,

(12) $$a = \delta\left(\frac{1-u}{u}\right)$$

Substituting (12) into (11) gives

(13) $$rV_U = \delta\left(\frac{1-u}{u}\right)\left(\left[\frac{e-1}{e}\right]P^{-1}\left(\frac{W}{m}\right)^*\right)$$

Now we can substitute (13) into the individual firm's no-shirking constraint (5), noting that the aggregate price index cancels out:

(14) $$W_i = \left[\frac{\delta\left(e-1\right)}{e\hat{m}_i}\right]\left(\frac{1-u}{u}\right)\left(\frac{W}{m}\right)^*$$

This no-shirking constraint for firm of type i is an extremely important equation. For given common parameters, the nominal wage at firm i is fully determined by its monitoring (which determines $\hat{m}_i$) and the macro variables $\left(1-u\right)/u$ and $\left(W / m\right)^*$.

We now focus on Equation (14) for the perfect monitoring firm, which we label firm 1, which is the firm whose nominal wage we have chosen as our numéraire. Setting $W_1 = 1$ and inserting $\hat{m}_1$ with $m_1 = 1$, this implies

(15) $$u = \left[\frac{A_1 \left(\frac{W}{m} \right)^*}{1 + A_1 \left(\frac{W}{m} \right)^*} \right] \qquad \text{where} \quad A_1 \equiv \left[\frac{\delta (e-1)}{e \hat{m}_1} \right] \text{ is a constant}$$

which is strictly between 0 and 1, as required.

Equation (15) is a central element of the macro side of our model, so it is crucial to examine it closely. Consider this first for a given wage distortion $(W/m)^*$. It is straightforward to show that unemployment is then increasing in both the death rate of jobs δ as well as the utility cost of effort e. Each shifts the balance of benefits against effort, the first because expected job tenure declines and the second because the utility derived from non-shirking employment declines.

We can also look at this for given A_1, in which case the focus is on $(W/m)^*$. From the Shapiro-Stiglitz side of our model, it is clear that the average wage distortion must be computed across all active jobs. Looking inside any single firm, all fixed cost activities have a wage distortion of unity (i.e. no wage distortion), while marginal cost activities have a wage distortion of (W_i/m_i). In response to trade liberalization, there will be two sources of changes in the average wage distortion. The first is within the firm, due to the fact that the mix of fixed and marginal activities changes. The second is the redistribution of these activities across firms, as some expand output to reach new markets, others contract and serve only the domestic market, while others exit, in addition to the fact that the steady state mass of entry will adjust. From Equation (9), the capital gain associated with moving out of unemployment rises with the average wage distortion $(W/m)^*$. In this case, unemployment becomes less daunting and effort will be forthcoming only if there is a higher unemployment rate u, which explains the positive association of these variables in Equation (15).

The development to this point has assumed that workers discount the future at rate $r > 0$. When we turn to integrating our labor market model with the Melitz model, we will take the limiting case where $r \to 0$, to be consistent with his assumption that firms do not discount the future. By inspection of Equations (8) and (15), focusing on this limiting case has no implications for the key results of this section.

In summary, we have developed a Shapiro-Stiglitz model with heterogeneity in firm monitoring and iceberg costs of effort. This model yields two key relations that carry over to the Melitz side of our model. The first is a schedule of nominal wages relative to that paid by the perfect monitoring firm. This plays a key role in pinning down firm marginal costs. Second, the model delivers a key macro relation between the no-shirking unemployment rate and the average firm distortion, defined as the employment-weighted average ratio of the nominal firm wage to its monitoring ability. That ratio emerges endogenously from the Melitz side of the model and so determines the equilibrium unemployment rate.

III. The Product Market

A. The Consumer's Problem

Preferences over goods are identical and homothetic, hence can be represented by those of a representative consumer. The representative consumer's problem is identical to that in Dixit and Stiglitz (1977) and Melitz (2003). Consumers allocate expenditures across available varieties to:

$$\text{Min } E = \int p(i)q(i)di$$

$$s.t.\ \left[\int q(i)^{\rho}\, di\right]^{\frac{1}{\rho}} = \text{V}$$

We also have $0 < \rho < 1$, and $\sigma = \dfrac{1}{1-\rho}$.

These deliver demand curves for product i of the form:

$$q(i) = \left[\frac{p(i)}{P}\right]^{-\sigma} Q$$

where $Q \equiv V$ and P is an aggregate price index given by

$$P = \left[\int p(i)^{1-\sigma} di\right]^{\frac{1}{1-\sigma}} \tag{16}$$

The associated revenues for the producer of an individual variety from this consumer are:

$$r(i) = RP^{\sigma-1}p(i)^{1-\sigma} \tag{17}$$

These revenues depend both on aggregate values, $RP^{\sigma-1}$, as well as the firm choice of $p(i)$, and will be key inputs to the producer's problem.

B. The Producer's Problem

Firms face a sequence of problems. There is an unbounded mass of potential firms. In the first stage, a mass M_e of firms will enter, pay a fixed entry cost of f_e, and receive information about their type. Here a firm's type is represented by the pair (φ_i, m_i) covering both productivity and monitoring ability in variable costs. We saw above in Equation (8) that there is a simple relation between equilibrium no-shirking wages and monitoring. This means that the firm can immediately translate the productivity-monitoring draw (φ_i, m_i) to a productivity-nominal-wage draw (φ_i, W_i). As it turns out, the firm's own choices are affected only by the ratio $z_i \equiv (\varphi_i / W_i)$, although we will need to examine φ_i and W_i separately in order to analyze market equilibrium. Here z_i can be thought of equivalently as wage-adjusted productivity in marginal cost activities or as the inverse marginal cost for firm i.

We consider now the problem of an individual firm that has already sunk the cost f_e to learn its type z_i. Having learned its type z_i, firm i will produce if its variable profits cover its per period fixed costs f; otherwise it will exit before producing. Physical labor requirements in firm z_i follow Melitz:

(18) $$\ell(z_i, \varphi_i) = f + \frac{q(z_i)}{\varphi_i}$$

Note that firm level physical labor demand requires knowledge of φ_i (not only z_i), so must be recovered to establish labor market equilibrium once the structure of the economy (including the wage bill for a firm of type z_i) is determined.

Costs also depend on the wages paid to those workers. Our focus on the Melitz approach requires that the only locus of firm level variation is in marginal costs. Hence we assume that the firm pays a wage $W_f \equiv 1$ for labor employed in any of its fixed costs and a wage W_i for labor employed in its variable costs.

For given macro variables, a particular firm i thus faces a demand curve as defined in the consumer's problem above and chooses output to maximize profits,

(19) $\pi_i = p_i \cdot q_i - W_i \frac{q_i}{\varphi_i} - f = p_i \cdot q_i - \frac{q_i}{z_i} - f = \frac{r_i(z_i)}{\sigma} - f$

The first order conditions yield the familiar price as a markup on marginal cost:

$$p(z_i) = \frac{W_i}{\rho\varphi_i} = \frac{1}{\rho z_i}$$

Prices and maximized profits vary across firms only because of variation in z_i. That is, firms with a common inverse marginal cost z may be paying different nominal wages, which are offset by productivity differences, but they charge the same price, will produce the same quantity, and have the same revenue, wage bill, and profits. Hence we will drop the subscript i henceforth except as necessary to clarify limits of integration or when it is necessary to specify physical labor demand.

C. The Marginal Firm and Equilibrium Structure of the Economy

The combination of a primitive distribution on (φ, m) and the equilibrium nominal wage from the labor market in Equation (8) allows us to derive the joint distribution for (φ, W). Knowledge of this joint distribution allows us as well to calculate the distribution of inverse marginal costs $z \equiv \frac{\varphi}{W}$ with cumulative distribution function $G(z) \equiv \Pr[Z \le z]$ and density $g(z)$. The full equilibrium will feature a cutoff level of inverse marginal cost, $z*$, such that firms with $z < z*$ exit immediately upon learning of their draw.

Given $g(z)$, we can also define the equilibrium density of active firms:

$$\mu(z) = \frac{g(z)}{1 - G(z^*)}, \qquad z \in [z^*, \infty).$$

Equilibrium structure in an autarkic Melitz economy is determined by the solution of two relations between average profits $\bar{\pi}$ and the wage-adjusted productivity of the marginal entrant $z*$. The first of these two relations is a free entry condition (FE), which asserts that from an unbounded set of *ex ante* identical firms, a sufficient mass enters so that the average profits from entry equal the fixed cost of entry. The FE condition is essentially identical to that of Melitz:

$$\bar{\pi}(z*) = \frac{\delta f_e}{1 - G(z*)} \qquad \text{(FE)}$$

The second key relation is the Zero Cutoff Productivity (ZCP), which we construct as follows. Consider if the cutoff firm is one with $z = z_0$. Then, by definition of the marginal firm, we have:

$$\pi\left(z_0\right) = \frac{r\left(z_0\right)}{\sigma} - f = 0$$

Solving through, we recover the macro factors consistent with this cutoff, i.e. $RP^{\sigma-1} = \sigma f\,(\rho z_0)^{1-\sigma}$. This suffices to determine profits $\pi\left(z\right)$ at all other firms. With all firms $z \geq z_0$ surviving, we can recover the density of active firms $\mu\left(z\right) = \frac{g\left(z\right)}{1-G\left(z_0\right)}$, for $z \in \left[z_0, \infty\right)$. And this density plus the profits by z allow us to construct average profits (including the negative profits for firms that fail). The pair $\left(z_0, \bar{\pi}\left(z_0\right)\right)$ define a point on the Zero Cutoff Productivity curve. Repetition for all z gives us the full ZCP. Finally, and as in Melitz, the intersection of the FE and the ZCP curves determines the equilibrium marginal entrant $z*$. The equilibrium exists and is unique under the same conditions.

The equilibrium $z*$ completely determines the structure of the economy, including output, revenue, employment, and profit for each firm. We now need to go on to recover the average wage distortion, determine the associated unemployment rate consistent with no-shirking, and thus determine the mass of firms that provides for equilibrium in the labor market.

