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Labour Market Power and the Dynamic Gains to Openness Reforms

Abstract

We develop a dynamic general equilibrium framework with firm heterogeneity and monopsonistic labour markets, for quantification of the impact of trade and FDI liberalisation episodes. Firms make standard extensive margin investment choices into exporting and multinational statuses. The labour market features upward-sloping supply curves and love of variety in employment. These features interact with the variable-fixed cost tradeoff of outward activity. We calibrate the model to U.S. data and study the effect of reductions in tariffs and outward FDI taxes in both bilateral and unilateral contexts, examining steady state and transitional effects. We compare the predictions of this model with a more standard version with perfectly competitive labour markets. Our headline finding is that the model with labour market power gives substantially different quantitative estimates to the perfectly competitive version. For instance, a bilateral trade liberalisation gives welfare gains that are over 10 times larger in the presence of monopsony power. Significant quantitative differences persist with a variety of robustness exercises.

JEL-Codes: F120, F130, F160, F230, F400, H250.

Keywords: monopsonistic labour market, trade liberalisation, love of firm variety, dynamics, foreign direct investment, corporate taxation.

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1 Introduction

While much of the research in international trade assumes perfectly competitive labour markets, this sits at odds with the growing evidence of labour market power.[1] Some recent papers (MacKenzie, 2019, Jha and Rodriguez-Lopez, 2021, Egger et al., 2022) have started incorporating labour market power into trade models. Contributing to this emerging research, in this paper we incorporate a monopsonistic labour market in a standard dynamic quantitative model of trade, to study the welfare implications of liberalising open economy policy instruments. We firstly consider a standard import tariff. We then consider an outward tax on FDI profits — the policy motivation being several recent unilateral and multilateral reforms from around the world to the tax treatment of multinationals' profits.[2]

Our modeling of monopsony in the labour market parallels the modeling of monopolistic competition in the goods markets. A representative worker endogenously chooses their labour supply. However, the worker's disutility for labour is modelled in such a way that they get lower disutility if they spread their labour supply over a number of firms. This leads to an upward sloping labour supply curve facing firms, giving rise to monopsony power. The worker's utility function ends up exhibiting love of variety for employers, parallel to the love of variety in consumption.[3]

Other than introducing monopsony in the labour market, the model is a standard dynamic general equilibrium framework with stochastic firm productivity and endogenous entry/exit. Firms are monopolistically competitive in the product market and labour is the only factor of production. Firms endogenously select into one of three modes — domestic, exporter, multinational — based on their state vector for the period. The fixed cost set up follows papers such as Alessandria and Choi (2007), Alessandria, Choi and Ruhl (2021) and Ruhl and Willis (2017), where firms pay a one-off sunk cost to establish a new operating segment and then pay fixed period-by-period costs to maintain it (and receive new productivity shocks) thereafter. The exporting-FDI tradeoff combines elements of Helpman, Melitz and Yeaple (2004) and Arkolakis et al. (2018) by including fixed and variables costs of exporting and FDI. In particular, not only do exporters incur an iceberg shipping cost, there are productivity losses associated with the operations of a foreign subsidiary as well. We

[1] See Naidu et al. (2018), Yeh et al. (2022)

[2] An example of a multilateral reform is the OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting agreement of 2021. A recent unilateral change was removal of the U.S. repatriation tax as in the Tax Cuts and Jobs Act of 2017.

[3] We also conduct robustness exercises where we shut down the love of variety for employers but keep the monopsonistic labour market structure.

discipline these parameters using data on the cross-section of U.S. firms.

With regard to trade liberalisation, we set our benchmark calibration at 10% tariffs and assume the labour market to be monopsonistic. We then perform counterfactual exercises for reducing the tariff to zero, both unilaterally and bilaterally. We compare these outcomes against the competitive labour market case where the initial tariff (which turns out to be 7%) is such that the ratio of tariff revenues to aggregate final output is same as in the monopsonistic labour market benchmark.[4] Additionally, we analyse the welfare effects by comparing the steady states as well taking the transition gains and losses into account. The key insight from the quantitative exercise is that the welfare gains in consumption equivalent variation from a bilateral trade liberalisation are much larger in the monopsonistic labour market case (13%) compared to the competitive labour market benchmark (1%). Then again, with the unilateral liberalisation the gains are larger with monopsonistic labour market, but in this case the bulk of the gains go to the non-liberalising country (10%) vs the liberalising country (5%).[5] The main source of asymmetric gain is the terms of trade losses for the liberalising country and the corresponding gains for the non-liberalising country.

The key intuition behind the larger gains from trade with monopsony compared to a competitive labour market comes from the fact that the labour supply of workers is inefficient in the calibrated steady state. Since wages are marked down below the marginal product while goods prices are marked up above the marginal cost, the opportunity cost of leisure is too low and workers end up consuming too much leisure and under-supply labour. This also results in a smaller mass of firms operating in a given country. Trade liberalisation ends up increasing the mass of producing firms, which also elicits greater labour supply from workers and alleviates the existing distortion. One reason why the mass of producing firms increases is because the upward sloping labour supply curve disincentivises exporting. In this setting, trade liberalisation has a large effect on the mass of exporters, much larger compared to the competitive labour market case. This ends up increasing the mass of producing firms in each country. In the case of unilateral liberalisation by Home, the mass of producing firms in Foreign increases significantly more.

Looking at FDI, we set the baseline rate of FDI profit taxes such that the profit tax to final output ratio is also 0.2%, for comparability across the exercises. This yields

[4]The benchmark monopsonistic calibration implies a tariff revenue to aggregate final output ratio of 0.2%

[5]In the case of a competitive labour market, the gains for the liberalising country are 0.2% while the gains for the non-liberalising country are 0.9%.

an initial tax rate of 1% in the monopsony case and 2.2% in the competitive labour market case. Again, the welfare gains from bilaterally eliminating FDI profit taxes are larger (2%) when the labour market is monopsonistic compared to the competitive labour market case (0.3%). However, unlike the case of trade liberalisation, a unilateral elimination of FDI profit taxes by Home benefits Home but hurts Foreign. Quantitatively, the effects of unilateral FDI liberalisation are several orders of magnitude larger with the monopsonistic labour market compared to the competitive labour market. When Home reduces the taxation of Home-based multinationals, it increases the value of being a Home-based multinational firm. This leads to more entry and firm creation in Home and more of them become entry into FDI status. The latter effect is amplified by the upward sloping labour supply curve which tilts the decision in favor of FDI over exporting. Not only do Foreign-based multinationals not benefit directly from a tax cut in Home, they also face higher wages in Home, hence more of them prefer to export rather than locate their production in Home. A consequence is that the mass of firms operating in Home increases significantly while the mass of firms operating in Foreign decreases. Given the love of variety for employers, this is a strong source of welfare gain for Home and a source of welfare loss for Foreign.

