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Good Jobs, Bad Jobs, and Trade Liberalization

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Abstract

Globalization threatens “good jobs at good wages”, according to overwhelming public sentiment. Yet professional discussion often rules out such concerns *a priori*. We instead offer a framework to interpret and address these concerns. We develop a model in which monopolistically competitive firms pay efficiency wages, and these firms differ in both their technical capability and their monitoring ability. Heterogeneity in the ability of firms to monitor effort leads to different wages for identical workers – good jobs and bad jobs – as well as equilibrium unemployment. Wage heterogeneity combines with differences in technical capability to generate an equilibrium size distribution of firms. As in Melitz (2003), trade liberalization increases aggregate efficiency through a firm selection effect. This efficiency-enhancing selection effect, however, puts pressure on many “good jobs”, in the sense that the high-wage jobs at any level of technical capability are the least likely to survive trade liberalization. In a central case, trade raises the average real wage but leads to a loss of many “good jobs” and to a steady-state increase in unemployment.

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I. Introduction

Treasury Secretary Henry M. Paulson, Jr., speaking in March 2007, cited a Pew Research Center survey to the effect that "more and more Americans seem to doubt that trade brings greater benefits than costs." While the public in the survey was roughly evenly split on the overall benefits of freer trade, among those stating an opinion there was an overwhelming sentiment that trade costs jobs and lowers wages.[1]

A central concept in public discussions of globalization is that of a "good job", a job that pays a high wage, offers generous benefits, and provides job security. Such jobs are the subject of envy for those in lesser jobs, and induce a feeling of good fortune in those who have them. In economists' terms, good jobs have an element of rent that bad jobs lack. The benchmark model of labor demand used in most general equilibrium trade models has no place for such a concept: workers are paid their marginal product. Trade models typically explain changes in wages in response to liberalization as the consequence of endogenous changes in marginal products. These models rule out *a priori* any discussion of good and bad jobs.

Our view is that trade economists are missing an opportunity to address public concerns, and adequately understand public attitudes, by neglecting models where trade liberalization might affect the incidence of labor market rents. In this paper, we offer such an analysis by combining the efficiency wage model of Shapiro and Stiglitz (1984) with the trade model of Melitz (2003). The Shapiro-Stiglitz model explains labor market rents and unemployment as arising from asymmetric information: firms monitor their workers' effort imperfectly, and in equilibrium use high wages to induce workers to value their jobs sufficiently that the workers won't risk being fired for shirking. The Melitz framework features equilibrium product market rents, and the distribution of these rents is affected by trade liberalization.

In our combined model, firms differ in both their ability to monitor workers and in their underlying productivity, and the interaction of these two forms of heterogeneity implies novel,

[1] Remarks by Treasury Secretary Henry M. Paulson, Jr. before the Economic Club of Washington, March 1, 2007; "Free Trade Agreements Get a Mixed Review," December 19, 2006, Pew Research Center For the People and Press. Lest it be thought that the perspective on job and wage losses is a partisan Democratic view, it is notable that Republicans also responded that freer trade costs jobs and lowers wages respectively by margins of three- and four-to-one.

and provocative, possibilities for adjustment to trade liberalization. Heterogeneity in monitoring costs implies different wages for *ex ante* identical workers, leading to a precise and intuitive definition of good jobs as those that pay above the economy wide average wage. As in Melitz (2003), trade liberalization in our model has a powerful efficiency-enhancing selection effect, with the lowest marginal cost firms expanding and less productive firms contracting or exiting. Unlike in Melitz, where all jobs pay the same and all workers benefit from liberalization, trade liberalization in our model has dramatically different effects on the welfare of individual workers. In a move from autarky to free trade, and controlling for firm productivity, trade destroys only good jobs. The number of bad jobs expands and this occurs most sharply for the worst jobs. Under the same experiment, efficiency is enhanced and the typical price falls. These are not conflicting effects; they are actually alternative descriptions of the same phenomenon.

The model also suggests there are likely to be aggregate employment effects arising from within-industry re-allocation. While not mandated by the model, there are good empirical reasons to believe that the net effect of liberalization will be to raise the average wage relative to the lowest wage in the economy. This occurs through selection effects that leave the relative wage offered by any individual firm unchanged. If trade does raise this average wage, though, it also tightens the incentive constraints on shirking. In the new steady state, the higher average wage makes job loss less daunting, and equilibrium unemployment must be higher to insure effort.

The second best nature of our model implies that aggregate income gains from liberalization are not certain, although they likely remain a central case. Trade in our model has a strong tendency to increase variety, lower prices, and shift production toward more efficient firms. However it also has a strong tendency to threaten what workers consider “good jobs” and could contribute to a rise in structural unemployment.

There are two 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. Janiak (2006) integrates Melitz (2003) with a Pissarides (2000) large firm search model to show that trade integration raises equilibrium unemployment. However, this specific result, and even the existence and uniqueness of equilibrium in Janiak's model, require implausible restrictions on the substitutability of products, so that equilibrium markups must be bounded below by 100 percent.

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

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[2]. 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.

We assume that utility is additively separable in consumption and effort. Utility from consumption is given by a standard CES aggregate of differentiated goods, which has an associated ideal price index P that is developed in Section IV below. Disutility from effort is measured in the same units as the wage. This implies that a household with income w_i has indirect utility given by:

$$(1.1) \qquad u_i = \frac{w_i - e}{P}$$

An implication of this specification is that real price declines due to technological progress or increases in variety, etc. do not lead to a change in the disutility of effort relative to the utility of consumption[3]. This is the assumption made implicitly by Shapiro and Stiglitz (1984), although the issue of trends in the relative cost of effort did not arise in their steady-state, one-good setting.

The worker who is employed will need to make a discrete decision to supply a unit of effort or to shirk and supply effort 0. For simplicity, we normalize the wage (or other benefits) received by the unemployed to zero.

Workers are risk neutral and discount the future at rate $r > 0$. Workers lose their job only if they are caught shirking or if the firm dies, and firm death happens at the exogenous rate δ. Firms monitor workers for shirking and m_i is an inverse measure of the firm's monitoring effectiveness. Hence if workers at firm i were to shirk, they would face a probability m_i^{-1} of

[2] 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.

[3] In the absence of such a specification, secular progress would be associated with a secular decline in unemployment, which is counterfactual (see Romer (2006), Chapter 10).

detection, with a penalty of being fired and spending a period in unemployment before finding a new job. We impose the technical condition that $m_i \in [m_0, \infty)$, where the lower bound $m_0 \equiv \frac{1}{1-\delta}$ is the maximally effective monitoring of any firm.[4]

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 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:

(1.2) $$rV_{Ei}^N = (w_i - e) + \delta(V_U - V_{Ei}^N)$$

(1.3) $$rV_{Ei}^S = w_i + (\delta + m_i^{-1})(V_U - V_{Ei}^S)$$

These consist of the flow benefit, $(w_i - e)$ or w_i respectively, plus an expected capital loss in the case of a shift to unemployment, where these terms differ because shirkers face a higher probability of a move to unemployment due to the firm's monitoring m_i^{-1} 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.

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 that $V_{Ei}^N \geq V_{Ei}^S$, a non-shirking constraint which firms will choose to meet with equality. Solving for the non-shirking wage constraint at firm i, we find:

(1.4) $$w_i = rV_U + e + (r+\delta)em_i$$

Equation (1.4) is the firm-level equivalent of the Shapiro-Stiglitz no-shirking constraint. First, note that since V_U is common to all firms, wages will vary across firms only due to monitoring ability and that equilibrium wages are in a one-to-one increasing relation with a firm's difficulty in monitoring. Second, note also that this is a *notional* wage. That is, this is the

[4] This insures that the instantaneous probability of job loss arising from all sources does not exceed unity.

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.

Since all active firms will meet the no-shirking constraint in equilibrium, we can define the value of being employed at firm i by substituting the no-shirking wage back into our definition of V_{Ei}^N to yield:

(1.5) $V_{Ei} = V_U + em_i$

This equation is intuitive. Rearranging, we see that $m_i^{-1}\left(V_{Ei} - V_U\right) = e$, or equivalently that the probability of being caught shirking times the capital loss associated with this should just compensate for the cost of effort. As the firm's ability to monitor workers deteriorates (higher m_i), ever higher wage rates are required to induce effort. Moreover, since this reflects the required no-shirking wage choice of *any* firm i, the unemployed will always find it advantageous to accept the first job offered.