D. Unemployment and Labor Market Equilibrium

We showed in Equation (15) that the unemployment rate is an increasing function of the average wage distortion $\left(\frac{W}{m}\right)^*$. In computing the average wage distortion, we account for the fact that workers in fixed cost activities are paid a wage of 1 (and thus have a wage distortion index of 1) while workers in variable cost activities are paid a wage given by (8). Employment in active firms is given by (18). Let $\psi\left(i \mid z^*\right)$ denote the density of active firms, where $i = \left(\varphi, W\right)$ identifies a firm type. This density depends on the primitive joint density of $\left(\varphi, W\right)$ as well as the cutoff z^* determined in the previous section. The employment-weighted average wage distortion in the economy per unit mass of active firms is then

(20) $$\left(\frac{W}{m}\right)^{*} = \frac{\delta}{1-G\left(z^{*}\right)} f_{e} + f + \int \frac{q(i)}{\varphi(i)} \frac{W(i)}{m(i)} \psi\left(i \mid z^{*}\right) di$$

Plugging (20) into (15) delivers the equilibrium unemployment rate. With the unemployment rate determined, the equilibrium mass of firms *M* is determined by setting employed labor equal to labor demand,

(21) $$(1-u)L = M\left[\frac{\delta}{1-G\left(z^{*}\right)} f_{e} + f + \int \frac{q(i)}{\varphi(i)} \psi\left(i \mid z^{*}\right) di\right]$$

The mass of active firms plus the prices of all active firms allow us to establish the aggregate price index P as in Melitz. Aggregate income consists of total wages and is equal to spending[8].

E. Trade and Selection Effects

In this section, we need to derive elements of the trading equilibrium that will be relevant for the discussions in subsequent sections. As before, key elements of equilibrium will be determined by the intersection of two curves. The first is the Free Entry curve, which is defined so that ex ante profits are zero, hence ties each potential cutoff z with an expected profit level $\bar{\pi}$. This curve is entirely unchanged in a move from autarky to costly trade. The second is the Zero Cutoff Productivity (ZCP) curve, which does change relative to autarky.

The new ZCP curve will lie above the autarky ZCP curve, essentially for the same reasons as in Melitz. To understand this, it is convenient to begin by deriving one point on the new curve. Fix one potential cutoff, say z_0, and assume that this corresponds to a zero profit firm. All discussion that follows in this paragraph is premised on this cutoff. Such a firm serves only the domestic market (foreign profits would be negative). Hence its profits are given by $\pi_0 = \frac{r\left(z_0\right)}{\sigma} - f = \frac{RP^{\sigma-1} p(z_0)^{1-\sigma}}{\sigma} - f = 0$. This can be solved for the aggregate variables $\left(RP^{\sigma-1}\right)_0$ consistent with z_0 being the cutoff, and is unchanged relative to autarky. Hence, conditional on the cutoff, all firms serving only the domestic market see their profits unchanged. Firms also have the opportunity to serve the foreign market. Those that do so will find demand

[8] Unlike in Melitz, nominal national income is not simply equal to the size of the labor force.

there that is $\tau^{1-\sigma} < 1$ times that available in the domestic market. With a fixed cost f_X of penetrating the export market, the cutoff z_0 will also have a cutoff exporter z_{X0} for whom the net change in profits just from exporting equal zero, or $\frac{\tau^{1-\sigma} RP^{\sigma-1} p(z_{X0})^{1-\sigma}}{\sigma} - f_X = 0$. For firms with $z > z_{X0}$, they earn profits equal to $\pi_{X0} = \frac{\left(1+\tau^{1-\sigma}\right) RP^{\sigma-1} p(z)^{1-\sigma}}{\sigma} - f - f_X$, which is strictly greater than in autarky. With the set of active firms fixed by the cutoff, with firms only oriented to the domestic market enjoying the same profits as in autarky, and with firms that export enjoying higher profits, expected profits at a cutoff of z_0 must be higher. That is, the point on the new ZCP curve corresponding to z_0 is above that from autarky. Since this is true for an arbitrarily chosen z_0, the trade ZCP curve lies above that in autarky. With the FE curve upward sloping, and the ZCP curve cutting FE once from above (as in Melitz), this implies that the equilibrium cutoff $z*$ must rise. That is, our model will feature the same kind of selection effects as in Melitz and for exactly the same reason – i.e. the new opportunities available to exporters and the new pressures from import competition. Given $z*$, the cutoff for exporting z_x^* is also found as in Melitz. With these cutoffs, we can calculate the new $\left(W / m\right)*$, hence also determine the unemployment rate. With these in hand, we can return to recover all other variables in the trading equilibrium.

IV. Autarky to Freer Trade in Two Special Cases

We have developed a general model that integrates the Melitz model of heterogeneity in firm productivity with a Shapiro-Stiglitz model amended to allow for heterogeneity in firm monitoring abilities. We have shown that the structure of the economy is isomorphic to that in Melitz and a function of firm marginal costs $mc_i = W_i / \varphi_i = z_i^{-1}$, which depend on firm variation in both wages and productivity. Before turning to examine the consequences of trade liberalization in the general case, it will prove useful to consider two special cases, each of which shuts down one of the two influences on marginal costs.

A. The Melitz-Type Model

Our first special case is what we term a "Melitz-type" model. Marginal costs are assumed to vary with heterogeneity in firm productivity, but we assume that all firms have the same monitoring ability hence pay the same nominal wage. If all firms monitor with the same efficacy, then they also offer the same nominal wage and $\left(W/m\right)^*$ is a constant independent of the marginal firm, so by Equation (15) unemployment is also at a fixed rate. If we go further to assume that all firms monitor perfectly, the unemployment rate is $u = 1/\left[1-\delta\left(e-1\right)\right]$ and all nominal wages are equal to unity.[9]

With $W_i \equiv 1$, we have $mc_i = 1/z_i = 1/\varphi_i$, as in Melitz. Figures 1A and 1B illustrate results familiar from Melitz, where in the (W_i, φ_i) space, all firms lie on the $W_i \equiv 1$ line. In autarky, firms whose marginal costs are higher than mc_a^* (productivity lower than φ_a^*) exit without producing.

Consider a substantial reduction of marginal trade costs that moves this economy out of autarky. This will have selection effects on the set of active firms for reasons familiar from Melitz (2003). In a move from autarky to a costly trade steady state, the highest marginal cost (lowest productivity) firms $\left[mc_a^*, mc^*\right)$ exit; the next lower marginal cost firms $\left[mc^*, mc_x\right)$ contract; the next lower marginal cost firms $\left[mc_x, mc_\pi,\right)$ succeed in exporting, although their profits fall; and finally the lowest marginal cost firms, $mc \le mc_\pi$, become super-exporters and raise their profits. Homogeneous labor and a common monitoring technology imply that nominal wages are unchanged. Still, the economy achieves higher productivity through the elimination or contraction of high marginal cost firms to the benefit of low marginal cost firms. And workers will be better off as a result of the availability of cheap imported varieties and through a possible increase in variety available locally.

The fact that the average wage distortion does not change implies that neither will there be a change in the unemployment rate. Within the context of our model, this justifies Melitz in having put aside issues of aggregate unemployment, since if the only source of heterogeneity in

[9] The unemployment rate is positive in spite of perfect monitoring because in the model shirking workers are still paid for the instant prior to firing and you thus positive unemployment is needed to ensure effort.

firm marginal costs is firm-level productivity, then unemployment, while it does exist, does not change in the move from autarky to freer trade.[10]

The Melitz model has many great features. But its constraint that all wages for all workers are identical makes it impossible to make sense of public concerns that trade destroys good jobs – no job is any better than any other. And the fact that there are aggregate gains from liberalization combined with the homogeneity of jobs suggests that all workers will benefit, at least eventually, from such a liberalization. This makes it hard to make sense of worker concern about trade and suggests the need for a richer model in which there is a clear sense of some jobs being better than others.[11]

B. Firm-Level Variation *Only* in Wages

A second special case arises when we abstract from heterogeneity in firm productivity and allow *only* for heterogeneity in firm monitoring, hence in wages. For this case, we set $\varphi_i \equiv 1$ and thus have $mc_i = W_i = 1/z_i$. Hence in this case, we can speak synonymously of marginal costs or wages. Note also that the fact that identical workers receive different wages at different firms means that workers perceive some jobs as being better than others. Figures 2A and 2B illustrate the relevant cases in autarky and in a move from autarky to freer trade. In the figures, all firms in the (W_i, φ_i) space lie on the $\varphi_i = 1$ line at wages $W_i \geq 1$. Exactly as in the previous case, in autarky firms with high marginal costs exit before producing. However, since all firms now have the same productivity, variation in marginal costs arises only due to differences in the wages that must be paid. Hence firms in autarky whose poor monitoring technology would require wages $W_i > mc_a^*$ exit before producing.

This model also provides a first opportunity to make sense of the public perception that freer trade destroys good jobs at good wages. In a move from autarky to freer trade, the highest wage firms in existence, those with wages $W_i \in \left(W^*, W_a^*\right]$, exit and all the high wage jobs at these firms are destroyed. The existing firms that offer the next highest wages, those with

[10] This result contrasts with Matusz (1996), where trade liberalization in a monopolistic competition model reduces unemployment. The key to the difference is that in Matusz' specification an equilibrium increase in variety reduces the incentive to shirk. Our specification of utility neutralizes this effect, for reasons discussed in section II.A

[11] As noted by Kletzer (2001), import-related job losses are often associated with extended spells of unemployment and substantial declines in wages when re-employed.

$W_i \in \left(W_x, W^*\right]$ contract and dismiss some of their workers. As we head down in the wage distribution to relatively low paying jobs, those with wages in the range $W_i \in \left(W_\pi, W_x\right]$, firms expand employment to reach new export markets, but even this export success is insufficient to raise their total profits. Employment expands most sharply at the firms offering the lowest wages, those in the range $W_i \in \left[1, W_\pi\right]$. And it is only these last firms, the ones offering the lowest wages and who become super-exporters, who actually have their profits rise as a result of liberalization. Indeed, the profit gains to these firms offering the lowest wages exceed the combined profit losses to all other firms, including those forced to exit.

Since the output response is greater at firms with better monitoring offering lower and lower wages, we can be sure that the average wage distortion falls in the move from autarky to freer trade. One compensation in this case is that the aggregate unemployment rate will for this reason fall. All workers will also benefit from the lower prices and possibly increased variety arising from trade. However, with a lower average wage, and all of the highest paying jobs eliminated from the economy, there are likely to be many workers who see themselves as worse off on account of liberalization.

This model in which the only source of variation in marginal costs is due to firm differences in wages has the great merit that it presents a very stark articulation of the public concerns that trade destroys good jobs at good wages. If we constrain all firms to have a common technology, then those that pay the highest wages are at risk of exit or contraction in the move from autarky to freer trade. Trade destroys the best jobs.