In addition to studying the steady state effects of tariff and FDI tax liberalisation, we also study the transition effects of these policy changes. In the case of bilateral tariff liberalisation, we find that there is a short term drop in consumption to finance extra firms when the labour market is monopsonistic. In contrast, consumption overshoots in the case of a competitive labour market, a result echoing the findings of Alessandria, Choi and Ruhl (2021). In addition, ignoring the welfare effects during transition overstates the gains from tariff reforms in the monopsony case and understates it in the competitive labour market case. Comparing the transitions of unilateral and bilateral tariff liberalisations in the presence of monopsony, we find that the world economy takes longer to converge in the former case. This is mainly driven by the slower adjustment of firms at the extensive margin in the trading partner of the country undertaking unilateral tariff liberalisation.

Looking at the transition effects of FDI tax liberalisation, we generally find that the transition is much longer compared to the case of trade liberalisation. Although the most productive firms transition to multinational status immediately, it takes much longer for firms with intermediate levels of productivity. This follows since it's generally optimal for these firms to transit via exporting. Moreover, the transition times in the case of bilateral FDI reforms do not depend on the structure of the labour market. This is because the FDI taxes are levied on firm profits, and hence wage bills become tax deductible. As a consequence, FDI taxes do not affect the intensive margin decisions of firms conditional on their status. Tariffs, on the other hand, distort sales and hence affect the intensive margin decisions. Finally, the transition effects of unilateral FDI tax liberalisation tend to be more volatile in the case of monopsony compared to a competitive labour market. For example, in the liberalising country the measure of entrants doubles on impact before settling down at 50% above the pre-liberalisation steady-state in the monopsony case while in the competitive labour market case these numbers are 16% and 6%, respectively.

As a robustness exercise, we shut down the gain from employer variety but keep the monopsonistic labour market structure intact. In this case, as expected, the gains from trade liberalisation are lower in magnitude, however, still significantly higher than with a perfectly competitive labour market. Interestingly, in the absence of the employer variety effect, a bilateral lowering of the taxes on outward FDI reduces welfare. This happens primarily because the increased presence of multinationals has an adverse effect on entry leading to a large decline in the mass of entrants and the mass of varieties available for use in production of aggregate final goods. The mass of producing firms increases which induces increased labour supply in the presence of employer variety effect but not so when this channel is shut down. Removing this source of welfare gain makes the overall effect FDI tax liberalisation welfare reducing. In a perverse way, the labour market power induces firms to go multinational, rather than taking the exporting route for selling in the foreign market. This allows them to pay lower wages in both locations and raises the possibility of there being too many multinationals leading to potential welfare losses. In this setting, a tax on multinational profits could increase welfare.

To sum up, our main finding is that, compared to the benchmark competitive labour market case, a tariff liberalisation provides much larger welfare gains when labour markets are monopsonistic. The welfare implications of FDI liberalisation are crucially tied to the employer variety effect. In the presence of employer variety effect, the gains from FDI liberalisation are also larger when labour markets are monopsonistic compared to a competitive labour market. However, the absence of the employer variety effect in combination with labour market power creates the possibility of there being too many multinationals.

2 Related Literature

Jha and Rodriguez-Lopez (2021) construct a theoretical model where monopsony power in the labour market arises because of workers' idiosyncratic preferences for jobs. This also gives rise to love for employer variety. They show how trade liberalisation could provide additional gains through the employer variety channel when monopsony power is high but detract from welfare gains when monopsony power is low. The current paper differs along several dimensions. Labour supply is endogenous in our framework, which opens an additional channel through which trade liberalisation affects welfare. While Jha and Rodriguez-Lopez (2021) provide a theoretical model and derive steady-state results under Pareto distribution of productivity, in this paper we perform a quantitative exercise and evaluate welfare effects in both steady state and during transition. Finally, we also allow firms to undertake FDI and study the implications of FDI tax liberalisation.

Egger et al. (2022) also incorporate a monopsonistic labour market in a model of trade with heterogeneous firms. They do not allow firms to engage in horizontal FDI as in our current model, but do allow firms to offshore inputs from abroad. Just as an upward sloping labour supply curve incentivises firms to engage in horizontal FDI compared to exporting in our set up, in their framework firms are induced to offshore input production. They find that trade in goods is welfare improving but offshoring can be welfare reducing because it allows firms to exercise their labour market power by reducing the size of their domestic operations. Our results on the adverse welfare implications of a cut in FDI taxes in the absence of employer variety effect echoes their finding of adverse welfare effects of offshoring.

MacKenzie (2019) uses a model with oligopoly in the product market with endogeous markups and oligopsony in the factor market with endogenous markdowns but a fixed number of firms and performs a quantitative analysis using data from India. He finds that trade liberalisation has a larger effect on markups in the product market than on markdowns in the labour market. In our framework, the markups and markdowns are constant but the mass of firms is endogenous and much of the impact of trade and FDI liberalisation through the extensive margin.

Our theoretical model shares some features of the Berger, Herkenhoff and Mongey (2022) model, where labour supply is endogenous and the disutility from labour is decreasing in the mass of firms, to which the workers supply the labour. However, the mass of firms is fixed in their framework and hence they do not pay heed to the employer variety feature of the model. Their focus is on estimating and quantifying the welfare effects of labour market power. They find a significant welfare loss from labour market power compared to the efficient allocation.

Jha and Rodriguez-Lopez (2022) also use a similar model to study the effects of minimum wages when workers care about employer variety. Their theoretical model quantifies the welfare effects of minimum wages through changes in the mass of employers.

The modeling of FDI in a quantitative open economy framework is similar to Spencer (2022), who studies the implications of corporate tax reforms targeted at multinational firms in the presence of financial frictions but competitive labour markets. We abstract away from financial frictions in the current paper but introduce a monopsonistic labour market. While tax cuts lead to welfare gains in the presence of financial frictions, it is not necessarily the case in the presence of labour market frictions.

A growing number of empirical studies provide evidence for firms facing finitely elastic labour demand. Naidu et al. (2018) survey the literature and provide a range of 1 to 5 for the labour supply elasticities facing firms. Berger, Herkenhoff and Mongey (2022) estimate firm-level labour supply elasticities ranging from 0.76 (for a firm that controls an entire local labour market) to 3.74 for the smallest firms. Webber (2015) uses the U.S. Census's Longitudinal Employer-Household Dynamics (LEHD) data and obtains a mean labour supply elasticity of 1.08 which is the number we use in our quantitative exercise. A consequence of a finitely-elastic labour supply is that firms have market power and they markdown wages below the marginal product of labour. Yeh et al. (2022) estimate the markdowns directly using the output elasticity and revenue share of labour. They find the markdowns to be substantial and increasing since the early 2000s. Our quantitative exercises show that labour market power can significantly affect the welfare effects of trade and FDI reforms.

3 Model Environment

Our model consists of two symmetric counties, referred to as Home (H) and Foreign (F). There are four types of agents in each country — households, intermediate producers, final producers and governments. Labour in each country is the only variable input into production; this factor is immobile across countries. There are flows of trade in intermediate good varieties across countries, as well as horizontal FDI. We adopt the notation convention that variables with a $*$ superscript correspond to activities in F, while those without correspond to those in H. In the exposition that follows, we focus on agents from the H economy, the setup for those from F can be defined similarly. Aggregate and firm-level variables are denoted with capital and lower-case letters respectively. Time is discrete and indexed by subscript t.