B. The No-Shirking Constraint and Aggregation

We have derived in Equation (1.4) a link between the firm's no-shirking wage, various parameters of the model, including the firm's monitoring ability, and the flow benefits of being unemployed, rV_U. The unemployed worker does not know *ex ante* from which firm an offer will arrive. Hence consideration of the flow benefits of being unemployed requires aggregation, to which we now turn.

Later we will address in detail how employment levels at individual firms are determined; for now we simply assume that the relevant distribution is known to all in the economy. Let $f(w_i)$, then, be the *equilibrium* density of employed workers at firm i, hence receiving wage w_i. These are the weights that will be applied in calculating averages for the benefits of being employed, for wages, and for monitoring ability of firms.

Let V_E be the *average* lifetime utility of an employed non-shirker. Expected job tenure doesn't vary across firms since in equilibrium no one shirks, so job loss happens only at the common exogenous rate δ as firm death. Hence we have

$$V_E \equiv \int V_{Ei} f\left(w_i\right) di .$$

Correspondingly, the average wage will be:

$$\bar{w} \equiv \int w_i f\left(w_i\right) di$$

And the average monitoring ability of firms is:

$$\bar{m} \equiv \int m_i f\left(w_i\right) di$$

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:

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

From equation (1.5), and taking averages, we have that:

$$\left(V_E - V_U\right) = e\bar{m}$$

so that substituting this in we find:

(1.6) $$rV_U = a\left(e\bar{m}\right)$$

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:

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

Substituting (1.8) into (1.6) and defining the unemployment rate to be $u \equiv \frac{U}{L}$, we find that

$$rV_U = \delta\left(\frac{1-u}{u}\right)e\bar{m}$$

This allows us to eliminate the term rV_U from Equation (1.4), and gives us:

$$w_i = e + \delta\left(\frac{1-u}{u}\right)e\bar{m} + (r+\delta)em_i$$

We can use this to calculate the average wage:

$$\bar{w} = e + \delta\left(\frac{1-u}{u}\right)e\bar{m} + (r+\delta)e\bar{m}$$

In order to keep this consistent with the Melitz (2003) model, we will consider this for the limiting case in which $r \to 0$.[5] Hence the last two equations become:

$$w_i = e + \delta\left(\frac{1-u}{u}\right)e\overline{m} + \delta e m_i \text{, and}$$

$$\overline{w} = e + \delta\left(\frac{1-u}{u}\right)e\overline{m} + \delta e\overline{m} = e + \frac{\delta e}{u}\overline{m}$$

Solving the second of these for $\overline{m} = \frac{(\overline{w}-e)u}{\delta e}$, and substituting this into the first, we finally arrive at a simple equation relating the wage paid by a firm to the aggregate unemployment rate, the average wage, and the firm-specific monitoring cost:

$$(1.9) \quad w_i = e + (1-u)(\overline{w}-e) + \delta e m_i$$

Equation (1.9) shows that the no shirking wage of the firm is increasing in the cost of effort e, the firm-specific monitoring cost m_i, and decreasing in the unemployment rate u, as one might expect from Shapiro and Stiglitz. But the firm wage is *increasing* in the economy-wide average wage $\overline{w}$, an effect Shapiro and Stiglitz couldn't separately identify. This also foreshadows a tradeoff between simultaneous increases in $\overline{w}$ and u that leave w_i unaffected, to be discussed further below.

The lowest feasible no-shirking wage, w_L, arises in the case of the maximally effective monitoring. In this case, $m_i = m_0$, and so $w_L = e + (1-u)(\overline{w}-e) + \delta e m_0$. Because identical workers will receive different wages, we cannot follow Melitz in choosing labor as the numéraire. Instead, we choose as our numéraire labor employed at tasks in which they earn the wage on offer at firms with the maximally effective monitoring technology. Hence $w_L \equiv 1$, which in turn implies:

$$(1.10) \quad 1 = (1+\delta m_0)e + (1-u)(\overline{w}-e).$$

Moreover, with this choice of numéraire, we can re-write Equation (1.9) as:

$$(1.11) \quad w_i = 1 + \delta e(m_i - m_0)$$

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[5] We have developed the key expressions here for the case of $r > 0$, as in Shapiro and Stiglitz (1984), and as the setup requires. Of course, we can see directly that the limits for the relevant expressions exist as $r \to 0$. We choose this path since the effects of r here are purely conventional, but the Melitz (2003) model is developed in a context

Equation (1.11) is extremely important. The foregoing has only assumed that there is *some* equilibrium distribution of wages, $f(w_i)$. From this we have now been able to derive an exact relation between the primitive distribution of m_i and the notional distribution of wages w_i that must hold in the no-shirking equilibrium. Wage differences for identical workers arise only if there are monitoring differences across firms and the magnitude of these wage differences rises proportionately with the monitoring gap itself, the exogenous job separation rate δ, and the level of effort e required to be productive.

Returning to the wage equation for the numéraire, Equation (1.10), and solving for the link between the unemployment rate and the average wage consistent with non-shirking, we find:

$$(1.12) \quad u = \frac{\overline{w} - 1 + \delta e m_0}{\overline{w} - e}$$

It is straightforward to show that the no-shirking unemployment rate for the relevant case is positive, increasing, and concave in the average wage $\overline{w}$.[6] Unemployment in this model is involuntary in precisely the same way as Shapiro-Stiglitz.

Equation (1.12) highlights a crucial difference, though, between the standard Shapiro-Stiglitz framework and the present approach. In the standard Shapiro-Stiglitz model, all firms are identical, hence it is impossible to separately identify the effect of the firm's own wage and the economy's average wage on incentives to shirk and equilibrium unemployment. Their aggregate no-shirking condition, then, shows the *total* effect of a simultaneous rise in the firm *and* average

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where the source of firm discounting is limited to the instantaneous firm death rate δ. Effectively, taking limits at this point just rids us of a nuisance parameter.

[6] With the maximally effective monitoring wage at unity, the average wage cannot be lower, so the numerator in Equation (1.12) is positive. Note that $\overline{w} > e$ or at least some of the workers would shirk (contrary to assumption), so the denominator is also positive. These two facts combined imply that equilibrium unemployment must be positive. Employment is feasible, i.e. $u < 1$, whenever the effort cost of being productive is not too high relative to the product of the effective discount factor from exogenous job separations times the probability of being detected when shirking at the maximally effective monitoring firms, or $\frac{e}{1-e} < \frac{1}{\delta} m_0^{-1}$. We also see that $\frac{du}{d\overline{w}} = \frac{1 - e(1+\delta m_0)}{\left(\overline{w} - e\right)^2}$, which is positive under the same conditions that make employment feasible. Further, $\frac{d^2 u}{d\overline{w}^2} = \frac{-2\left(1 - e(1+\delta m_0)\right)}{\left(\overline{w} - e\right)^3}$ is negative under the same conditions. While a rise in the average wage raises the equilibrium unemployment rate, the sensitivity of the unemployment rate to movements in average wages is greatest

wage, and shows that this wage rise reduces equilibrium unemployment along the no-shirking constraint. It would be simple to conclude that with efficiency wages a rise in prevailing wages inevitably reduces equilibrium unemployment. This would, though, be incorrect.

Our equation (1.9) shows that, as in Shapiro and Stiglitz, there is a *negative* relation between the *firm's own wage* and the level of required unemployment consistent with no shirking. But equation (1.12) shows, by contrast, that there is a *positive* relation between the *average wage* and the equilibrium no-shirking unemployment rate.

The contrast is simple to understand. A fall in the unemployment rate on its own always makes shirking more attractive. For the no-shirking constraint to be met weakly requires something that makes shirking less attractive. At the firm level, the fall in the unemployment rate requires a *rise* in the *firm's wage* to prevent shirking, hence unemployment and the firm's wage have an inverse relation. When considering the average wage, though, a drop in the unemployment rate that makes shirking more tempting must be met with a *drop* in the *average* wage to make shirking less tempting, since the average wage is the wage a fired worker receives when eventually re-employed. Thus, while the unemployment rate and the firm's own wage are negatively related, the unemployment rate and the average wage must be positively related. This contrast will be key to our results below.