Nevertheless, there are good reasons to believe that this model in which all variation in firm level marginal costs is due to differences in wages is at best incomplete. Most pointedly, it would have the implication that high wage firms are also small and unprofitable firms. The data contradict this: there is a postive correlation between wages and firm size (see Brown and Medoff (1989), Idson and Oi (1999) and Manning (2003), among others). Like the Melitz model, which allowed marginal costs to vary only with firm productivity, this model in which marginal costs vary only due to firm level wage differences has important shortcomings. We will now turn to the general model, which allows for marginal costs to vary for both reasons to see that we can address the concerns that arise in the two special cases.[12]

V. Trade Liberalization in the General Case

This section will consider the consequences for firms and workers of trade liberalization in our general model. Sections V.A. and V.B. consider this in detail for the case of a move from autarky to freer trade. In Section V.C., we will discuss liberalization in economies that are already partially open.

We divide our discussion of a move from autarky to freer trade into two pieces. The first will consider the case of a liberalization that affects the structure of the economy, but not its scale. As discussed above, the link in our model between structure and scale is the average wage distortion, $(W/m)^*$, through the impact of this on the equilibrium unemployment rate. Depending on the primitive distribution of productivity and monitoring (φ, m), our model is consistent with either a rise or fall in this average wage distortion with liberalization. As a base case, we begin by assuming that liberalization has *no* impact on this average wage distortion. This implies that the structure of the economy will change, but not its scale. Once the analysis of a change in structure is complete, we go on to consider how we would need to amend the conclusions of that analysis once we allow for changes in scale as well.

The analysis in this section, in formal terms, is comparative steady state analysis. A complete analysis of the time path of adjustment would be required to make definitive statements about welfare and political economy. That is beyond the scope of this paper. Nonetheless, the basic nature of the adjustments required along the path to the new steady state does emerge from our model. We believe that this provides a powerful heuristic for understanding the forces at work in identifying winners and losers, hence also in understanding the political economy of liberalization.

[12] The general model allows for a positive association between wages and firm size. As developed, it remains true here that good jobs are lost only at small firms. There are at least two amendments one could consider that are consistent with our framework that would allow for the loss of good jobs at large firms. One path would be to allow for multiproduct firms, in which case the loss of good jobs could be in small product lines at large firms. The other path would be to consider the possibility that fixed costs differ across firms. This introduces a dimension of

A. Changes in Structure Only

We consider here the special case in which our economies move from autarky to freer trade, but in which the average wage distortion, hence also aggregate employment, is unchanged. This implies that the analysis of the structure of firms' price and output decisions in the product market, as well as profit, entry and exit, will be precisely as in Melitz, so long as we use our own measure of inverse marginal cost, given by *z*. Here, though, workers have attachments to specific firms because of rents created by differences at the firm level in wages.

We can use Figures 3A and 3B to think about the comparison of autarky and freer trade as it affects profits of firms and employment of workers. The lowest feasible wage is the perfect monitoring wage and equals one by choice of numéraire. In Figure 3A, the ray labeled mc_a^* indicates the highest level of marginal cost consistent with zero post-entry profits, and thus defines the cutoff for active firms. Firms with lower marginal costs are to the southeast of the mc_a^* ray, and firm size is monotonically decreasing in marginal cost. An implication is that even if monitoring ability and physical productivity are *ex ante* uncorrelated, there will be an *ex post* correlation between productivity and wages, because only high productivity firms can afford to stay in business while paying high wages. If *ex ante* monitoring costs and productivity are positively correlated, our model offers a potential explanation for the firm size-wage premium: highly productive firms are likely to have higher monitoring costs and consequently pay higher wages. As long as the high wages don't completely offset high productivity, high wage firms will also be big firms on average (this conjecture was also made by Bulow and Summers (1986)). Our model is quite consistent with the Idson and Oi (1999) explanation for the firm size-wage premium. Idson and Oi dismiss the efficiency wage model on theoretical grounds and claim in their title that "Workers are more productive in large firms" which is why they are paid more. With an *ex ante* correlation between monitoring costs and productivity, efficiency wages and productivity are complementary rather than substitute explanations for the firm size-wage premium.[13]

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complexity to the Melitz model that we will not pursue here, but it is intuitively clear that for a firm with high fixed costs, exit will occur at a larger firm size. Again this allows the possibility of the loss of good jobs at large firms.

[13] We have modeled the monitoring ability of a firm as a simple stochastic draw. If one were to model monitoring itself as an increasing returns activity, one might imagine large firms would have an incentive to monitor more thoroughly, which taken alone might suggest that large firms would pay *lower* wages, contrary to evidence. However there are also contrary influences. If the organization of work at large firms differs from that in small firms (e.g. more teamwork) in ways that make monitoring more difficult, this could give rise to higher wages there.

The impact of the shift in comparative steady states from autarky to trade, illustrated in Figure 3B, gives rise to three additional critical values in inverse marginal costs. The first is mc^*, the marginal entrant under freer trade. Next is mc_x, the marginal exporter. Finally is mc_π, the highest marginal cost for which a firm sees its profits rise with freer trade. Accordingly, these boundaries define Regions I to IV in the figure.

The impact of trade on firms' profits and output is straightforward. All firms in Region I exit with trade, so their profits and output fall to zero. Firms in Regions II and III also see a decline in profits. For firms in Region II, the entry of foreign firms into their home market reduces their domestic demand and profits, yet leaves them incapable of finding a sufficient foreign market to justify the fixed costs of exporting. Output for these firms declines. It is notable that firms in Region III suffer a decline in profits in spite of the fact that they not only survive in the domestic market but also find a foreign market for their products; the losses in the home market are not fully compensated by the new profits in the export market. Total output for these firms expands and so the decline in profits is attached to the fixed cost of entering the export market. Only the largest firms, those in Region IV, find that their profits rise with trade. Notably, firms can find their way into Region IV either by their inherent productivity or by effective monitoring of workers, which allows them to elicit effort at low wages.

The analysis of the impact on workers is only slightly more complex. We have set aside until the next subsection any impact of trade on the average wage distortion and equilibrium unemployment. The nominal wage of a worker who maintains employment at a specific firm is determined by the firm specific monitoring technology and parameters of the model, so is unaffected by trade liberalization.

This leaves only two channels for trade to affect workers. The first, as in Melitz, is that liberalization lowers the typical price and may raise total variety of products available to workers *qua* consumers. This benefits all workers and should be considered as a potential offset to losses incurred by some workers.

Similarly, if as in Rosen (1982), entrepreneurs concerned about span of control have to choose to allocate their effort to product improvements or monitoring employees, and if stronger entrepreneurs have comparative strength in product improvement, they could find it optimal to substitute high wages for close monitoring, again reinforcing a size-wage correlation. These considerations, as well as the fact that not all labor is homogeneous, suggest not leaning too heavily on any one piece of evidence to judge the merits of any particular model of firm wage formation.

The second channel for trade to affect workers here is via changes in employment, which is most directly related to the fate of firms in the output market. We have already seen that firms in Region I exit the market, hence all workers at these firms lose their jobs. Firms in Region II contract their output, hence workers at these firms may be seen as facing a probability of job loss related to the degree of contraction. Firms in Regions III and IV expand employment sufficiently in the new steady state to provide precisely the same number of new jobs as those lost via firings among firms in Regions I and II.

Workers at firms in Regions III and IV should expect to be unambiguously better off with the move from autarky to freer trade. The firms there are expanding output, so should have no unusual layoffs. And they enjoy gains from lower typical prices and possibly increased variety.

The situation is more intricate for workers initially with firms in Regions I and II. As noted, on one side are the common variety and price gains from liberalization. On the other side is the certainty (Region I) or probability (Region II) of job loss. In the model workers must pass through a period of unemployment before finding new employment. Since workers always prefer to be employed rather than unemployed, this is a cost. The magnitude of the cost of a job loss is higher the higher the initial wage. While we don't have an explicit model of the transition between steady states, this particular comparative steady state creates a great deal of turnover while costing zero net jobs. This should be good news for those currently unemployed, who are happy to accept any job on offer and suddenly find a lot of hiring going on, even though the transition would require more people to pass through unemployment.

This comparative steady state also provides a window on the debate over whether trade liberalization threatens "good jobs". A precise way to state the consequences for jobs here is that liberalization destroys jobs with high marginal costs of production. Sometimes these are low wage jobs with very low productivity; sometimes they are high wage jobs with productivity that may be high but is not quite high enough to secure the jobs.

However, there is another – from a worker's perspective, quite natural – way to interpret the consequences of the shocks. This is to hold fixed the type of firm, indexed by its productivity ϕ, and compare what happens to different types of jobs at comparable firms defined in this way. Figure 4 provides a simple window on this way of looking at the world. To the previous diagram, Figure 4 adds the average wage in autarky, $\overline{W}_a$, and a specific productivity level φ_0, which for illustrative purposes was chosen to intersect the average wage line at the boundary of Regions II and III. Perhaps the simplest definition of a "good job" in autarky is one that pays a wage above the average, i.e. $W_a > \bar{W}_a$. Holding productivity fixed at φ_0, we see that trade threatens *all and only* good jobs. Controlling for firm productivity φ_0, the highest paying jobs are those in Region I – all of which are lost in the opening to trade. The next highest paying jobs are those in Region II – some, but not all, of which will be lost to trade. Controlling for productivity, only the lowest paying jobs survive the opening to trade. Indeed, trade leads to an expansion of these jobs and most sharply among the lowest paying of these (those along φ_0 in Region IV).

We see that the public perception that trade destroys good jobs at good wages does have foundation in the context of this model. Some workers who in autarky would enjoy high wages will find that a move to freer trade eliminates their jobs. Indeed, if we condition on productivity, trade always destroys the best jobs.

Having acknowledged this, it is also crucial to understand the limits of this way of thinking. Yes, trade will eliminate some of what workers perceive as good jobs, and conditioning on productivity, trade always destroys the best jobs. Yet this is perfectly consistent with the possibility that trade will simultaneously expand the number of high wage jobs sufficiently that the average wage will rise. Indeed, we will argue below why we think this is the normal case. The net gain for specific workers and for workers as a whole will then need to account for changes in prices and variety, which will typically be additional sources of gain, as well as for changes in aggregate unemployment. Moreover, in this model, all income accrues to labor. Good jobs are naturally very attractive to those who have them; however, the associated inefficiencies cost labor as a whole.