3.1 Households and Monopsonistic Labour Markets

A representative household faces a budget constraint of the form

$$P_t C_t = W_t N_t + \Pi_t + T_t \tag{1}$$

where P_t is the CPI, C_t is consumption of final goods, W_t is an index of wages and N_t is a labour supply index (defined below), Π_t is aggregate profits (net of fixed costs) and T_t are lump-sum tax rebates from the government.[6] We assume that the household owns all of the equity of the firms incorporated in their country of residence.[7] The household has preferences similar to Berger, Herkenhoff and Mongey (2022) and Jha and Rodriguez-Lopez (2022) of

$$U_t = \sum_{t=0}^{\infty} \beta^t \left[C_t - \frac{N_t^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}} \right] \tag{2}$$

where $\phi \geq 0$ is the Frisch elasticity of labour supply and $\beta \in [0,1]$ is the discount factor.[8] Varieties of intermediate goods producers are indexed by ω. The household supplies labour to firms producing in its country of residence; the mass of such firms is defined as

$$\Omega_t^P = \Omega_t + \Omega_t^M$$

where the P superscript in Ω_t^P stands for "producing". Variable Ω_t is the mass of operative firms incorporated in H, while Ω_t^M is the mass of multinational firms incorporated in F. That is — the household supplies its labour to both domestic firms and to the H subsidiaries of multinationals from abroad. We define the labour supply index as

$$N_t = (\Omega_t^P)^{\frac{\eta}{1+\theta}} \left(\int_{\omega \in \Omega_t^P} n_t(\omega)^{\frac{1+\theta}{\theta}} d\omega \right)^{\frac{\theta}{1+\theta}} \tag{3}$$

[6] Since our model is dynamic, firms will generate positive profits in equilibrium due to the presence of discounting.

[7] Note also that the household implicitly makes a decision each period in the number of shares to hold in the domestically-incorporated firms. Given that there is only one household, in equilibrium they hold all of the equity. As such, we abstract from writing this part of the problem to keep the exposition simple.

[8] We make this assumption of household risk neutrality to keep the model computations tractable. Accounting for risk aversion and consumption smoothing is an important extension in thinking about the transition; something that we plan to undertake in future versions of this work.

where $\theta > \phi$ is the elasticity of substitution across jobs from different employers and $\eta \in [0, 1]$. A low value of θ indicates a high degree of monopsony power in the labour market — due to low substitutability across jobs — whereas the $\theta \to \infty$ case corresponds to the standard perfectly competitive labour market. The parameter η governs the degree of love of variety in employment preferences; a value of $\eta = 0$ gives full love of variety for employers, while $\eta = 1$ eliminates the effect. We set $\eta = 0$ in our baseline analysis but perform robustness on this parameter in later exercises.[9]

3.2 Final Goods Firms

A representative final goods producer aggregates over the intermediate goods varieties that are utilised domestically. As will be discussed later, the final good is utilised for both consumption and fixed costs. We define the mass of varieties utilised as

$$\Omega_t^U = \Omega_t + \Omega_t^{X*} + \Omega_t^M$$

where the U in Ω_t^U stands for "utilised" and Ω_t^{X*} is the mass of exporters sending goods from F to H. Final goods producers use technology

$$A_t = \left(\int_{\omega \in \Omega_t^U} q_t(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} \tag{4}$$

where $q_t(\omega)$ denotes the input of intermediate goods of variety ω and $\sigma > 1$ is the elasticity of substitution across varieties. As in Alessandria, Choi and Ruhl (2021), we introduce a parameter $\widehat{\tau}^X \geq 1$ as a tariff levied by the H Government on imported goods from F. This tariff is borne by the final goods firms at the point they purchase imported varieties from abroad.

3.3 Intermediate Goods Firms

Intermediate firms operate under a dynamic Helpman, Melitz and Yeaple (2004) structure with fixed and sunk costs associated with maintaining and upgrading their statuses respectively. An incumbent's state variable will change over time and it will always have the option to exit the industry. As such, we describe the environment for incumbent and new entrant firms in turn. To economise on notation, we omit variety-level notation in what follows.

[9] Blanchard and Giavazzi (2003) use a similar structure to neutralise the love of variety in consumption.

3.3.1 Incumbents

Incumbent firms seek to maximise the discounted value of expected dividends they pay to their shareholders

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t d_t \tag{5}$$

where the discount factor β is that of the household given above, d_t is the dividend in period t and the expectation operator is with respect to their idiosyncratic shocks. These firms produce using a constant returns to scale technology $y_t = z_t n_t$ where y_t is output, z_t is the firm's idiosyncratic productivity level and n_t is its employment of labour. The productivity level evolves over time through process

$$\log(z_t) = \rho_z \log(z_{t-1}) + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma_z^2) \tag{6}$$

where $\rho_z \in [0, 1)$ is a persistence parameter, ϵ_t is a shock with normal distribution about a zero mean with variance σ_z^2. As shorthand, we will refer to the conditional process defined by (6) by $Q(z_t|z_{t-1})$. We assume, to keep the state space small, that the same productivity process applies to production in F should this H firm choose to become a multinational.

Firms make a choice of how much labour to hire, subject to the optimal labour supply choices of households (to be described in section 4). A firm with operations in H must offer a wage to induce the desired supply of labour from the H household. A multinational will make the same considerations when making their labour choice in F.

Incumbents make a choice about their operations at the extensive margin. They choose a status each period s_t, which can be either to exit (E), operate as a domestic firm (D), an exporter (X) or a multinational (M).[10] A domestic firm sells its goods only to the market of its country of incorporation. An exporter also sells to the final goods producer abroad, from its domestic production. A multinational establishes a local subsidiary abroad, employing in the local workforce, for production of goods sold in the local market.

As in papers such as Alessandria and Choi (2007), Alessandria, Choi and Ruhl (2021) and Ruhl and Willis (2017), firms pay a one-off sunk cost to establish a new operating

[10]Note that although firms make the choice of s_t each period, the calibration of the fixed costs will be done to match the persistence of statuses in the data.

segment. They then pay fixed period-by-period costs to maintain it (and receive new productivity shocks) thereafter. Post-entry, all firms incur fixed cost f^C, (the C is shorthand for "continuation"), each period they remain active. A firm changing its status to $s_{t+1} \in \{X, M\}$ from status $s_t \in \{D, X, M\}$ with $s_{t+1} \neq s_t$, incurs sunk cost $f_t^{s_{t+1}, s_t}$. That is — the sunk costs are allowed to vary with the firm's current status. A firm that maintains a status of $s_{t+1} \in \{X, M\}$, having incurred the associated sunk cost previously ($s_{t+1} = s_t$), pays period-by-period cost $f^{s_{t+1}, C}$. Notice also the time subscript on $f_t^{s_{t+1}, s_t}$; we allow these four possible sunk costs ($f_t^{X,D}, f_t^{M,D}, f_t^{X,M}, f_t^{M,X}$) to exhibit some randomness to generate dispersion for technical reasons. We then denote the vector of a firm's vector of fixed costs as f_t and the probability distribution they follow by $H(f_t)$.[11] As in Jha and Rodriguez-Lopez (2021), these fixed costs are all denoted in terms of final goods (of their country of incorporation), given the non-competitive labour market.