In our model, the average wage will be able to move through firm selection effects even when the wage is constant among all active firms. When these selection effects lead the average wage to rise, unemployment will have to rise as well.

Let us take stock of what this section has achieved. We have derived a simple relation between the unemployment rate and the average wage consistent with a no-shirking equilibrium. We have also derived a simple relation between the equilibrium no-shirking wage offered at individual firms and exogenous firm-level monitoring ability. These will be crucial in developing our model of the product market.

Shapiro and Stiglitz closed their model with a neoclassical labor demand approach featuring identical competitive firms (even if the firms recognized the binding nature of the no-shirking constraint). We will go on now to develop a monopolistically competitive product

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when average wages are relatively low. We will focus precisely on these cases for which equilibrium unemployment is $u \in (0,1)$.

market as the basis for our model of labor demand, one that will feature firm heterogeneity not only in productivity, as in Melitz, but also in monitoring ability.

III. Links Between The Models of Heterogeneity in Productivity and Monitoring

In this section we develop a variant of the heterogeneous firm model of Melitz (2003) and show how to link it to the heterogeneous efficiency wages model based on Shapiro and Stiglitz (1984) that we derived in Section II. We first discuss the high level links between the models and then derive the key elements formally.

Equilibrium in a standard Melitz model may be analyzed in three parts – structure, scale, and the link between the two. By the equilibrium *structure*, we mean the price, quantity, wage bill, and profits for each firm i per unit mass of firms. In the Melitz framework, and for given parameters, this is fully determined by the distribution of marginal costs across firms. And in Melitz's own model, the variation in marginal costs across firms is fully described by the variation in firm physical productivity in marginal cost, indexed by φ_i.

By equilibrium *scale* in a Melitz model, we mean the mass M of firms of each type that is required to insure equilibrium in the labor market. Given Melitz's assumption of competitive labor markets, this determines the mass M from full employment of the labor force L given the economy's structure.

Finally, the *link between structure and scale* comes from the labor demand per unit mass implied by the equilibrium structure of the economy. This is given by the total revenue per unit mass divided by the average wage, where both are defined to include entry, fixed, and marginal costs. This takes a particularly simple form in Melitz, where all firms pay a common competitive wage, taken as the numéraire, and so labor demand per unit mass is simply equal to revenue for this mass.

Turning to our model, equilibrium structure is also fully determined by the distribution of marginal costs across firms. However marginal costs in our model vary across firms not only due to variation in firm level productivity, φ_i, but also due to firm-specific no-shirking wages w_i in marginal cost activities. Indeed firm marginal costs will be given as the ratio of these two, $\frac{w_i}{\varphi_i}$.

Our measure of *inverse* marginal costs (productivity) is then defined as $z_i \equiv \frac{\varphi_i}{w_i}$. This allows us to use Melitz's results on the determination of the economy's structure as a function of the distribution of marginal costs without modification, where these are now indexed by z_i.

Equilibrium scale of the economy also differs from Melitz. It still features adjustment of the mass of firms M to ensure labor market equilibrium. However labor market equilibrium now requires this mass to adjust so that total labor demand equals the total labor force adjusted for the unemployment rate u. From our firm-based efficiency wage model, the unemployment rate u is in a one-to-one relation with the average wage $\overline{w}$. And the average wage $\overline{w}$ is itself determined by the structure of the economy.

The link between the structure and scale of the economy also varies from that of Melitz. As before, this link comes from labor demand per unit mass implied by the equilibrium structure of the economy. Again, this is given by total revenue per unit mass divided by the average wage, both defined to include entry, fixed, and marginal costs. However, because we no longer have competitive factor markets, the average wage departs from unity. Hence we have to take the total revenue and average wage, as determined by the equilibrium structure of the economy, and convert these into the implied labor demand per unit mass of firms. The total mass of firms then adjusts to attain labor market equilibrium, which here requires that that total employment is consistent with the unemployment rate required for non-shirking given this same average wage.

In sum, just a few elements serve to link the models. To follow the Melitz framework, all firm variation in costs must affect only marginal costs. Hence we assume all firms have common monitoring and pay a common wage w_f in all fixed cost activities. For convenience, we assume that these fixed cost activities have the maximally effective monitoring, which from Section II implies $w_f \equiv 1$. Hence firm level variation in monitoring will affect only wages in marginal cost activities, giving rise to marginal costs $\frac{1}{z_i} = \frac{w_i}{\varphi_i}$. These firm level marginal costs, combined with the distribution of firm types, determine the structure of the economy. This structure, again in combination with the distribution of firm types, determines the average wage. The average wage, in combination with results from Section II, determines the unemployment rate u as well as the labor demand per unit mass of firms. And these in turn determine the equilibrium mass of firms in the economy, hence the full equilibrium.

We turn now to show these results more formally.

IV. 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:

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

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

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

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

The demand curve above is a key input 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 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 (1.11) that there is a simple relation between equilibrium no-shirking wages and monitoring, given by $w_i = 1 + \delta e(m_i - m_0)$. This means that the firm can immediately translate the productivity-monitoring draw (φ_i, m_i) to a productivity-wage draw (φ_i, w_i). As it turns out, the firm's individual choices are affected only by the ratio $z_i \equiv \frac{\varphi_i}{w_i}$, although we will be interested in examining 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 or as the inverse marginal cost for firm 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. In what follows, we work from the individual firm problem and aggregate up.

C. The Individual Firm

We consider now the problem of an individual firm that has already sunk the cost f_e to learn its type z_i. Physical labor requirements in firm z_i follow Melitz:

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

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.

As we noted, our use of 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 its fixed costs and a wage w_i for labor employed in its variable costs.

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

$$\pi_i = p_i \cdot q_i - f - w_i \frac{q_i}{\varphi_i} = p_i \cdot q_i - f - \frac{q_i}{z_i}$$

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 wages, which are offset by productivity differences, but they charge the same price, will produce the same quantity, and have the same revenue and profits. Hence we will drop the subscript i henceforth except as necessary to clarify limits of integration.

D. Aggregation

We have seen that the combination of a primitive distribution on (φ_i, m_i) and the equilibrium from the labor market, we can derive the joint distribution for (φ_i, w_i). 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 $G(z) \equiv \Pr[Z \leq z]$ 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:

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

If there is a mass M of firms, then the number of them at any given inverse marginal cost z is $Mg(z)$, and the number of those that survive and produce is $M\mu(z)$.

The definition of the CES price index gives

$$\begin{aligned} P &= \left[\int_{z^*}^{\infty} p(z)^{1-\sigma} M \mu(z) dz \right]^{\frac{1}{1-\sigma}} \\ &= M^{\frac{1}{1-\sigma}} \left[\int_{z^*}^{\infty} p(z)^{1-\sigma} \mu(z) dz \right]^{\frac{1}{1-\sigma}} \\ &= M^{\frac{1}{1-\sigma}} \tilde{p} \end{aligned}$$

where $\tilde{p}$ is implicitly defined in the last step. As usual in this type of model, holding the density of firms fixed, the price level is decreasing in the number of firms, which is the love-of-variety effect.

Substituting in $p(z) = (\rho z)^{-1}$ gives

$$\tilde{p} = \left[\rho^{\sigma-1} \int_{z^*}^{\infty} z^{\sigma-1} \mu(z) dz \right]^{\frac{1}{1-\sigma}} = \frac{1}{\rho \tilde{z}}$$

where, making the dependence of $\tilde{z}$ on z^* explicit,

$$\tilde{z}(z^*) = \left[\int_{z^*}^{\infty} z^{\sigma-1} \mu(z) \, dz \right]^{\frac{1}{\sigma-1}}$$

This last variable, $\tilde{z}$, is a measure of aggregate inverse marginal costs and plays a key role in the determination of equilibrium in the product market.