B. Changes in Structure *and* Scale

In the previous section, we abstracted from the possibility that liberalization may affect the average wage distortion, hence unemployment, so turn to this now. The firm level wage distortion, (W_i / m_i), is a constant, so unaffected by liberalization. The average wage distortion across all firms is affected by the redistribution of output (including exit) across firm types that may have different levels of distortions. At any marginal cost, indexed by z, there exist firms with heterogeneous wage distortions. While we can make specific predictions about which firms will exit according to the ordering by z, it is not possible to say whether the average wage distortion will rise or fall with liberalization without knowledge of the full joint distribution of (ϕ, m).[14] In short, $(W/m)^*$ is a function of z^*, but it need not be monotonic.

1. The Average Wage Distortion, Macro Effects, and the New Steady State

The macro implications of changes in the average wage distortion come directly from our heterogeneous firm model of efficiency wages: a rise in the average wage raises equilibrium unemployment. From Equation (15), we recall that $u = A_1\left(\frac{W}{m}\right)^* / \left[1 + A_1\left(\frac{W}{m}\right)^*\right]$. As discussed in Section II.B., a rise in the average wage distortion, through firm selection effects, raises the expected capital gain from moving between unemployment and employment, so makes unemployment less daunting, requiring a rise in the structural unemployment rate to maintain the balance of incentives to elicit effort.

This rise in unemployment relative to the case of no change in the average wage distortion changes the scale of the economy, but not its structure. Because of the general second best nature of the economy, we cannot rule out that with a sufficient rise in the unemployment rate, total real income may decline with liberalization, although we would consider this an unusual case. Similarly, even as the average price of products declines, there can be a rise in the economy's price index because the rise in unemployment causes a decline in the total mass of varieties available in the market. The fact that the *possibility* of absolute losses might arise in a model with factor market distortions would not be surprising, although such an outcome in the world seems unlikely.

The rise in unemployment anticipated with the move from autarky to freer trade reduces the steady state mass of firms of each type relative to the previous case in which employment was unchanged. In principle, a sufficiently sharp rise in the average wage distortion, accompanied with a sharp rise in the required unemployment rate, could lead to a reduction of the presence even of the most productive export firm types in the new steady state and a loss in total employment there.[15]

[14] Unfortunately even knowledge of movements in the average nominal wage would not suffice to determine the qualitative change in the average wage distortion, as they need not be monotonically related.

[15] While the present paper develops only comparative steady states, it would be interesting to study transition dynamics for the case in which the rise in the average wage distortion, hence also the unemployment rate, in the new steady state requires a smaller mass even of the highly productive firm types. We conjecture that in this case the

2. Political Economy

The main thrust of the political economy for comparative steady states from the view of firms can be understood through examination of Figure 3B. As before, the move from autarky to freer trade divides the space into four key regions in terms of marginal costs. All firms with $mc > mc_{\pi}$, i.e. those in Regions I, II, and III, lose profits as a result of the move of comparative steady states from autarky to freer trade. Only the largest firms, those with $mc < mc_{\pi}$ gain. Hence a move from autarky to freer trade should be supported only by the largest firms.

Turning to workers, we start with several general observations. Trade always serves to lower the typical price and (unless unemployment rises sharply) will also raise the total (local and imported) number of varieties available in the market to consumers. Hence typically the price index will fall in the move from autarky to freer trade, which is a gain to all workers.

Selection effects from liberalization may also alter the distribution of types of jobs in the economy. We have to treat distinctly three separate concepts, namely the average wage distortion, $(W/m)^*$, the average nominal wage, W^*, and the general equilibrium impact on the average real income of workers. As we have noted, the unemployment rate is linked directly to the average wage distortion. We have seen at the firm level that a "good job", i.e. one that pays a high wage (relatively) is one where this distortion is high. Yet when the average rises, unemployment rises, which is costly directly due to lost output and also due to associated loss of variety. While the average nominal wage in the economy seems likely to be positively associated with the average wage distortion, close examination reveals that this connection is not a necessary one. Still, we may expect that $(W/m)^*$ and W^* may typically move together, which would in such cases suggest a tradeoff between high unemployment and high average wages in the typical job. It is worth keeping in mind, though, that "good jobs" come at a price. Here all

transition will feature *overshooting* of both the average wage and the unemployment rate along the path to the new steady state. The logic is simple. Apart from exogenous firm deaths, firm exits only arise when expected present discounted profits are negative. But firm profits are monotonically decreasing in marginal costs. Hence if the "crowding" of the market by the excess prevalence of low marginal cost firms during the transition relative to the steady state leads to exit, this exit will be among the highest marginal cost (small) firms. But if indeed these small firms are on average also the low wage distortion firms, then this change in composition will lead the average wage distortion to be higher in the transition than in the steady state. All else equal, the rise in the average wage distortion also requires a higher unemployment rate to insure effort, since the no-shirking constraints have to hold at all times.

income accrues to workers, so that average real income to workers is maximized exactly when total real income is maximized. The distortions that give rise to "good jobs" here lower aggregate real income and so also lower the average real income of workers.

There are also important distributional effects – job loss will fall particularly heavily on some. Since firms in Region I exit and those in Region II contract output, all workers in Region I firms lose their jobs and some in Region II firms lose their jobs as well. It is interesting to observe that although firms in Region III lose profits with the liberalization, workers there do not lose jobs, and so should have no reason to oppose liberalization on this basis.

C. Trade Liberalization in Partially Open Economies

We now consider the consequences of trade liberalization in economies already partially open. We can again separate our discussion into the impact on the structure of the economy, which follows Melitz, and the scale, which requires adjustment for aggregate unemployment. Because the Melitz results are well known, we highlight only the novel consequences in our framework. In the discussion that follows we continue to assume that large firms typically pay higher wages.

The three types of liberalization in partially open economies are (1) An increase in the number of trading partners; (2) A reduction in variable iceberg trading costs; and (3) A reduction in the fixed costs of entering export markets.

The key analytic elements to keep track of are: (i) The shifts in margins between those who produce and those who exit, between those who do or don't export; and between those whose profits rise with the specific liberalization and those whose profits fall; and (ii) Whether the liberalization raises the average wage distortion, with consequent implications for the unemployment rate.

The three types of liberalization in partially open economies share some features. In particular, all three require lower marginal costs for firm survival. This forces the exit of the smallest firms, eliminating the jobs of workers at those firms, which we have suggested will typically, but not always, be lower wage jobs.

Our conjecture, then, is that both the average wage distortion and unemployment will overshoot in the transition to the new steady state. Confirming this conjecture is beyond the scope of the present paper.

The liberalizations differ in their impact on the margins of which firms do or do not export. The increase in the number of trading partners makes it harder for the small exporter to continue, while the decrease in either the marginal or fixed cost of exporting makes entry into foreign markets easier. The logic is simple. An increase in the number of trading partners implies that a firm has opportunities in more markets, but with more competitors, it will have a smaller slice of each market. With the fixed per-market cost of export penetration unchanged, the initially smallest exporters will find that the new per-market demand is too small to justify the fixed cost of entry; they will exit the export markets, requiring lower marginal costs to survive. By contrast, a reduction in variable or fixed costs of trade raises demand or reduces costs associated with entering exporting, so leads to new exporters, i.e. to the entry of relatively high marginal cost exporters.

Firms who cannot export even with the liberalization, or in the case of an increase in the number of trading partners, exit exporting, will find that their domestic market, profits, and employment are all eroded. The jobs lost will not typically be the economy's highest wage jobs, although some of them could be relatively highly paid.

In the case of an increase in the number of trading partners, there will be an interval of surviving exporters near the marginal exporter whose profits fall even as their employment rises due to the larger number of fixed costs involved in servicing the new markets and the smaller demand per market (including the home market). Similarly, in the cases of declines in variable or fixed trade costs, there will be an interval of firms who newly enter the export market, whose employment and output rise, but whose penetration of the foreign markets is insufficient to compensate them for profits lost in the domestic market and the fixed costs of entering foreign markets.

In the case of an increase in the number of trading partners, the greatest gainers are the largest firms, who expand both employment and profits. The fixed costs of trade associated with entry to the new markets are of secondary importance to them, but they gain both by the access to new markets and by the exit of previously marginal exporters. These more than compensate for the loss of domestic market share. The profits of the largest firms also increase in the case of a decline in variable trade costs.

The consequences for pre-existing exporters in the case of a decline in fixed costs of trade are more subtle. We have examined this for a case in which productivity (inverse marginal costs) follows the Pareto distribution. In the case we examine, the smaller pre-existing exporters gain profits from the reduction in the fixed cost of trade while the largest pre-existing exporters lose profits.[16] The intuition for this contrast is straightforward. The benefit of a reduction in the fixed cost of trade is constant for exporters large or small. But since lost revenues are proportional to initial presence in each market, the costs are considerably greater for the larger firms. Hence even if the decline in fixed costs benefits smaller exporters on net (as in our example), sufficiently large firms will find that the lost sales from new entry in all markets outmatches the gain from a lower fixed cost of exporting.

One of the important consequences of these analyses is that, unlike the case of a move from autarky to freer trade, the output and so employment response of firms will not be monotonic in the size, or equivalently, marginal cost of the firm. In particular, output responses will typically be sharpest among firms at either the bottom of the size distribution, where they exit, or in the middle of the distribution, where they transit into or out of exporting. Given that we continue to assume that wages and size are positively correlated, the exit of the smallest firms generally would be expected to raise the average wage. But sharp changes in employment in the middle of the distribution could push either way depending on the direction of employment change (entering or exiting exporter status) and on whether the gains or losses are for jobs above or below the initial average wage. In either case, if the liberalization raises the average wage, the unemployment rate must rise; if it lowers the average wage, the unemployment rate will fall.

VI. Numerical Analysis

As the discussion in previous sections makes clear, our model offers a rich set of implications for how labor markets adjust to trade liberalization. In this section we simulate the model, where possible using parameters taken from previous studies. The purpose of these simulations is to see how large the effects identified in the model are.[17]

To preview our numerical results, trade liberalization leads to little change in variety, a rise in aggregate real income, and tremendous churning in the labor market, with the gross loss of as many as one-fourth of good jobs.

[16] This provides a small corrective to Melitz (2003), p. 1718, where he claims that all pre-existing exporters lose both revenue and profits as a result of a decline in the fixed costs of trade. The decline in revenue is correct, but the decline in profits is true only for the larger pre-existing exporters.
[17] All calculations were performed in *Mathematica*, and the programs are available on request.