Firms that export or undertake FDI are also subject to variable cost inefficiencies. We denote $\tau^X \geq 1$ as the standard iceberg trade cost incurred by an exporter. As in Arkolakis, Ramondo, Rodríguez-Clare and Yeaple (2018), we also define parameter $\tau^M \geq 1$ as a productivity loss associated with the operations of its foreign subsidiary.[12] For both of these variable costs, a firm must produce τ^s output, for $s \in \{X, M\}$, in order to sell 1 unit of output to the relevant final goods producer. Finally, incumbent firms who generate profits through multinational activity are taxed by the government of their country of incorporation on such profits at rate $\widehat{\tau}^M \in [0, 1]$. Note the difference in the treatment of the distortions levied by the Government across imports and FDI. The tariff rate is on the sale value of imported goods, while the FDI tax is levied on corporate profits of multinationals abroad. We follow this approach to map the policies closely to the data.[13] Be sure to note though that these distortions will have fundamentally different effects on firm decisions. The tariff distorts the exporting firm's demand curve, potentially affecting both the extensive and intensive margins. This differs from the FDI tax, which solely affects the

[11]Specifically, we assume that $f_t^{s_{t+1}, s_t} \sim LN\left(\widehat{f}^{s_{t+1}\, s_t}, \sigma_f^2\right)$ where $\widehat{f}_t^{s_{t+1}, s_t}$ is the mean and σ_f^2 is the variance of a log-normal distribution for $s_{t+1} \in \{X, M\}$ and $s_t \in \{D, X, M\}$ with $s_{t+1} \neq s_t$. These costs are drawn iid overtime. Note that σ_f^2 is the same for all four sunk costs. This cost structure allows for better convergence properties of the quantitative exercises. In practice, this amounts to introducing another parameter σ_f that must be disciplined with data.

[12]As in Arkolakis et al. (2018), we will use these two variable costs to match sales intensities in the data.

[13]The outward tax on FDI can be thought of as resembling the repatriation tax levied by the U.S. Government prior to the TCJA or as a minimum tax, such as the 15% agreement reached by the OECD, implementable by the end of 2023.

extensive margin choice, given that labour expenses are tax deductible.

We summarise the timing of the incumbent's problem below.

1. Enter the period with state vector (z_{t-1}, s_t).
2. Draw new productivity shock z_t from distribution in equation (6).
3. Make static production choices in accordance with s_t and newly-drawn z_t.
4. Draw sunk cost shocks.
5. Make new discrete choice $s_{t+1} \in \{E, D, X, M\}$.

3.3.2 Entrants

Variables and parameters pertaining to new entrant firms will be denoted with superscripts T. These firms create a new variety upon startup. An entrant pays a sunk cost to incorporate their firm, which we denote by f^T. Their initial status is as a domestic firm $s_{t+1} = D$. They draw their initial productivity shock from unconditional distribution denoted as $Q^T(z)$. They then operate as incumbent firms thereafter. We denote the mass of these new entrants by M_t^T.

3.4 Government

The Government acts passively. They raise taxes exogenously and re-distribute the proceeds to the household. The expression for aggregate tax collections is given as

$$T_t = (\widehat{\tau}^X - 1)I_t + \widehat{\tau}^M \Pi_t^{M*} \tag{7}$$

where the first term represents collected tariff revenues on the value of imports I_t and the second is proceeds from taxing the multinationals' profits Π_t^{M*}.

4 Model Equilibrium

This section details the optimisation problems agents in the model solve, as well as characterising their solution. We take the price of the final good in H as the numéraire, meaning that $P_t = 1\ \forall t$. Note however that we keep P_t in the notation that follows so the equations can be easily translated to those of F.

4.1 Households

The household's problem amounts to choosing the amount to work in each firm $n_t(\omega)$, for a given period, to maximise its utility. This objective is obtained from equations (1) and (2) as

$$\max_{n_t(\omega)} \ \frac{1}{P_t}\left\{\int_{\omega\in\Omega_t^P} n_t(\omega)w_t(\omega)d\omega + \Pi_t + T_t\right\} - \frac{N_t^{1+\frac{1}{\phi}}}{1+\frac{1}{\phi}},$$

which is maximised subject to equation (3). Variable $w_t(\omega)$ denotes the wage offered by the firm of variety ω. Notice that the household takes aggregate profits and government distributions as given. Their choice trades-off more income from working, the first term inside the brackets, with more disutility from labour supply, the last term in their objective. Their optimal choice yields a variety-level labour supply condition

$$n_t(\omega) = B_t w_t(\omega)^\theta \tag{8}$$

where $B_t = 1/\left(P_t^\theta(\Omega_t^P)^\eta N_t^{\frac{\theta-\phi}{\phi}}\right)$. Equation (8) says that the labour supplied to the firm of variety ω depends on a shifter-term comprised of aggregates and a term that is increasing in the wage the firm offers. We then define an index over firm-level wages

$$W_t = (\Omega_t^P)^{\frac{-\eta}{1+\theta}}\left(\int_{\omega\in\Omega_t^P} w_t(\omega)^{1+\theta}d\omega\right)^{\frac{1}{1+\theta}}. \tag{9}$$

Using the definitions in equations (3) and (9) in conjunction with (8) yields the relationship

$$N_t = \left(\frac{W_t}{P_t}\right)^\phi \tag{10}$$

which can be interpreted as a standard aggregate-level labour supply condition. One can also write the budget constraint as $P_tC_t = W_t^{1+\phi}/P_t^\phi + \Pi_t + T_t$ and re-express $B_t = 1/\left(P_t^\phi(\Omega_t^P)^\eta W_t^{\theta-\phi}\right)$.

4.2 Final Goods Firms

The firm chooses inputs of intermediate goods to maximise their profits

$$\max_{q_t(\omega)} \ P_tA_t - \int_{\Omega_t+\Omega_t^M} p_t(\omega)q_t(\omega)d\omega - \int_{\Omega_t^{*X}} \widehat{\tau}^X p_t(\omega)q_t(\omega)d\omega$$

subject to technology as in (4) and the CPI P_t is taken as given. Variable $p_t(\omega)$ denotes the price specific to intermediate variety ω. This problem yields demand curves of the form

$$\begin{aligned} q_t(\omega) &= A_t P_t^{\sigma} p_t(\omega)^{-\sigma} && \forall \omega \in \Omega_t + \Omega_t^M \\ q_t(\omega) &= A_t P_t^{\sigma} [\widehat{\tau}^X p_t(\omega)]^{-\sigma} && \forall \omega \in \Omega_t^{*X} \end{aligned} \tag{11}$$

where notice that the final goods producer internalises the effect of the tariff as an increase in the variety's effective price. See then from the definition of (4) with (11) that

$$A_t = \left(\int_{\omega \in \Omega_t + \Omega_t^M} \left\{ A_t P_t^{\sigma} p_t(\omega)^{-\sigma} \right\}^{\frac{\sigma-1}{\sigma}} d\omega + \int_{\omega \in \Omega_t^{*X}} \left\{ A_t P_t^{\sigma} (\widehat{\tau}^X)^{-\sigma} p_t(\omega)^{-\sigma} \right\}^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$$

$$\Rightarrow P_t = \left(\int_{\omega \in \Omega_t + \Omega_t^M} p_t(\omega)^{1-\sigma} d\omega + \int_{\omega \in \Omega_t^{*X}} (\widehat{\tau}^X)^{1-\sigma} p_t(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}},$$

which serves as our definition of the CPI.