E. The Marginal Firm and Equilibrium Structure of the Economy

Equilibrium structure in an autarkic Melitz economy is determined by the solution of two relations between average profits $\bar{\pi}$ and the marginal cost 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. Written in these terms, the FE condition is:

$$\left[1 - G(z^*)\right] \frac{\bar{\pi}}{\delta} = f_e$$

For a given marginal entrant z^*, $1 - G(z^*)$ is the *ex ante* probability of successful entry, $\bar{\pi}$ the per-period average profits for successful entrants, and $\frac{1}{\delta}$ the factor that yields expected value when the stochastic exit rate for successful firms is δ. Solving, we have:

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

This formulation points at the path to solution, which is to link average profits to the marginal entrant. The first step draws on the aggregate measure of inverse marginal cost $\tilde{z}(z^*)$, from above. The second step is to show that total profits can be written as $\Pi = M\pi(\tilde{z})$, so that average profits are:

$$\bar{\pi}(z^*) = \pi(\tilde{z}(z^*)) = \frac{\Pi}{M}.$$

The proof follows Melitz and is omitted here.

The second of the two key relations is the zero cutoff productivity (ZCP), which requires that the firms with the highest marginal costs that actually produce should have variable profits equal to the per-period fixed cost, or $\pi^V(z^*) = f$. To convert this to a form amenable to the simple determination of equilibrium via $\bar{\pi}$ as a function of z^* requires only a few more steps.

Generally, variable profits for an active firm are given by $\pi^V(z) = \frac{r(z)}{\sigma}$, and the revenue for this firm is given by $r(z) = R[P\rho z]^{\sigma-1}$. Ratios of variable profits are equal to the ratio of revenues and depend only on the ratio of inverse marginal costs, so that we can write $\pi^V(z_1) = \left(\frac{z_1}{z_2}\right)^{\sigma-1} \pi^V(z_2)$ for any active z_1 and z_2. Recalling that $\pi(\tilde{z})$ is equal to average profits $\bar{\pi}$, we can write this out for inverse marginal costs $\tilde{z}$ and z^* as $\bar{\pi} = \left[\frac{\tilde{z}(z^*)}{z^*}\right]^{\sigma-1} \frac{r(z^*)}{\sigma} - f$. If we further define $k(z^*) = \left\{\left[\frac{\tilde{z}(z^*)}{z^*}\right]^{\sigma-1} - 1\right\}$, and recall that the zero cutoff productivity has $\frac{r(z^*)}{\sigma} = f$, we can impose this condition by requiring:

$$\bar{\pi} = fk(z^*) \qquad \text{(ZCP)}$$

The remainder of the derivation follows Melitz and is omitted.

The Free Entry and Zero Cutoff Productivity conditions define two relations in $\bar{\pi}$ and z^* and can be solved for equilibrium values as in Melitz. The equilibrium exists and is unique under the same conditions.

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

F. Labor Supply and Demand

The labor force in our model is divided into four elements:

U the unemployed

L_e workers in fixed entry cost sector

L_f workers in per-period fixed cost activities

L_V workers in variable cost activities

The aggregate labor force constraint is

$$L = U + L_e + L_f + L_V$$

For entry, we need to consider the steady state. The number of new entrants every period is a fraction of the incumbents which is exactly equal to the number of firm deaths, δM . Thus labor devoted to new entry in steady state is:

$$L_e = \delta M f_e$$

The physical levels of employment in fixed cost is simply

$$L_f = Mf$$

For the variable cost activity, we now have to make precise the distinction between wages and physical marginal productivity. It is the latter that gives employment in each firm. The complexity arises because firms with a given z (and hence a given level of output) may have an infinite number of physical productivities φ.

Physical variable labor demand for firm i is given by $\ell_{Vi}(z_i,\varphi_i) = \dfrac{q(z_i)}{\varphi_i}$. From the joint distribution of (φ_i, w_i) and the equilibrium z^* we can construct the equilibrium joint distribution represented by the density $\psi(\varphi_i, z_i)$. With the mass of firms M and this joint density, total employment in variable costs is given by:

$$L_V = M\int_{z^*}^{\infty}\int_{i\in z_i} \frac{q(z_i)}{\varphi_i}\psi(\varphi_i, z_i)\,di\,dz$$

We can now write the labor market clearing condition in quantity terms as:

$$(1-u)L = M\left[\delta f_e + f + \int_{z^*}^{\infty}\int_{i\in z_i} \frac{q(z_i)}{\varphi_i}\psi(\varphi_i, z_i)\,di\,dz\right]$$

Note that for a given unemployment rate u (hence average wage $\overline{w}$), the mass of firms M is directly proportional to the labor force size L and employment $(1-u)L$.

G. Average Wages

Now we turn to determining average wages. Multiplying each firm's employment of labor in variable cost $\ell_{Vi}(z_i,\varphi_i) = \dfrac{q(z_i)}{\varphi_i}$ by the firm-specific wage w_i gives the firm's wage bill in variable cost as

$$z^{-1}q(z) = z^{\sigma-1}Q[P\rho]^{\sigma}$$

which allows us to conclude that aggregate payments to labor in variable cost are

$$M\int_{z^*}^{\infty} z^{\sigma-1}Q[P\rho]^{\sigma}\mu(z)\,dz = MQ[P\rho]^{\sigma}\int_{z^*}^{\infty} z^{\sigma-1}\mu(z)\,dz = MQ[P\rho]^{\sigma}\,\tilde{z}^{\sigma-1}$$

which, using

$$Q = M^{\frac{1}{\rho}}q(\tilde{z}), \qquad P = M^{\frac{1}{1-\sigma}}(\rho\tilde{z})^{-1},$$

becomes

$$M\frac{q(\tilde{z})}{\tilde{z}}$$

To get total payments to labor we add employment in fixed and entry cost activities, where the wage is one. Thus aggregate payments to labor are

$$M\left(\delta f_e + f + \frac{q(\tilde{z})}{\tilde{z}}\right)$$

so the average wage is

$$\overline{w} = \frac{M}{(1-u)L}\left(\delta f_e + f + \frac{q(\tilde{z})}{\tilde{z}}\right)$$

H. Equilibrium in the Labor Market

With the structure of the economy determined by z^* in Section IV.E., we now have three equations in three unknowns, u, $\overline{w}$, and M.

- From Section IV.F, the physical labor market clearing condition:

$$(1-u)L = M\left[\delta f_e + f + \int_{z^*}^{\infty}\int_{i\in z_i}\frac{q(z_i)}{\varphi_i}\psi(\varphi_i, z_i)\,di\,dz\right]$$

- From Section IV.G, we find that the average wage satisfies:

$$\overline{w} = \frac{M}{(1-u)L}\left(\delta f_e + f + \frac{q(\tilde{z})}{\tilde{z}}\right)$$

- And from Section II, the no-shirking constraint requires:

$$u = \frac{\overline{w} - 1 + \delta e m_0}{\overline{w} - e}$$

We can substitute the first of these equations into the second to solve for $\overline{w}$. We then substitute $\overline{w}$ into the no-shirking constraint to get *u*, and solve for M by substituting back into the section IV.G equation for $\overline{w}$. This completes the solution of the model.

V. Autarky to Free 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 $mc_i = \frac{w_i}{\varphi_i} = \frac{1}{z_i}$, 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, which for convenience we assume are at the maximal attainable level. With $w_i \equiv 1$, we have $mc_i = \frac{1}{\varphi_i} = \frac{1}{z_i}$, 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.

In a move from autarky to free trade steady states, 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. Interestingly, the fact that the average wage does not change implies that neither will there be a change in the unemployment rate (see Equation (1.12)). 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 firm marginal costs is firm-level productivity, then unemployment, while it does exist, does not change in the move from autarky to free trade[7].

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.[8]

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 $mc_i = w_i = \frac{1}{z_i}$. 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 free 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.

[7] 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
[8] 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.

This model also provides a first opportunity to make sense of the public perception that free trade destroys good jobs at good wages. In a move from autarky to free 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 $w_i \in \left(w_x, w^*\right]$ 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 offering lower and lower wages, we can be sure that the average wage falls in the move from autarky to free 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. In this model, it does. 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 free 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 (Idson and Oi, 1999). 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.