A. The wage and productivity distributions

The numerical version of our model requires specification of the *ex ante* joint distribution of productivity and wages, as well as values for the other model parameters such as fixed and variable trade costs, fixed and sunk entry costs, and the elasticity of substitution.

In specifying the distribution of productivity and wages, we are guided by the large empirical literature on the firm size and wage distributions. This literature almost invariably models wages as log normal, and the firm size distribution as Pareto, so we do the same.

A key parameter in our model is the dispersion of wage rents. As discussed in our introduction, Krueger and Summers (1988), among others, argued that large measured industry wage differentials were evidence of labor rents, while Murphy and Topel (1987) and others argued that unobserved heterogenity in workers' marginal products was resp[onsible for industry wage differentials. A similar dispute arises in interpreting the well-documented correlation between firm size and wages (e.g. Brown and Medoff (1989), Idson and Oi (1999), Manning (2003, Chapter 4)). To resolve this dispute requires information on worker and firm characteristics, as well as enough "job switchers" to be able to reliably identify what component of a worker's wage is due to her inherent productivity and what component is due to the firm where she works. Abowd, Kramarz and Margolis (1999) have assembled data (a panel of French workers and firms from 1976 to 1987) that can answer this question. Their conclusion is that the "person" effect is much more important than the "firm effect":

> Virtually all of the inter-industry wage differential is explained by the variation in average individual heterogeneity across sectors. Person effects, and not firm effects, form the basis for most of the inter-industrial salary structure. (Abowd, Kramarz and Margolis, 1999, pg. 253)

While this result can reasonably be interpreted as vindication for the view that labor rents are smaller than Krueger and Summers may have thought, "virtually all" does not mean all. In their Table IV, middle panel, Abowd *et al* report their estimate of the standard deviation of the firm effect on log French wages as 0.06.[18] In our model the "firm effect" corresponds to wage

[18] We are referring here to Abowd *et al*'s parameter ψ. The estimate is 0.0685 for men, 0.0566 for women. The sample standard deviation of log wages is 0.519 and 0.480 for men and women respectively, so the ratio of the standard deviation of the firm effect to the standard deviation of log wage is 0.13 and 0.12 for men and women respectively.

variation due to variation in monitoring ability across firms, so we parameterize the marginal distribution of wages $F_w(w)$ as being log normal with a standard deviation of 0.06.

Following many authors, we model the *ex ante* marginal distribution of unit labor requirements a, $F_a(a)$, as following a Pareto distribution with parameter κ. (where $a = \varphi^{-1}$) and upper bound α. The Melitz (2003) model can be solved analytically with this distribution (Baldwin 2005), but solution requires the technical assumption that $\kappa > \sigma - 1$. The literature on the firm size distribution suggests that κ is close to one (see, for example, Axtell (2001)), although Del Gatto, Mion, and Ottaviano (2006) find $\kappa = 2$ on average across industries and countries. Most estimates of the elasticity of substitution σ exceed 2 (for example, Harrigan (1993) estimates σ to be between 5 and 12, while Broda and Weinstein (2006) find median values of σ greater than 2). Thus there is an uncomfortable tension between the mathematical requirements of the model and the empirical evidence. In our simulations we choose $\kappa = \sigma = 2$, a choice which does approximately equal violence to both facts while allowing us to simulate the model[19].

B. Parameters of the efficiency wage model

With wages given by draws from the distribution $F_w(w)$, the associated values of monitoring costs are given by inverting Equation (8). To guide our choice of the remaining parameters of the efficiency wage model, we work with Equation (15) which gives the equilibrium unemployment rate. Along with the average distortion, the determinants of the equilibrium unemployment rate are the exogenous firm death rate δ and the utility cost of effort e. We choose these two parameters so that the equilibrium unemployment rate is reasonable for an OECD country, which leads us to $\delta = 0.05$ and $e = 1.1$.

[19] We also simulated the model for $\kappa = \sigma = 3$, with very similar results, so in the interests of brevity we do not report these results.

C. Joint distribution of wages and productivity

With the marginal distributions for wages and productivity fixed by the considerations described above, it remains to model the joint distribution. We do so using the Ali-Mikhail-Haq copula, which specifies the joint cdf of wages *w* and unit labor requirements *a* as a function of the marginal cdfs and a parameter θ,

$$F(w,a)=\frac{F_w(w)F_a(a)}{1-\theta\left(1-F_w(w)\right)\left(1-F_a(a)\right)},\quad \theta\in[-1,1)$$

The degree of association between *w* and *a* is governed by θ, with independence corresponding to $\theta = 0$. As θ ranges between -1 and 1, the correlation coeffcient between *w* and *a* ranges between -0.27 and +0.48. A negative correlation implies that, *ex ante*, high-wage firms tend to have higher productivity. In the simulation we set $\theta = -0.9$, which delivers an *ex post* positive correlation between firm size and wages in equilibrium, as well as a positive export-wage premium, both of which are features of the real world. For more on copulas and sampling from the above joint cdf, see Nelsen (2006).

A deeper justification for assuming a correlation between wages and productivity is provided by the efficiency wage model of Mehta (1998). Mehta observes that managers monitor, and that time spent monitoring one worker has an opportunity cost in terms of monitoring other workers and/or time spent on other managerial activities. Since there is a tradeoff between wages and monitoring effort in getting workers not to shirk, it may be optimal for managers at high productivity firms to substitute toward higher wages so they can spend more time at the margin in other activities. Modelling of this trade-off is beyond the scope of our paper, but the intuition is captured by our assumption that monitoring efficiency is inversely related to productivity.

D. Fixed and variable costs

Our measures of variable trade costs come from the influential survey by Anderson and van Wincoop (2004). Using U.S. and other data sources, the authors report that trade costs are about 74 percent, which reflects the combined influence of border costs of 44 perecent and transport costs (including the time cost of goods in transit) of 21 percent. Thus in our simulations, we take $\tau = 1.74$ as our measure of variable trade costs in the move from autarky to trade. We also report simulations that set all border barriers to zero, which implies $\tau = 1.21$. The difference between $\tau = 1.74$ and $\tau = 1.21$ is thus a measure of the effect of the removal of all border barriers.

Like Melitz (2003), our model has three fixed costs: the sunk cost of entry f_e, the fixed cost of production f, and the fixed cost of exporting f_x. We have little empirical evidence to guide our choice these parameters. However, what matters for the equilibrium is not the absolute size of these parameters but rather their relative size. Solving Melitz (2003) with the Pareto distribution, it can be shown (e.g. Baldwin 2005) that the productivity cutoffs for survival z^* and exporting z_x^* are given by

autarky: $$z^* = \alpha \left[\Omega \frac{f}{\delta f_e} \right]^{\frac{1}{\kappa}}$$

costly trade: $$z^* = T\alpha \left[\Omega \frac{f}{\delta f_e} \right]^{\frac{1}{\kappa}}, \qquad z_x^* = z^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\sigma-1}}$$

where $\Omega \equiv \dfrac{\sigma - 1}{1 + \kappa - \sigma} > 0$ and $T \equiv \left(1 + \tau^{-\kappa} \left[\dfrac{f}{f_x} \right]^{\frac{1}{\Omega}} \right)^{\frac{1}{\kappa}} > 1$. For the model to make sense requires $f > \delta f_e$, which guarantees that some low-productivity firms will not enter. However, given that firms that do not enter have no empirical counterpart, the data is silent on the relative size of f and δf_e. Given our value of $\delta = 0.05$, we set $f = 2\delta f_e$. Turning to the export cutoff, we set $f_x = f$, which implies $z_x^* = \tau z^*$. The parameter α is a normalization which we set to 10 for numerical reasons.

E. Numerical Results

Table 1 provides the key results of our numerical simulations, covering both high ($\tau = 1.74$) and low ($\tau = 1.21$) trade cost cases. The conventional Melitz model provides two avenues for gains. The first, familiar from Krugman (1981), is gains from variety. Our simulation shows that for this economy, the gains from variety are essentially zero. In the high and low trade cost cases respectively, from 25 to 40 percent of local firms are driven from the market. The arrival of new varieties just about exactly offsets this, so that the total change in variety is almost zero. The second avenue for gain in the Melitz model is the rise in productivity due to selection – the fact that trade drives high marginal cost firms from the market. In the two liberalization scenarios, we see a rise in productivity (and real wages) of from 15 to 30 percent. Although variety has not increased, the price index falls due to higher productivity.

Our model features negligible changes to the unemployment rate as a result even of very strong liberalizations. In the simulations, the unemployment rate barely budges from its autraky value of 7.9 percent (the difference occurs in the fourth significant digit). In both cases, the size-wage correlation of the simulations is approximately 0.04. This is very close to the level preferred by Manning (2003).[20]

Most importantly, the churning that is the very essence of the Melitz model's selection effects here results in very substantial job losses. This falls slightly more heavily on bad jobs (those paying below average wages), which is a result of the positive correlation between wages and productivity in the *ex ante* joint distribution. But, for the two cases, roughly one-sixth to one-fourth of good jobs are also lost. As noted, the aggregate gains from trade are very real. But so are the redistribution effects.

Figure 6 illustrates the employment effects of liberalization in our simulation. For the purpose of understanding Figure 6 it is useful to think of each dot as representing an active firm in autarky, although strictly speaking the dots are draws from a continuous joint distribution.[21] The firms that expand employment are exporters, and the dispersion of this cloud reflects the long, thin upper tail of the Pareto productivity distribution. The cluster of firms just to the left of the vertical axis are firms that survive the opening to trade but do not export: instead, they shed workers in the face of import competition. Finally, the cluster of firms to the far left shut down and layoff their labor force when trade opens up. The key message illustrated by the figure is that workers with the same wages can suffer very dissimilar fates: their firm can shut down, contract, or expand (possibly a lot) when the economy opens to trade. A related message is that among the three categories of firms (exiters, import competers, and exporters) there is great heterogeneity in wages.

[20] We refer here to Manning's Table 4.2, pg.87, which reports that the estimated elasticity of wages with respect to employer size is anywhere between 0.013 and 0.145. An estimate of 0.04 seems to be preferred.

[21] For aesthetic reasons, Figure 6 is constructed by drawing 4,000 times from $F(w,a)$, rather than the more numerically accurate sample of 20,000 draws used to construct Table 1. In the figure, there are 2200 active firms in autarky, of which 540 become exporters and 500 exit when trade is opened up.