4.3 Intermediate Goods Firms

We now present the recursive formulations of the incumbent and entrant's problems. We leave time subscripts on functions and variables given the transition analysis in the quantitative results.

4.3.1 Incumbents

The value function for an incumbent firm with state (z_t, s_t) is given by

$$\begin{aligned} v_t(z_t, s_t) &= \mathbb{1}_{s_t=D} \pi_t(z_t, D) + \mathbb{1}_{s_t=X} \pi_t(z_t, X) + \mathbb{1}_{s_t=M} (1 - \widehat{\tau}^M) \pi_t(z_t, M) \\ &\quad + \mathbb{E}_f \max_{s_{t+1} \in \{E,D,X,M\}} \widetilde{v}_t(z_t, f_t, s_{t+1}) \end{aligned} \tag{12}$$

where $\pi_t(z_t, s_t)$ is the period profits given current status $s_t \in \{D, X, M\}$; these all depend on the firm's new z_t draw. Operator $\mathbb{1}_a$ is an indicator for when the argument a is true. The term $\widetilde{v}_t(z_t, f_t, s_{t+1})$ is the continuation value of the firm, conditional on choosing a status s_{t+1}. Notice that this function depends on the draws of the firms' sunk costs, captured by vector f_t. See also that the expectation operator is with respect to the sunk cost shocks given that $v_t(z_t, s_t)$ is at the beginning of the period, right after drawing the new z_t. We denote the policy function for the optimal status choice by $s_{t+1}(z_t, f_t, s_t)$. The conditional value from exiting is given simply by $\widetilde{v}_t(z_t, f_t, E) = 0$; the firm ceases to exist. A non-exit choice ($s_{t+1} \in \{D, X, M\}$) yields conditional value

$$\widetilde{v}_t(z_t, f_t, s_{t+1}) = -f_t(s_{t+1}, s_t) + \beta \mathbb{E}_t[v_{t+1}(z_{t+1}, s_{t+1})] \tag{13}$$

where $f_t(s_{t+1}, s_t)$ represents the entry in vector f_t for a firm moving from status $s_t \in \{D, X, M\}$ to s_{t+1}.Equation (13) says that the firm pays the corresponding fixed cost combination for their choice, based on their current status and drawn sunk cost shocks, then receives the corresponding expected discounted continuation value. The expression for period profits is then given by

$$\begin{aligned}\pi_t(z_t, s_t) = \max_{\{k_t(z_t,s_t)\}} & p_t(z_t, s_t) q_t(z_t, s_t) + \mathbb{1}_{s_t=X} \left[p_t^*(z_t, X) q_t^*(z_t, X)\right] - w_t(z_t, s_t) n_t(z_t, s_t) \\ & + \mathbb{1}_{s_t=M} \left[p_t^*(z_t, M) q_t^*(z_t, M) - w_t^*(z_t, M) n_t^*(z_t, M)\right]. \end{aligned} \tag{14}$$

where $k_t(z_t, s_t)$ is an array of static control variables, which depend on the firm's status. The first expression on the right-side of equation (14) is the sales the firm generates domestically. The second term represents the extra sales income it receives, should it choose to export some of its output. The third term is the wage bill the firm incurs domestically. Note that the first and third terms will differ potentially between a domestic firm and exporting firm, holding z_t constant, due to the upward-sloping labour supply curve. The fourth term in (14) is the profits from overseas operations, should the firm have multinational status. The array $k_t(z_t, s_t)$ consists of $p_t(z_t, s_t), q_t(z_t, s_t), w_t(z_t, s_t), n_t(z_t, s_t)$ for all three statuses, with the addition of $p_t^*(z_t, s_t), q_t^*(z_t, s_t)$ for $s_t \in \{X, M\}$ and also $w_t^*(z_t, s_t), n_t^*(z_t, s_t)$ for $s_t = M$. We defer expressions for optimal controls to appendix 8.

4.3.2 Entrants

An entrant receives value function $v_t^T \geq 0$ of the form

$$v_t^T = -f^T + \beta \mathbb{E}_t^T[v_{t+1}(z_{t+1}, D)] \tag{15}$$

where notice that the expectation is with respect to the entrants' draw from the unconditional distribution of productivity. The entrant incurs the fixed cost at time t and then receives the discounted expected expected value from being an incumbent with domestic status. This value must be weakly positive for a positive mass of entrants to exist; this mass is zero otherwise.

4.4 Cross-Sectional Measure

We track the cross-section of firms in each country along the state space (z_t, s_t). Denote the corresponding cross-section of firms at the start of period t, after drawing shock z_t but before the sunk cost shocks are drawn, by $\mu_t(z_t, s_t)$. The law of motion for this measure is given as follows

$$\mu_{t+1}(z_{t+1}, s_{t+1}) = \sum_{s_t \in \{D,X,M\}} \int_{z_t} \int_{f_t} \mathbb{1}_{s_{t+1}=s_{t+1}(z_t,f_t,s_t)} Q(z_{t+1}|z_t) H(f_t) \mu_t(dz_t, ds_t) + M_t^T \mathbb{1}_{s_{t+1}=D} Q^T(z_{t+1}) \quad (16)$$

for any arbitrary z_t, z_{t+1} and $s_t, s_{t+1} \in \{D, X, M\}$. Equation (16) says that the incumbent firms draw from the sunk cost probability process $H(f_t)$, upon which their status choice $s_{t+1}(z_t, f_t, s_t)$ is conditional. They then draw a new productivity shock z_{t+1} at the start of period $t+1$. We then integrate and sum over all possible z_t, f_t and s_t values that can lead to arbitrary state (z_{t+1}, s_{t+1}) at $t+1$ to obtain $\mu_{t+1}(z_{t+1}, s_{t+1})$. The mass of entrants M_t^T each enter at status $s_{t+1} = D$ by design and draw their initial shock from unconditional distribution $Q^T(z_{t+1})$.

4.5 Equilibrium Definition

We define equilibrium in terms of an infinite sequence of equilibrium objects for H

$$\Gamma \equiv \{\{v_t(z_t, s_t), \mu_t(z_t, s_t), k_t(z_t, s_t)\}_{(z_t,s_t)}, A_t, P_t, W_t, N_t, \Pi_t, C_t, F_t, T_t\}_{t=0}^{\infty} \quad (17)$$

such that the following conditions hold.