VI. Trade Liberalization in the General Case

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

We divide our discussion of a move from autarky to free 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 relative to the maximally effective monitoring wage, through the impact of this average wage on the equilibrium unemployment rate. Depending on the primitive distribution of productivity and monitoring (φ_i, m_i), our model is consistent with either a rise or fall in this average wage with liberalization. As a base case, we begin by assuming that liberalization has *no* impact on this average wage. This implies that the structure of the economy will change, but not its scale, as the unchanged average wage neutralizes any impact on aggregate employment. 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.

A. Changes in Structure Only

We consider here the special case in which our economies move from autarky to free trade, but in which the average wage relative to the maximally effective monitoring wage is unchanged. With an unchanged average wage, 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 free trade as it affects profits of firms and employment of workers. The lowest feasible wage is the maximal 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.

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 free 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 free 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 and equilibrium unemployment. The 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 (see Equation (1.11)).

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.

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 free 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.

This also provides an additional window on the debate over whether trade liberalization threatens "good jobs". The selection effects can be viewed from two perspectives. The first is to fix a productivity level φ_0 and consider the effect of variations in w_i on selection, and then considering the reverse relation, fixing a wage w_0 and consider the selection effects of variation in φ_i.

To the previous diagram, Figure 4 adds the average wage in autarky, $\bar{w}_a$, 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 free 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.

B. Changes in Structure *and* Scale

We have just examined the consequences of a move from autarky to free trade under the assumption that this liberalization does not affect the average wage. This allowed us to separate the question of structure from that of scale, a question to which we now turn.

We need to consider a few issues. The first is whether a rise in the average wage is more likely than a fall or vice versa. The second concerns the macro implications of equilibrium changes in the average wage. Finally, we discuss how these considerations lead us to amend the conclusions from the previous subsection.

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

In considering the likely impact of trade liberalization on the average wage, as discussed above, there are two seemingly conflicting forces. At each level of productivity, employment contracts most sharply at the highest wage firms and expands most rapidly at the lowest wage firms. However, at each wage level, firm survival depends on productivity. Thus there are selection effects that favor productive firms that are more able to survive in the face of high required wages. Which effect will dominate in its effect on the average wage – the loss of good jobs controlling for productivity, or the expansion of jobs at high productivity firms?

The logic of our model does not mandate that a move from autarky to free trade raise the average wage – this depends on the distribution of firm productivity and monitoring abilities as well as the induced changes in outputs. Nonetheless, in the context of this model, we have discussed above that there are very good empirical reasons to believe that liberalization does raise average wages. Recall that marginal costs provide both an ordering by firm size and also an ordering of the output response to the move from autarky to free trade (see Figure 5). If firm size is positively correlated with the wage (as it is in data; see, for example, Idson and Oi (1999)), then a liberalization that leads to a contraction of small firms and expansion of large firms will raise the average wage. We will take this as the central case and discuss its implications.

The macro implications of changes in the average wage come directly from our heterogeneous firm model of efficiency wages: a rise in the average wage raises equilibrium unemployment. From Equation (1.12): $u = \frac{\overline{w} - 1 + \delta e m_0}{\overline{w} - e}$. The mechanism is that individual firm wages are already tied down by the monitoring technology and other parameters of the model. Firm selection effects that raise the average wage also reduce the penalty associated with shirking (since the average wage is what unemployed workers expect to earn when re-employed). If employed workers are to provide effort in equilibrium, structural unemployment must rise.

This rise in unemployment relative to the case of no change in the average wage changes the scale of the economy, but not its structure. Because of the general second best nature of the economy, with a sufficient rise in the unemployment rate, total real income can decline with liberalization, even as the average wage for those who find employment rises. 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 can arise in a model with factor market distortions is to be expected, although such an outcome in the world seems unlikely.

The rise in unemployment anticipated with the move from autarky to free 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 average wages, 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.[9]

[9] 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, 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 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 firms, then this change in composition will lead the average wage to be higher in the transition than in the steady state. All else equal, the rise in the average wage also requires a higher unemployment rate to insure effort, since the no-shirking constraints have to hold at all times. Our conjecture, then, is that both the average wage and unemployment will overshoot in the transition to the new steady state. Confirming this conjecture is beyond the scope of the present paper.

2. Political Economy

Here we will discuss the political economy of a move from autarky to free trade in two parts. The main points are most easily conveyed if we consider what happens to the typical firm or worker at each z and by only examining the comparative steady states. We do this for our central case, in which the move to free trade raises the average wage.

The main thrust of the political economy for comparative steady states can be understood through examination of Figure 3B. As before, the move from autarky to free 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 free trade. Only the largest firms, those with $mc < mc_\pi$ gain. Hence a move from autarky to free 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, may 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 free trade, which is a gain to all workers.

Our central case in which the selection effects of trade raise the average wage is a gain to workers generally. The no-shirking constraint of firms insures that workers always prefer to have a job than to be unemployed. Hence workers are always unhappy to learn of a job loss even though some of them will eventually be very happy if they happen to secure a new job with a sufficiently high wage. In our framework, there is always a trade-off arising from the fact that if indeed trade raises the average wage, it will also raise the equilibrium unemployment rate. In this sense, a move from autarky to free trade raises the variability of outcomes for workers – when employed they enjoy a higher average wage, but more of them will be unemployed.

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, 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.

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.[10] 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.

[10] 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.

One of the important consequences of these analyses is that, unlike the case of a move from autarky to free 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.

VII. Conclusions

There is a strong public perception that trade threatens "good jobs at good wages." Yet much of the international trade literature abstracts both from issues of aggregate employment and the attachment of workers to particular jobs. Nearly all of the literature that has addressed unemployment has done so in the context of inter-sectoral reallocation, although empirically the vast majority of re-allocation in response to liberalization occurs within sectors.

The recent appearance of models of firm heterogeneity in models of intra-industry trade, notably that of Melitz (2003), provides an opening to address these issues. In this paper, we merge Melitz's model with the Shapiro-Stiglitz (1984) model of efficiency wages, amended to allow for firm heterogeneity in monitoring. Unemployment arises, as in Shapiro and Stiglitz, as a necessary condition for workers to exert effort. However, our firm based model allows us to go beyond Shapiro and Stiglitz to separate the effects of changes in a firm's own wage from changes in the economy's average wage on incentives to shirk, so also on unemployment. While a rise in an individual firm's wage reduces incentives for shirking, a rise in the average wage raises incentives for shirking and in equilibrium requires a higher unemployment rate consistent with the supply of effort by workers. This meshes well with the Melitz results on the move from autarky to free trade. Here, when this liberalization raises the average wage, which we consider the normal case, it will also raise the unemployment rate.

We also provide a coherent account of the sense in which the public perception that trade threatens good jobs at good wages is correct, if only partial. Framing the issue as a comparison between firms with common levels of technical capability (φ_i), a move from autarky to free trade indeed eliminates the highest paid jobs, causes contraction of the next highest paid jobs, expands relatively poorly paying jobs, and expands most sharply the lowest paying jobs. Those who lose high paying "good jobs" will not be pleased. However we also show that the productivity-normed perspective is only partial. In particular, it operates even if the net effect of the move from autarky to free trade is to raise the *average* wage. There are good reasons to believe this is the normal case. If the average wage rises with liberalization, as we have noted, so also will the unemployment rate.

Our ability to speak about the attachment of specific workers to specific jobs also provides an opportunity to fill in some elements of political economy missing from the Melitz model. In the original formulation, the move from autarky to free trade creates winners and losers among firms – only the super-exporting firms see their profits rise – but leaves all workers favoring liberalization. This is not an appealing model of worker perspectives on liberalization. In our formulation, unless unemployment rises very sharply, workers who keep their jobs will all experience gains via price reductions and possibly variety gains. This source of gains is also available to workers who lose their jobs, but for many this will be insufficient compensation for the loss of job-specific rents.

This combination of results also suggests a potential rise in the variability of outcomes for workers. Average wages will be expected to rise. But so will the unemployment rate. Some workers will lose what they perceived to be good jobs. If their initial wage was sufficiently high, those workers won't be able to expect to find an equally highly paying job even if the average wage in the economy rose.