VII. Conclusions

How do labor markets adjust to trade liberalization? The experience of major trade liberalizations underscores the importance of intra-industry reallocations. First generation models of intra-industry liberalization, based on Krugman (1981), emphasize that such integration will be smooth: no firm goes out of business, no worker loses a job, and welfare rises for everyone as the price index falls owing to variety gains. In such a world, liberalization should command universal approval. Of course, trade liberalization in reality remains highly controversial, with overwhelming majorities in the United States saying that it costs jobs and lowers wages.

A new generation of intra-industry trade models, based on Melitz (2003), provides an opening to make sense of these facts. In a benchmark case for the new models, the Krugman variety gains disappear entirely, even though consumers value variety. All of the gains come through the product market churning that expands output at high productivity firms and leads low productivity firms to contract or exit.

Our innovation is to link this product market churning to labor market churning, while giving workers a reason to care about their jobs. We do this by merging the Melitz model with a variant of the Shapiro-Stiglitz model of efficiency wages. In this model, workers care about job loss for two reasons. First, and in contrast to Melitz, there is involuntary unemployment, so job loss may give rise to a spell without work or wages. Second, different jobs pay different wages to identical workers, so that a worker with a particularly good job (high wage) may reasonably fear that displacement from that job will result in eventual re-employment only at a lower wage. Of course, idiosyncratically high wages at a job, all else equal, also make that job more vulnerable in the face of liberalization. Hence this also helps us to make sense of public concerns of trade costing jobs and lowering wages.

We develop a simulation of our model based on the best available parameter estimates. We find quite substantial aggregate gains in our simulations. While unemployment exists in our model, it is little affected by liberalization. However, there is a tremendous amount of labor market churning. In one experiment, up to one-fourth of all “good” (above average wage) jobs are destroyed. Given best estimates of the magnitude of the firm-specific component of wages, this could lead many to lose as a result of liberalization.

In short, we have developed a model of intra-industry exchange in which the combination of labor market churning and job specific rents can make sense of public concerns that trade costs jobs and lowers wages. The model explains this in a context that continues to feature large aggregate gains common in intra-industry models.

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Figure 1A
Melitz-Type Model and the Autarky Entry Decision

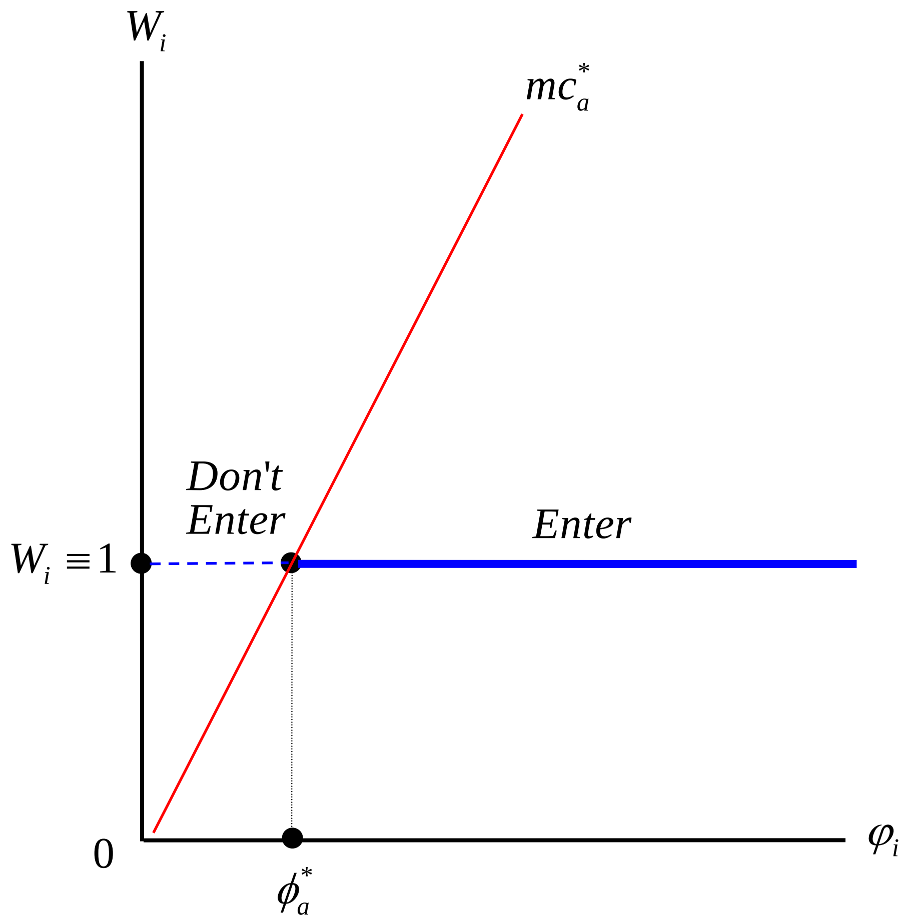


Figure 1A illustrates the first of three models of the entry decision. Generically, all three models condition entry to production on random draws that deliver sufficiently low marginal costs. In a Melitz-type variant of the model, homogeneous labor and identical monitoring costs require firms to pay a common wage $W_i \equiv 1$ so that the only source of firm-level variation in marginal costs arises from variation in marginal physical productivity φ_i. Here, the decision to produce in autarky requires a productivity draw of $\varphi_i \geq \varphi_a^*$.

Figure 1B
Melitz-Type Model:
Autarky to Freer Trade

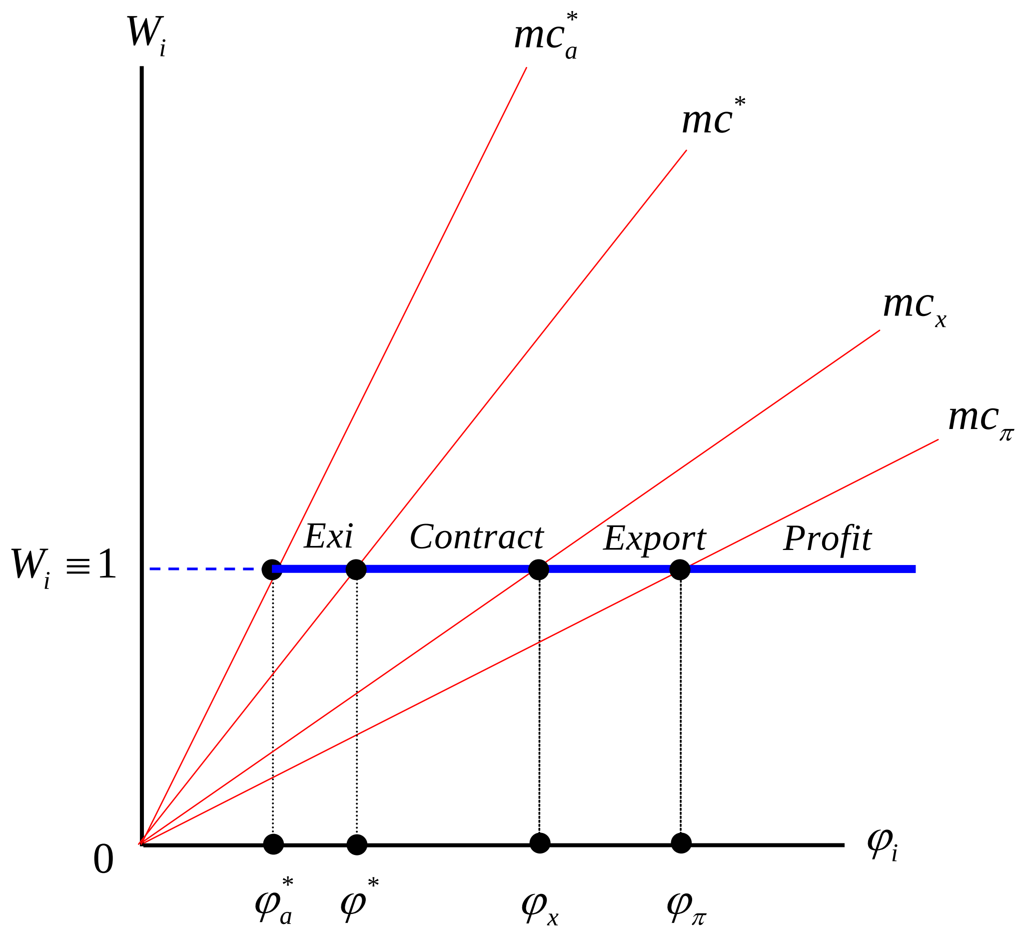


Figure 1B illustrates the move from autarky to free trade in our model when we suppress firm heterogeneity in monitoring, so again the only firm level variation in marginal costs arises, as in Melitz, from differences in marginal physical productivity. The consequences of this liberalization are familiar from Melitz. The lowest productivity firms exit; the next lowest productivity firms contract output; the next higher export, but are unable to maintain their autarkic profit levels; finally, only the super-exporters have higher profits with trade.

Figure 2A
Heterogeneous Firm Shapiro-Stiglitz Model
and the Autarky Entry Decision