1. The household optimises its labour-leisure choice taking W_t, Π_t and T_t as given.
2. The value function $v_t(z_t, s_t)$ and set of policy functions for control variables $k_t(z_t, s_t)$ solve firm problem (12) with all aggregate objects taken as given.
3. Cross-sectional measure $\mu_t(z_t, s_t)$ satisfies the law of motion given in equation (16).
4. The free entry condition holds: $v_t^T = 0$ where value to entry is given by equation (15).
5. Aggregate objects can be found using the cross-sectional measure $\mu_t(z_t, s_t)$. Market clearing in the final goods market gives

$$A_t = C_t + F_t$$

where A_t is given by equation (4), C_t is given by the household budget constraint in equation (1) and F_t is aggregate fixed costs used by H firms. Aggregate object Π_t is aggregate profits and T_t is aggregate tax collections.

6. The government budget constraint holds as in equation (7), giving T_t.
7. The labour market clearing condition holds, meaning that aggregate labour demand, given in (10) equals supply as defined in equation (3) and the aggregate wage index is given by equation (9).

The conditions for F are defined similarly with infinite sequence denoted by Γ^*. Note the conditions in H and F all hold simultaneously in any equilibrium.

5 Calibration

In this section, we detail the choices of parameters used in the numerical solution. We consider four different parameter calibrations listed as follows.

- Calibration 1 (C1): FDI is prohibitively costly ($\widehat{f}^{M,D} = \widehat{f}^{M,X} = f^{M,C} \to \infty$) and employers have market power $\theta < \infty$.
- Calibration 2 (C2): FDI is prohibitively costly and labour markets are perfectly competitive ($\theta \to \infty$).
- Calibration 3 (C3): FDI is not prohibitively costly ($\widehat{f}^{M,D}, \widehat{f}^{M,X}, f^{M,C} < \infty$) and employers have market power.
- Calibration 4 (C4): FDI is not prohibitively costly and labour markets are perfectly competitive.

We consider these four configurations for the purpose of understanding the role of different features of the model. In Calibrations 1 and 2, firms can sell abroad only through exporting; comparing tariff reduction exercises across the two sheds light on the role of employers' market power on the effect of trade liberalisation. We then add selection into multinational status in Calibrations 3 and 4, then again varying the θ parameter to shed light on its impact on the effect of FDI openness reforms.

Note that the two countries are taken to be symmetric across all four calibrations. To keep the computational burden low and to ensure proper identification, we calibrate two sets of parameters. One set are for parameters chosen outside the model, directly from the data and previous studies in the literature. The second set consists of parameters calibrated inside the model to ensure consistency of firm-level model moments with the data.

Parameter	Symbol	Value	Source
Discount factor	β	0.98	Literature
Frisch elasticity	ϕ	0.20	Literature
Elasticity of labour supply	θ	1.08	Literature
Love of variety control	η	0.00	Baseline
Elasticity of substitution	σ	5.00	Literature
Exporting tariff in C1	$\widehat{\tau}^X$	1.10	Literature
Persistence of productivity	ρ_z	0.66	Compustat
Variability of productivity	σ_z	0.22	Compustat

Table 1: Parameters calibrated outside the model.

Table 1 shows the parameter values selected outside the model as well as their source. The discount factor is taken to be consistent with real interest rates in recent years. This is also the value used in several papers studying firm dynamics (e.g. see Corbae and D'Erasmo (2021)). We take the Frisch elasticity as the lower bound of those considered in Berger, Herkenhoff and Mongey (2022).[14] We take the elasticity of the variety-level labour supply to be 1.08, the mean firm-level empirical estimate from Webber (2015).[15] In the baseline exercises, we leave the full love of variety effect in place (i.e. $\eta = 0$), but we relax this assumption in robustness exercises. We take the elasticity of substitution across varieties in final goods aggregation as 5 as in Alessandria, Choi and Ruhl (2021); similarly in Calibration 1 we use a 10% tariff rate.

The parameters for the firm productivity process are estimated from firm-level data in Compustat over the period 1979–2018. We use the estimation method in Cooper and Haltiwanger (2006) to this end, yielding estimates of 0.66 for the persistence parameter and 0.22 for the variability parameter. We then discretise the productivity process into a Markov process using the method of Tauchen (1986).

We then calibrate 12 parameters inside the model using simulated method of moments.[16] Table 2 shows each parameter, the value it takes under each of the four calibrations as well as the target moment that identifies it. We calibrate the param-

[14]The authors find that the welfare losses of labour market power are increasing in the Frisch elasticity. As such, this value will give more conservative estimates of the friction's effect on openness reforms.

[15]There is a large spread in empirical estimates of this elasticity; this value sits within this range. For a comprehensive discussion of the empirical literature, see Jha and Rodriguez-Lopez (2021).

[16]Specifically, we choose the 12 parameters to minimise the mean squared distance between the model and data moments.

eters in each case to minimise the squared difference of the model moments from their data analogues.

Parameter		C1	C2	C3	C4	Target
		Calibration				
Sunk cost of entry	f^T	0.295	0.430	0.299	0.468	Unit wage
Sunk cost of (D, X) mean	$\widehat{f}^{X,D}$	0.029	0.193	0.025	0.144	Transition (D, X)
Fixed cost of X	$f^{X,C}$	0.012	0.035	0.012	0.031	Transition (X, X)
Sunk cost variability	σ_f	0.400	0.900	0.550	6.000	Transition (X, E)
Fixed cost	f^C	0.463	0.210	0.468	0.210	Exit rate
Physical iceberg cost X	τ^X	1.350	1.400	1.330	1.322	Export intensity
Export tariff	$\widehat{\tau}^X$	1.100	1.070	1.120	1.120	Taxes/Output C1
Sunk cost of (D, M) mean	$\widehat{f}^{M,D}$			0.174	0.303	Transition (D, M)
Sunk cost of (X, M) mean	$\widehat{f}^{M,X}$			0.149	0.176	Transition (X, M)
Sunk cost of (M, X) mean	$\widehat{f}^{X,M}$			0.066	0.128	Transition (M, X)
Fixed cost of M	$f^{M,C}$			0.081	0.066	Transition (M, M)
Physical iceberg cost M	τ^M			1.855	1.235	FDI sales intensity
FDI tax	$\widehat{\tau}^M$			0.010	0.022	Taxes/Output C1

Table 2: Parameters calibrated inside the model. Fixed costs are expressed as a fraction of total final output.

We now briefly turn to describe the identification of the parameters. It is important to note that, since this is a general equilibrium model, there is not a one-to-one mapping of any given parameter to a data moment. But rather, a change in one parameter will likely impact several moments. But we choose target moments that will shed the most light on the parameter of interest. Since it is difficult to disentangle parameters f^C and f^T in the data, we follow standard practice in firm dynamics papers, by setting f^T to normalise the wage rate to one (e.g. see Hopenhayn and Rogerson (1993)). We leverage the geographical segment data in Compustat, along with the cleaning process outlined in Fillat and Garetto (2015), to classify firms as domestics, exporters or multinationals.[17] We then take the mean of the stochastic sunk cost process for any status change to match the corresponding transition probability in the data. A higher variability in the sunk cost distribution gives larger spread in the productivity of firms upgrading to X or M status. As such, we identify this parameter by matching the exit rate of exporting firms.