In short, this paper provides a framework that allows us to make sense of the public perception that trade threatens good jobs at good wages. Viewed from the proper perspective, this perception is perfectly correct. But it is only partial. A full view of the effects of liberalization also must take account of the productivity enhancements that comes from the equilibrium selection for relatively productive firms. This can be expected to raise the average wage in the economy, although it may also raise certain measures of dispersion of outcomes and leave at least some of those who lost jobs to trade considerably worse off.

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

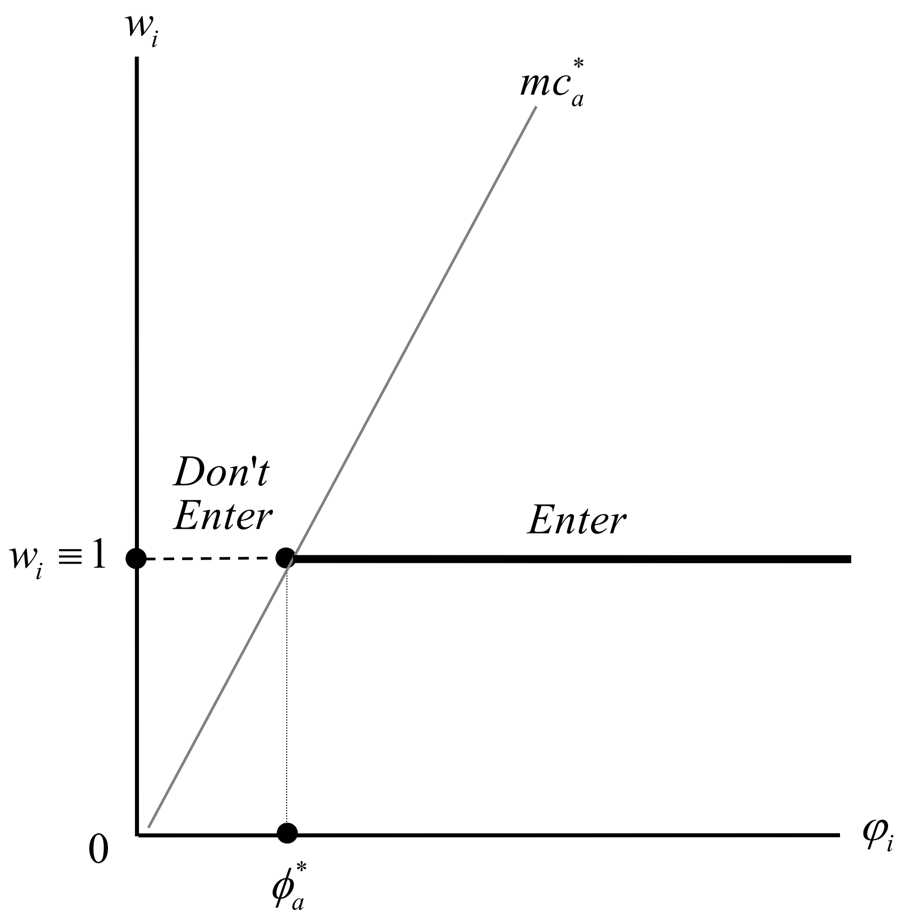


Figure 1A illustrates the first of three models of the entry decision. Generically, all three models condition entry to production on random draws that deliver sufficiently low marginal costs. In a Melitz-type variant of the model, homogeneous labor and identical monitoring costs require firms to pay 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 Free Trade

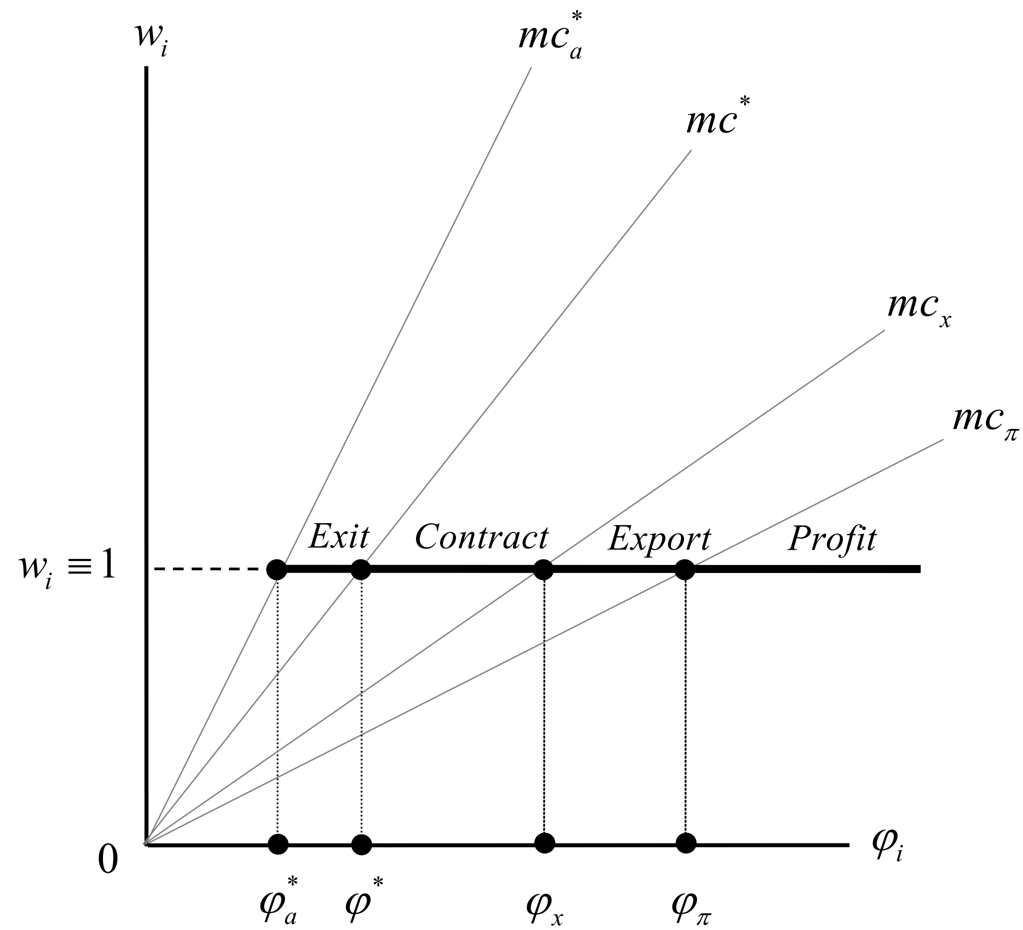


Figure 1B illustrates the move from autarky to free trade in our model when we suppress firm heterogeneity in monitoring, so again the only firm level variation in marginal costs arises, as in Melitz, from differences in marginal physical productivity. The consequences of this liberalization are familiar 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