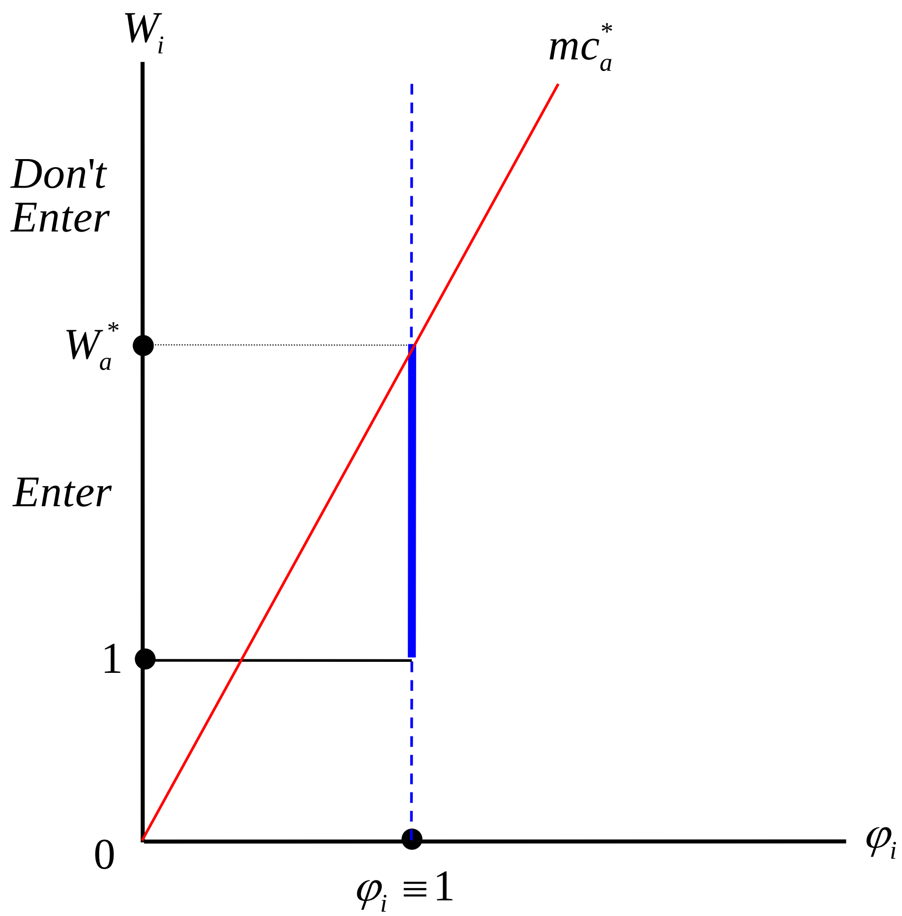


Figure 2A presents the alternative extreme to the Melitz-type approach. In it we abstract entirely from firm-level variation in marginal physical productivity by assuming $\varphi_i \equiv 1$. Firm level variation in marginal costs is thus assumed to arise here entirely due to firm level variation in wages W_i. Marginal costs are $mc_i = W_i$, where these firm-level efficiency wages reflect monitoring differences across firms. The minimum feasible wage is unity by choice of numéraire. Firms successfully produce only if $W_i \in \left[1, W_a^*\right]$.

Figure 2B
How Trade Threatens "Good Jobs at Good Wages"

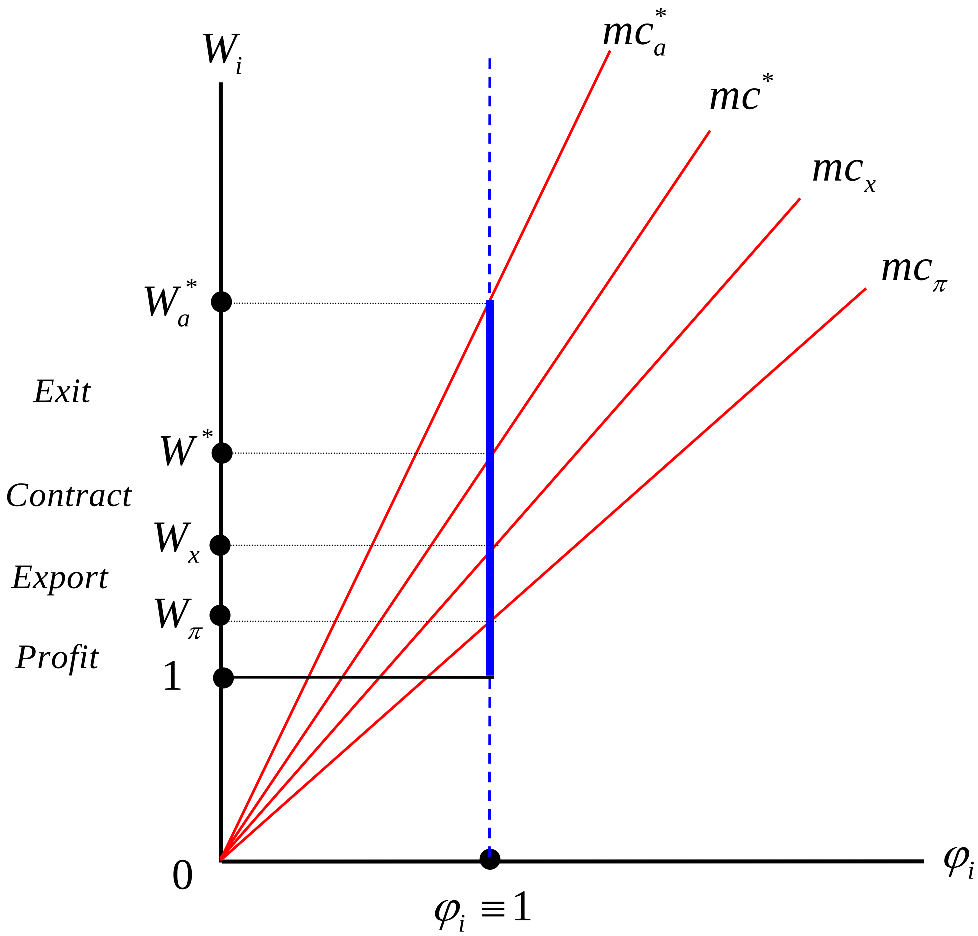


Figure 2B illustrates the consequence of a move from autarky to free trade in the model in which we allow variation in marginal costs to arise only due to firm-level wage variation arising from firm differences in monitoring. It is straightforward to see that it maps the Melitz analysis precisely into this alternative determinant of marginal costs. This also provides the starkest articulation of public fears that trade destroys good jobs at good wages. All of the highest wage jobs, those with $W_i \in \left(W^*, W_a^*\right]$ are destroyed with the liberalization. Firms that pay the next highest wages, $W_i \in \left(W_x, W^*\right]$, have a contraction of employment. Firms paying the next lower set of wages, $W_i \in \left(W_\pi, W_x\right]$, manage to penetrate export markets, although on net they lose profits. The firms that pay the lowest wages, $W_i \in \left(1, W_\pi\right]$, become super-exporters, have the sharpest rise in employment, and are the only firms to profit from this liberalization. Here trade does destroy good jobs with good wages. While shortcomings in this model variant motivate our hybrid model, the threat to good jobs at good wages will survive as a *conditional* prediction.

Figure 3A
The General Model and the Autarky Entry Decision

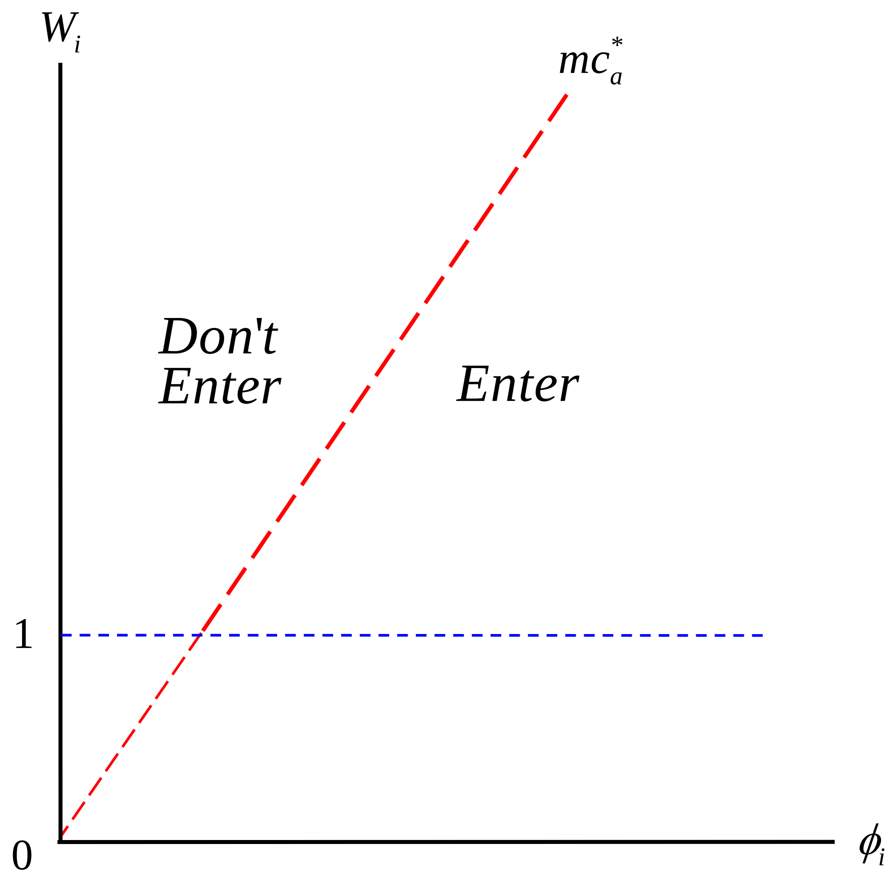
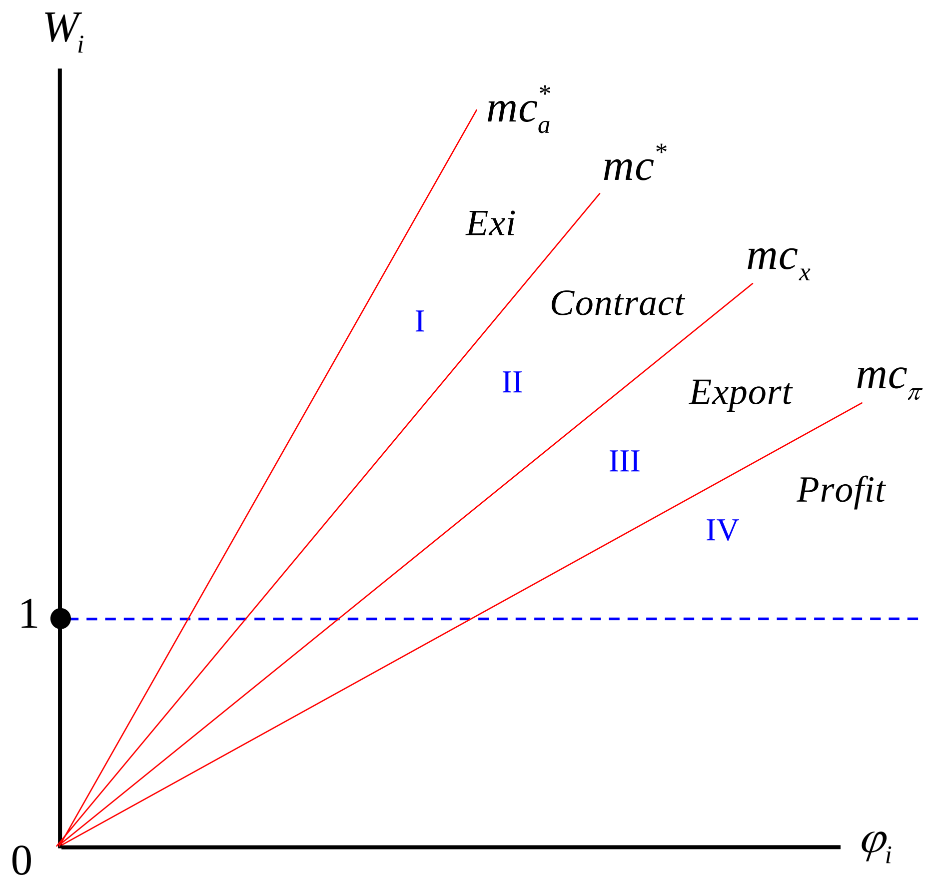