[17] We defer more details about the data compilation and cleaning process to appendix D.

The fixed continuation cost for all firms to maintain their headquarters, f^C, targets the economy-wide exit rate. This number is reported around 11% in papers such as Decker, Haltiwanger, Jarmin and Miranda (2016) and Tian (2018). The fixed continuation costs for X and M status are identified by the status' persistence. We calibrate the physical iceberg costs for X and M statuses by matching the average export intensity (16%) and the foreign sales intensity (30%) from Compustat respectively.[18] Lastly, recall that we set the export tariff in Calibration 1 to be 10%. We then compute the aggregate tax collections to final output ratio for the economy under Calibration 1, which is found to be around 0.2%. We then use this number as a moment to target in the subsequent calibrations. We match this ratio for both the export tariff ($\widehat{\tau}^X$) and FDI tax ($\widehat{\tau}^M$) rates with a view towards keeping the size of whatever tax relief the government gives the same across quantitative exercises. That is, the two tax rates are set such that the corresponding source of revenue gives 0.2% of final output. All of the data and model moments across the calibrations are presented in table 3.

	Calibration			**Calibration**			
Moment	**Data**	**C1**	**C2**	**Data**	**C3**	**C4**	**Source**
Transition (D, X)	0.011	0.012	0.012	0.011	0.027	0.015	Compustat
Transition (X, X)	0.872	0.878	0.878	0.820	0.821	0.827	Compustat
Transition (X, E)	0.074	0.050	0.050	0.070	0.076	0.053	Compustat
Exit rate	0.110	0.120	0.120	0.110	0.120	0.100	Literature
Export intensity	0.157	0.157	0.157	0.157	0.154	0.157	Compustat
Taxes/Output $\widehat{\tau}^X$	0.002	0.002	0.002	0.002	0.002	0.002	C1
Transition (D, M)				0.022	0.023	0.024	Compustat
Transition (X, M)				0.060	0.078	0.075	Compustat
Transition (M, X)				0.004	0.001	0.001	Compustat
Transition (M, M)				0.890	0.888	0.887	Compustat
FDI sales intensity				0.299	0.300	0.300	Compustat
Taxes/Output $\widehat{\tau}^M$				0.002	0.002	0.002	C1

Table 3: Data moments and model counterparts. Note that we report separate data moments for C1 and C2, which are conditional on firms that do not transition to multinational status.

[18]Note that one could alternatively calibrate to the aggregate FDI sales intensity using the BEA data on multinational firms. This number is very close to the 30% we obtain from Compustat.

6 Quantitative Exercises

We proceed by dividing the quantitative analysis into two parts. First we run a tariff reduction exercise, where $\widehat{\tau}^X$ is set to 1, in the context of calibrations 1 and 2. We then do an FDI tax liberalisation, where $\widehat{\tau}^M$ is set to zero, using Calibrations 3 and 4. Comparing across the two Calibrations for each exercise quantifies the effect of labour market power on the reforms' efficacy.

For both the trade and FDI exercises, the design is as follows. We take the calibrated economy to be the steady state at time $t = 0$. At time $t = 1$, the government(s) announce the policy rate change and that it will last indefinitely. We then map the full transition dynamics to the new steady state equilibrium. We map the transition using a standard shooting-type algorithm, similarly to Spencer (2022).[19]

In thinking about the two sets of exercises, we consider both bilateral and unilateral reforms. Bilateral reforms have both countries implementing the same policy change, at the same time. Unilateral reforms have H changing their policy parameter only.

6.1 Trade Liberalisation

Table 4 presents numerical results from the trade liberalisation exercises. Figure 1 depicts the transition path after a bilateral liberalisation, while figures 2 and 3 give those from a H unilateral liberalisation for H and F respectively. Overall, the results show stark quantitative differences in the predictions of the model across the imperfectly and perfectly competitive labour market scenarios. In the description that follows, we will refer to the imperfect and perfect labour markets scenarios by their calibration numbers, C1 and C2 respectively.

We start by studying the bilateral episode. Given fundamentally different cost structures between C1 and C2, the expansionary responses of firms to the reform differ considerably across the two scenarios. In the former, the upward-sloping labour supply curve brings a higher variable cost burden of expanding to export and a smaller fixed cost burden, as shown in table 2. The measure of exporters jumps at $t = 1$ in both C1 and C2, but the magnitude of this jump is considerably larger in the former. This holds true in both the absolute sense and relative to the final steady state change in the measure — around 60% of this change is realised at $t = 1$ in C1 versus around 33% in C2. Moreover the transition for this variable is largely complete by $t = 5$ in C1, while adjustment still takes place in $t = 10$ in C2. Given the lower calibrated sunk cost of exporting in C1, there are more firms close to the

[19] More details on the computational algorithms are deferred to appendix B.

boundary between domestic and exporter status. As such, many change status on impact, while the adjustment is more gradual in C2, where it takes time for firms' productivity to exogenously move towards the boundary before upgrading.

	Calibration 1 ($\boldsymbol{\theta = 1.08}$)			**Calibration 2 ($\boldsymbol{\theta \to \infty}$)**		
	Bilateral	**Unilateral**		**Bilateral**	**Unilateral**	
Steady state	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$
Welfare	0.136	0.048	0.101	0.010	0.002	0.009
Consumption	0.160	0.056	0.113	0.011	0.003	0.009
Disutility	0.150	0.050	0.074	0.008	0.002	0.004
Measure D	-0.796	-0.691	-0.647	-0.422	-0.208	-0.205
Measure X	9.452	7.347	7.179	4.398	2.114	2.101
Measure T	-0.052	-0.104	-0.075	-0.121	-0.035	-0.032
Measure all	0.103	0.015	0.040	-0.060	-0.034	-0.032
Measure P	0.103	0.015	0.040	-0.060	-0.034	-0.032
Measure U	0.857	0.593	0.630	0.251	0.115	0.117
Average wage	0.072	0.035	0.089	0.007	0.002	0.039
Profits	0.459	0.256	1.652	0.340	0.157	0.717
Taxes	-1.000	-1.000	7.698	-1.000	-1.000	1.652
P index	0.000	0.000	0.045	0.000	0.000	0.036
W index	0.124	0.042	0.109	0.007	0.002	0.039
Transition						
Welfare	0.127	0.045	0.094	0.010	0.002	0.009