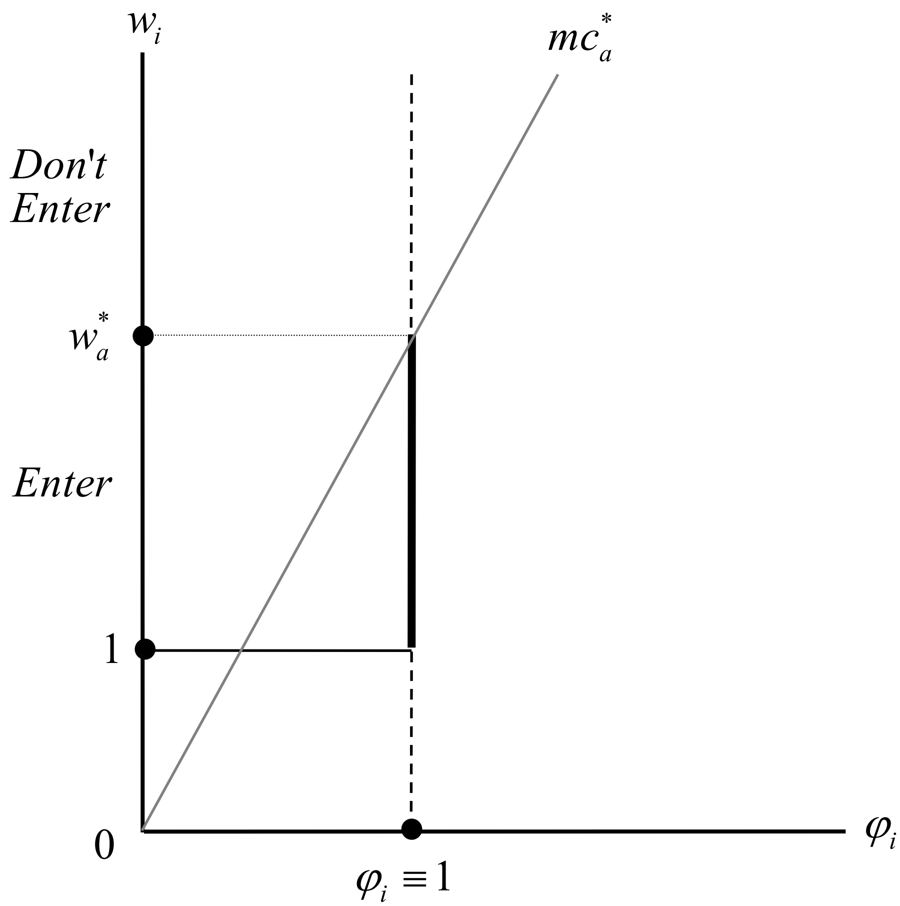


Figure 2A presents the alternative extreme to the Melitz-type approach. In it we abstract entirely from firm-level variation in marginal physical productivity by assuming $\varphi_i \equiv 1$. Firm level variation in marginal costs is thus assumed to arise here entirely due to firm level variation in 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"

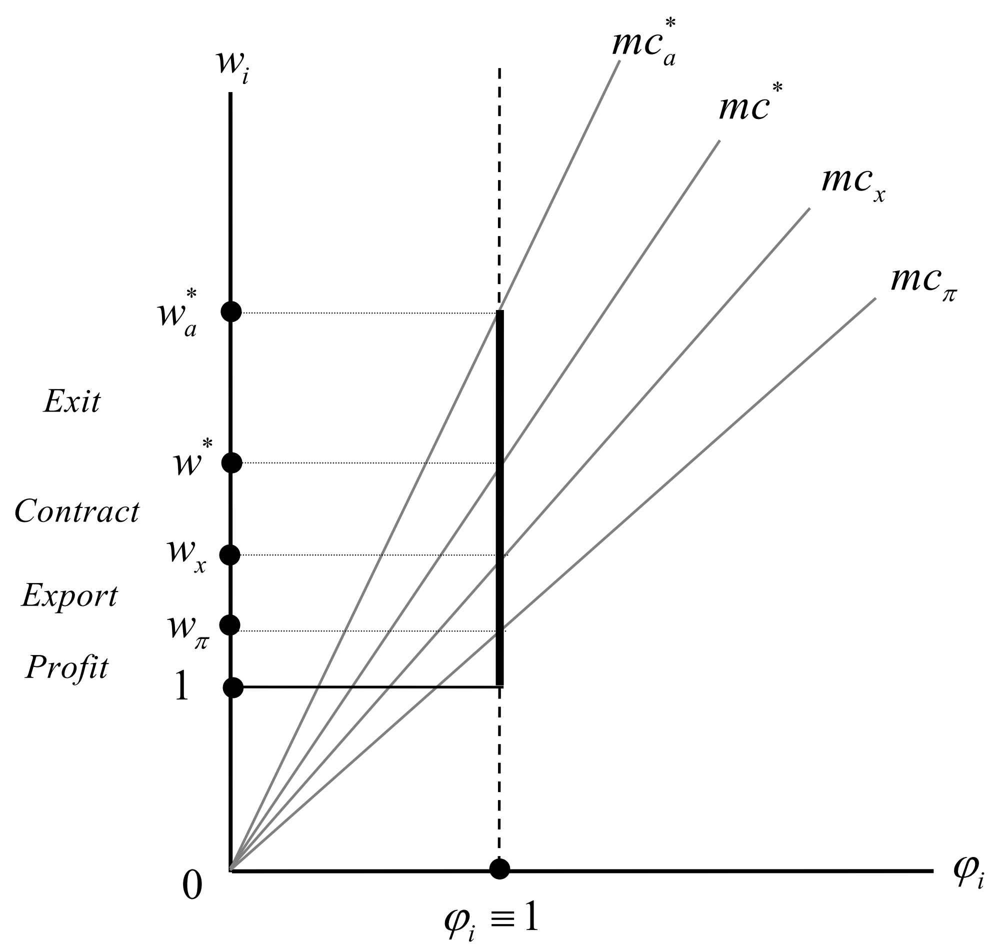


Figure 2B illustrates the consequence of a move from autarky to free trade in the model in which we allow variation in marginal costs to arise only due to firm-level wage variation arising from firm differences in monitoring. It is straightforward to see that it maps the Melitz analysis precisely into 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

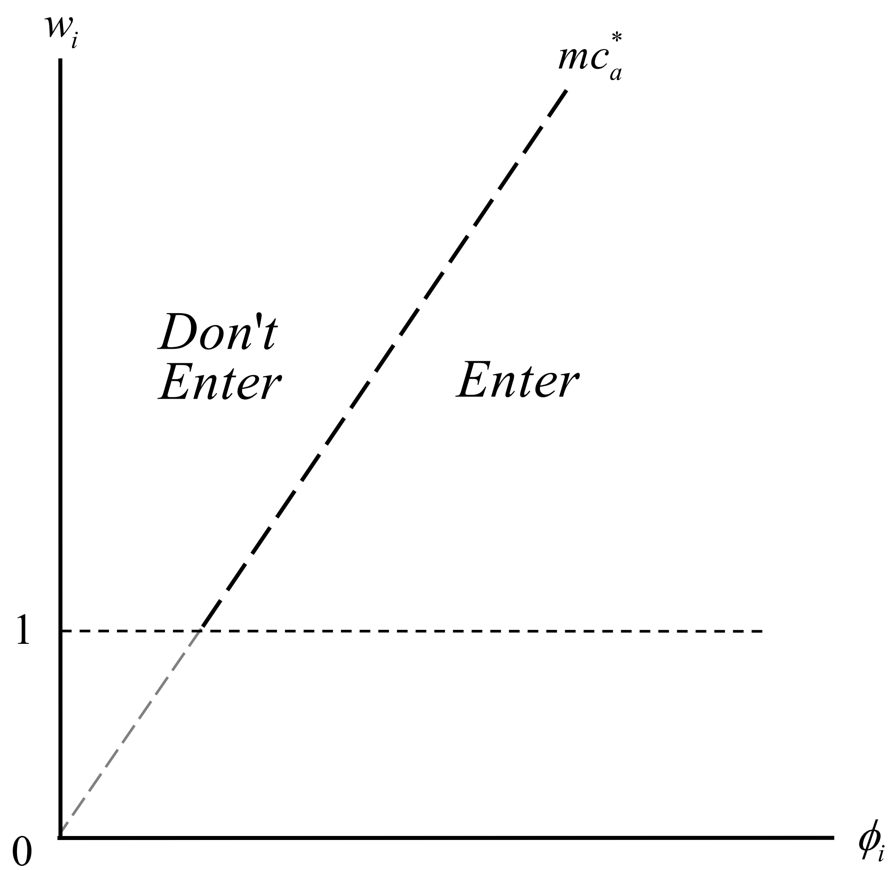
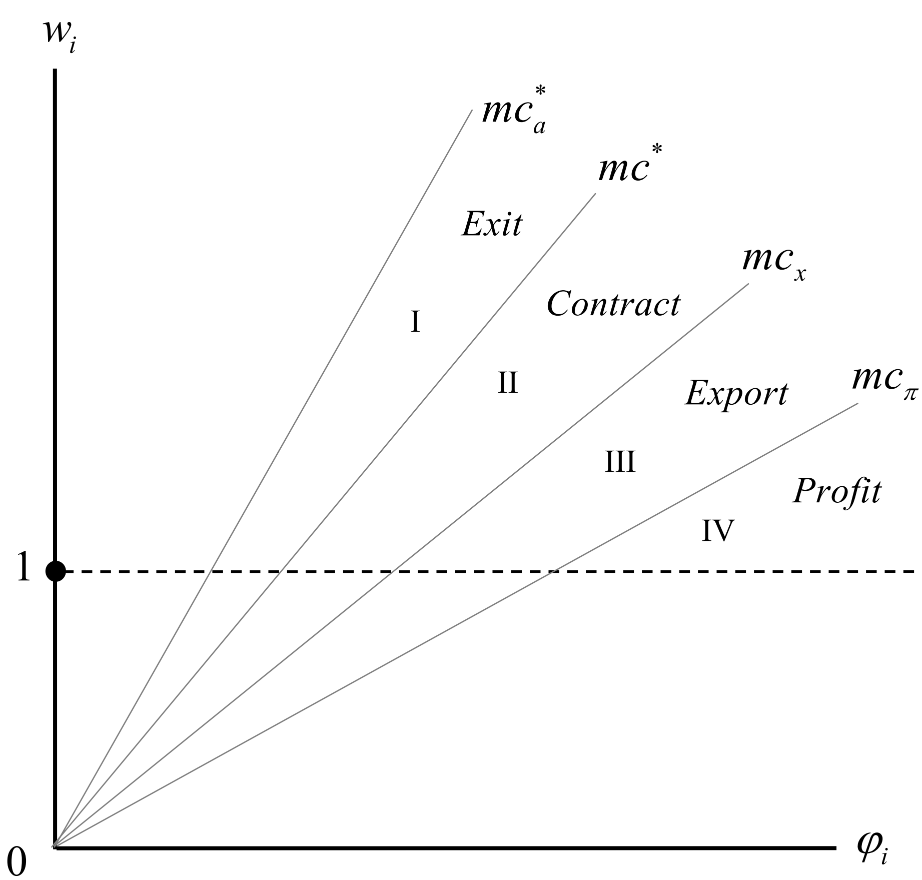