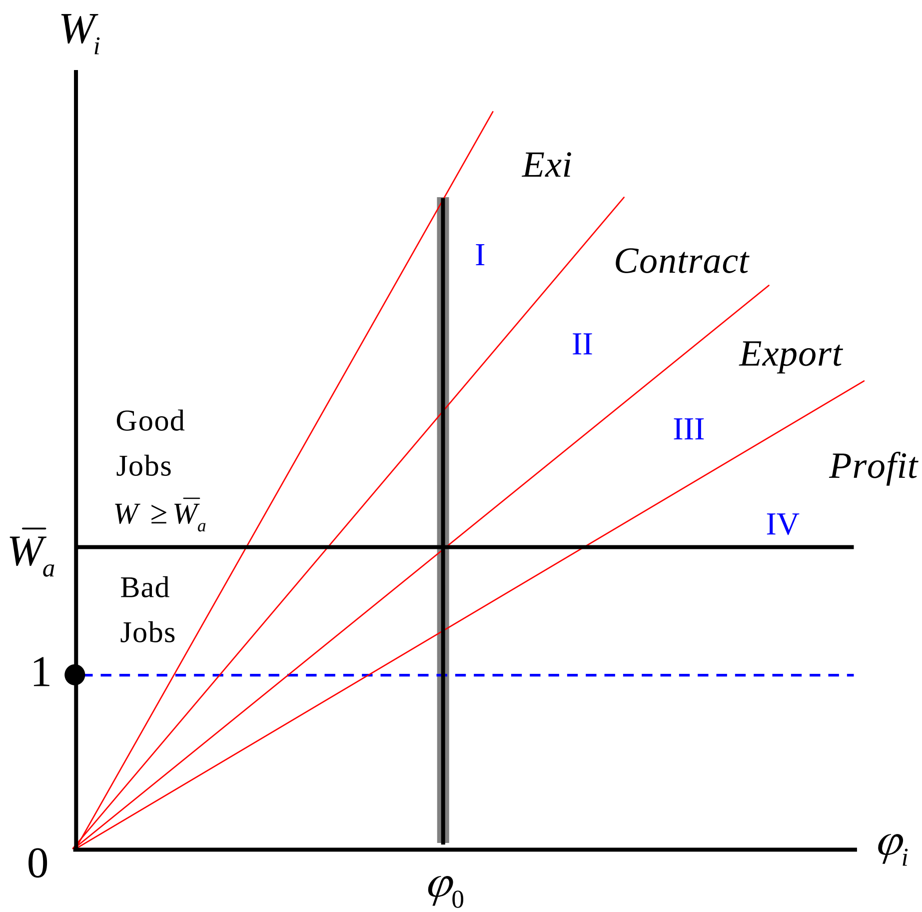
Figure 3A illustrates the autarky production entry decision for our core model. This core model is a hybrid in which marginal costs depend on firm level variation in both wages and marginal physical productivity. These marginal costs are given by $mc_i \equiv \frac{W_i}{\varphi_i} \equiv \frac{1}{z_i}$, represented as a ray from the origin. The shaded region indicates the fact that our more general model allows for draws of any technology and monitoring that satisfies $W_i \geq 1$. Along any ray, firm output, prices, revenues, wage bill, and profits are constant, although firm employment varies inversely with the wage. No firm pays a wage lower than the minimum-monitoring wage, our numéraire. The marginal entrant in autarky, with marginal cost $mc_a^* = \frac{1}{z_a^*}$, earns zero profits. The margin of entry is determined by the underlying structure of the heterogeneous firm model.

Figure 3B
Autarky to Freer Trade in the General Model



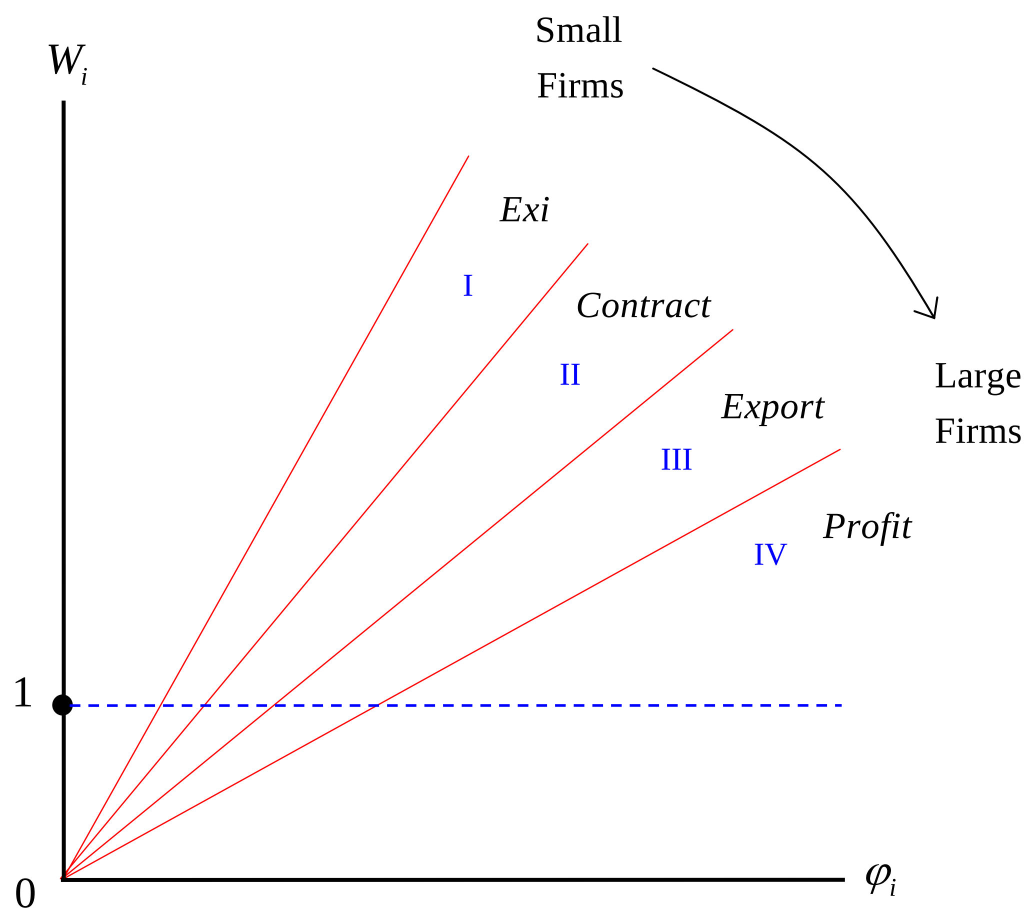
The move from autarky to free trade changes the marginal firms from those with marginal costs mc_a^* to mc^*. This leads to exit of the high marginal cost firms in Region I; contraction of the next highest marginal cost firms in Region II; and expansion of low marginal cost firms in Regions III and IV as they enter new export markets. Profits drop to zero in Region I firms and decline for firms in Regions II and III. The Region III firms experience the profit decline in spite of their success in exporting – the loss of local market share and the fixed costs of exporting are not compensated by the new profits in the foreign market. Only the super-exporting firms in Region IV experience higher profits. Job loss occurs wherever output contracts, namely in Regions I and II.

Figure 4
A *Conditional* Threat to "Good Jobs at Good Wages"



A good job may be defined as one that pays more than the average wage in autarky. For illustrative purposes, consider a productivity level φ_0 that corresponds to the point at which the average autarky wage curve crosses the boundary between Regions II and III. *Conditional* on productivity level φ_0, the highest wages on offer are at jobs in Region I firms; all of these good jobs are destroyed in the move from autarky to free trade. The next highest wages are on offer at jobs in Region II firms; some of these jobs are lost as output contracts. The Region III jobs expand, but these are bad jobs. The sharpest expansion of jobs occurs at the Region IV firms offering the worst jobs. These Region IV firms offering the worst jobs are also the only ones who increase profits in the move from autarky to free trade. *Conditional* on this productivity level, trade destroys only good jobs and expands only bad jobs.

Figure 5
How Trade May Raise the Average Wage



Low marginal cost firms are both the larger firms in autarky and also the firms that expand their output most rapidly with the move from autarky to free trade. If there is a positive correlation between firm size and firm wage, then the fact that liberalization causes the exit or contraction of small firms to the benefit of expanding larger firms would be expected to raise average wages. In terms of our efficiency wage model, this would require that more productive firms have somewhat worse monitoring technologies, but not so much as to fully offset the productivity advantage (hence the positive correlation of wages and size). This might arise, for example, if larger firms require more teamwork, where individual effort may be harder to monitor.

Table 1

Simulations of the Model for High and Low Trade Costs

	High Trade Costs	Low Trade Costs
Trade relative to autarky values		
Real Wage	1.16	1.30
Productivity	1.17	1.31
Variety	0.99	0.99
Active Local Firms	0.75	0.59
Price Index	0.87	0.77
Wage Distortion Index	1.00	1.00
Unemployment Rate	1.00	1.00
Levels		
Autarky Unemployment Rate	7.9 %	7.9 %
Trade Unemployment Rate	7.9 %	7.9 %
Autarky Size-Wage Correl.	0.070	0.070
Trade Size-Wage Correl.	0.043	0.032
Share of jobs lost in move to trade		
Good jobs	16.6 %	23.8 %
Bad Jobs	21.6 %	30.3 %

Notes to Table 1: The high and low trade costs respectively are $\tau = 1.74$ and $\tau = 1.21$. All other parameters identical across columns. Simulation computed using 20,000 draws from *ex ante* joint distribution of wages and productivity. For other parameter values, see text.

Figure 6

Notes to Figure 6: Each dot represents a firm active in autarky, its' wage, and the employment response when trade costs fall from $\tau = \infty$ to $\tau = 1.74$. The scales on the axis are arbitrary, but the relative magnitudes are meaningful.