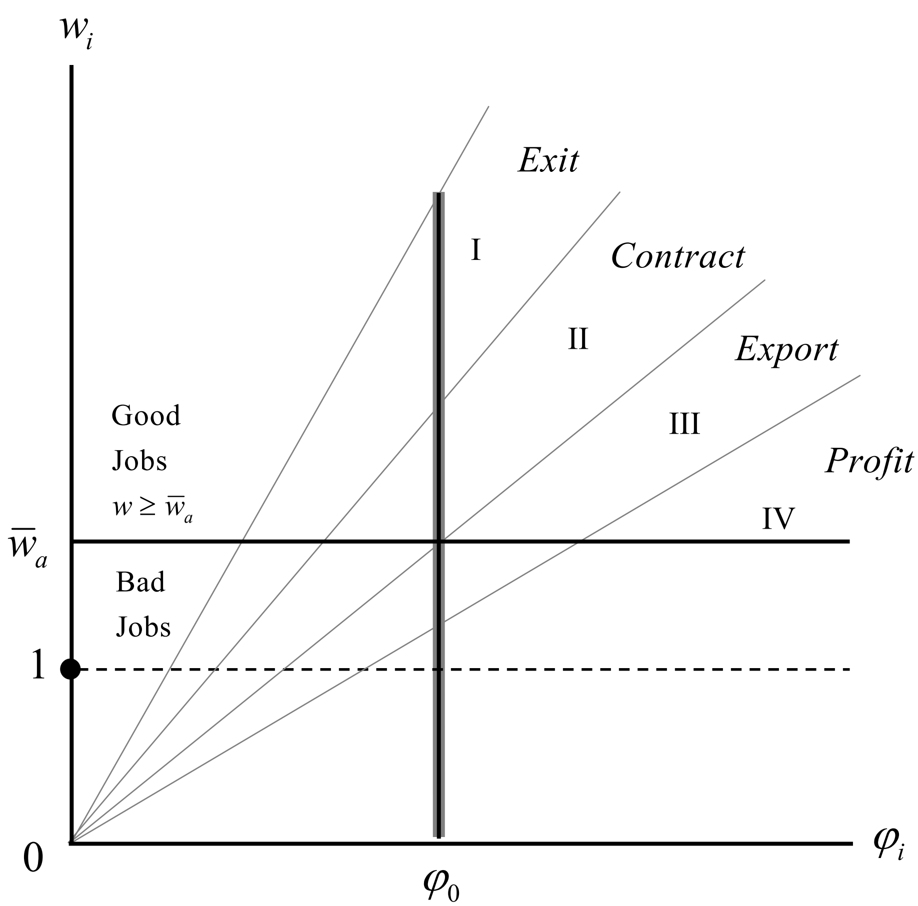
Figure 3A illustrates the autarky production entry decision for our core model. This core model is a hybrid in which marginal costs depend on firm level variation in both wages and marginal physical productivity. These marginal costs are given by $mc_i \equiv \frac{w_i}{\varphi_i} \equiv \frac{1}{z_i}$, 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 numeraire. 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 Free Trade in the General Model



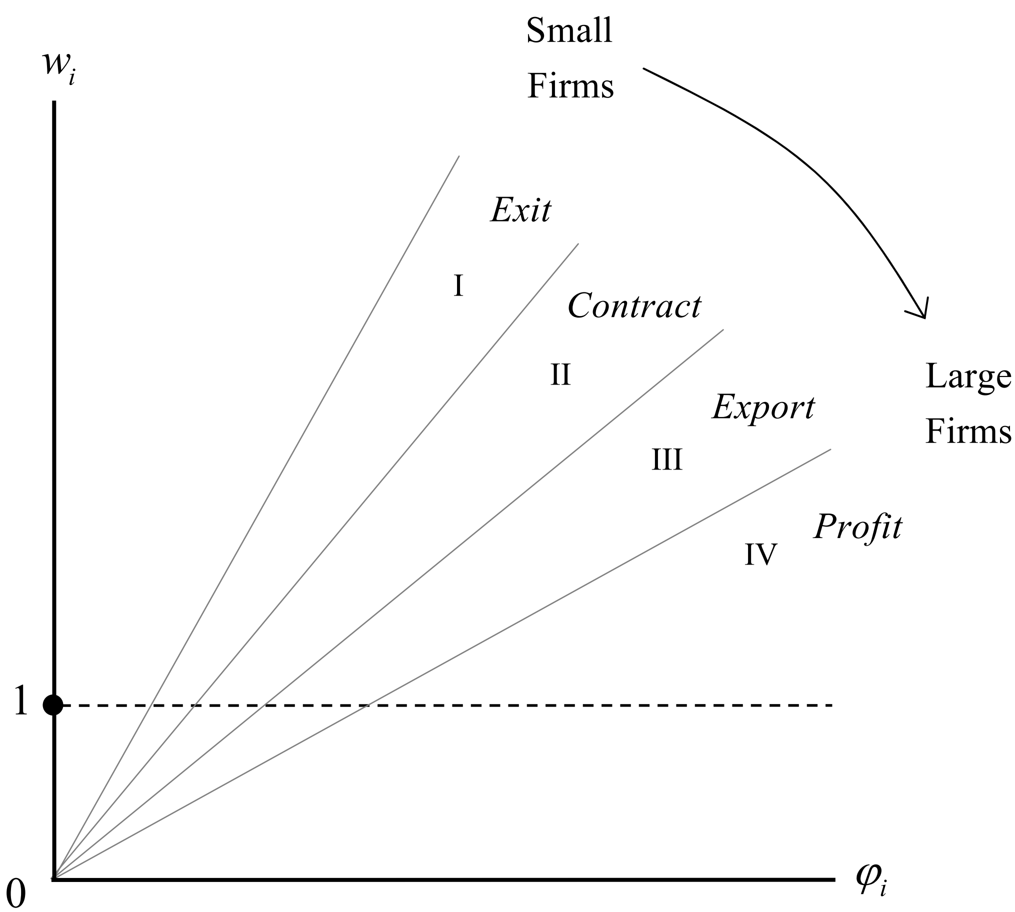
The move from autarky to free trade changes the marginal firms from those with marginal costs mc_a^* to mc^*. This leads to exit of the high marginal cost firms in Region I; contraction of the next highest marginal cost firms in Region II; and expansion of low marginal cost firms in Regions III and IV 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.