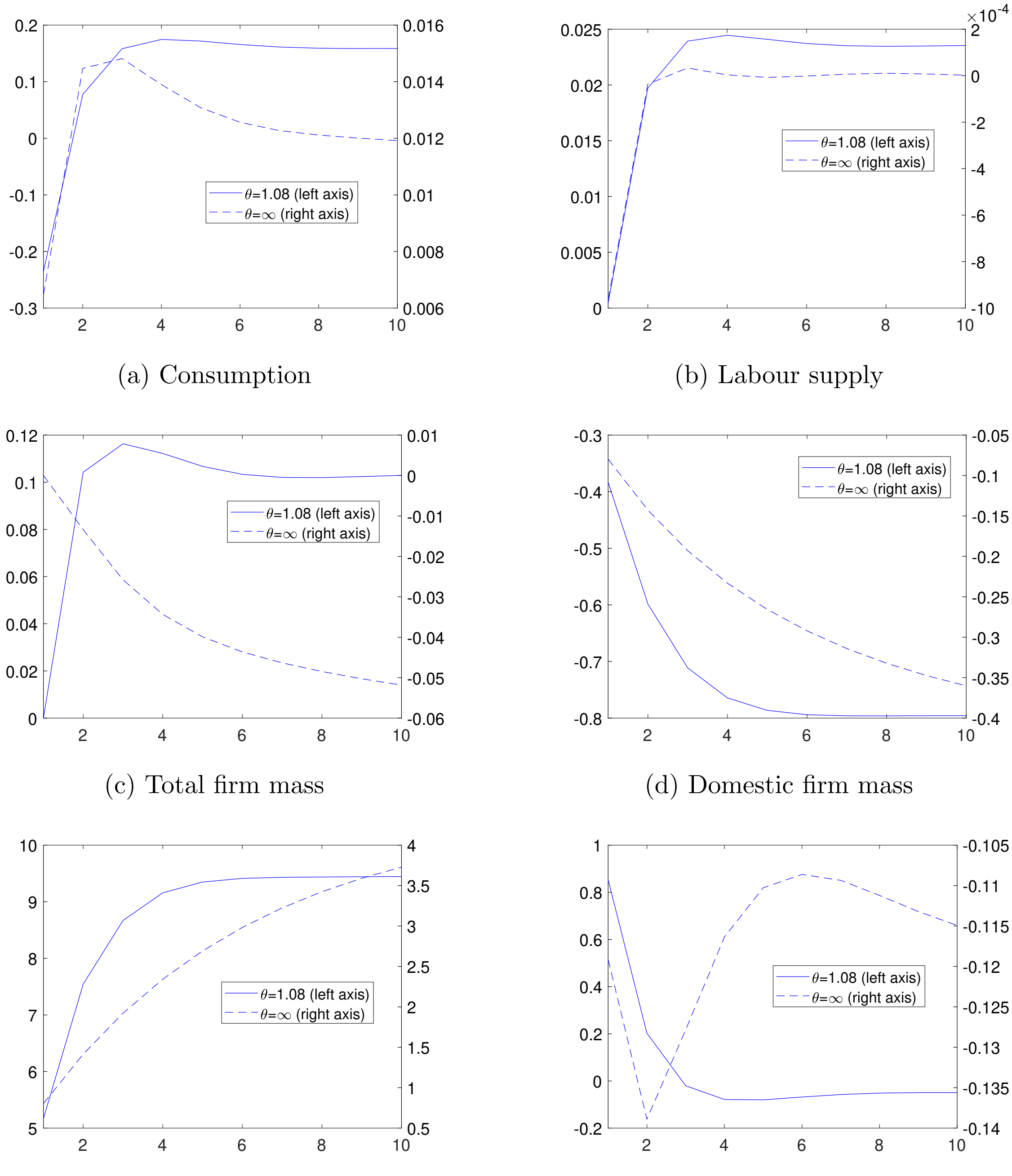
Table 4: Numerical results from trade liberalisation exercises. Numbers above the dividing line compare steady states, while those below consider the full transition dynamics. Numbers are percentage deviations from calibrated steady state (prior to multiplication by 100). Measure all is that of all firms originating from the country in consideration. Measure P denotes object Ω^P (the mass of producing firms in the relevant country), while measure U is object Ω^U (the mass of varieties utilised in production of the aggregate final good).

The expansionary activity into exporting has quantitative implications for entry. Although both C1 and C2 predict that the measure of entrants declines in their new steady states, by 5% and 12% respectively, the transition analysis gives a different picture. While entry drops close to its new steady state immediately in C2, it booms for a period of time in C1. With imperfect labour markets, when a firm upgrades to export, the variable cost of producing for the domestic market increases. These upgrading firms contract their scale of production for this market, leaving more space domestically for new firms. This drives a temporary increase in the associated value, an effect that subsides by period $t = 3$, as the domestic market is consolidated. In contrast, with perfectly competitive labour markets, firms' variable production costs are separated across production for domestic and export sales. Consequently, there is no adverse impact on an upgrading firm's domestic scale, which combined with the squeeze on resources for the sunk costs of exporting, lowers the value to entry.

The contrasting effects between C1 and C2 at the cross-section yield different behaviours at the household level. In terms of welfare, utility is influenced positively by consumption and negatively by labour supply. The changes to the population of firms in C1 give an increase in the measure of firms in each country. This translates into an 86% increase in the steady state measure of new varieties in the production of the final good and a 10% rise in the measure of employers. This latter effect drives a source of welfare gains in C1, as more variety in employment lowers the disutility of labour supply. In terms of consumption, the households have three sources of income — labour earnings, profits (net of fixed costs) and tax revenue rebates. In C1, the creation of new firms and exporting branches requires a large injection of funds from the household, giving a short-term drop in consumption of more than 20% in the first period of the transition. Instead in C2, consumption over-shoots the new steady state along the transition, as the drop in entry and overall firm mass releases more resources. The trajectory for consumption in the perfectly competitive case mirrors a result from the baseline exercises of Alessandria, Choi and Ruhl (2021).

Overall, table 4 shows that the transition-inclusive welfare gains of the bilateral liberalisation differ markedly across the labour market power and perfectly competitive scenarios. The welfare gains in consumption equivalent variation are 13% in C1, compared with 1% in C2. Our welfare results also show that treatment of the labour market has implications for policy inferences based entirely on steady state analysis. Not accounting for the transition leads one to over-state the gains to reform by around 1 percentage point in C1, while it under-states them by around 0.03 percentage points in C2.

We now move to discuss the unilateral trade liberalisation. The qualitative steady state effects are similar for most variables across C1 and C2. As H removes its tariff, its final goods producer substitutes towards imported varieties. Given that trade is balanced in our framework, this necessitates an increase in the exports of H firms as well. These changes are facilitated by more exporting firms at the extensive margin in both countries. The ensuing general equilibrium effects, such as higher local wages,

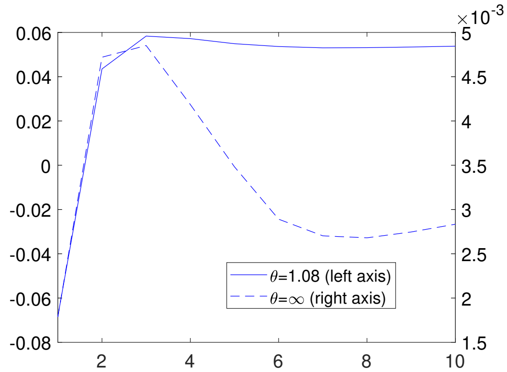


(a) Consumption (b) Labour supply

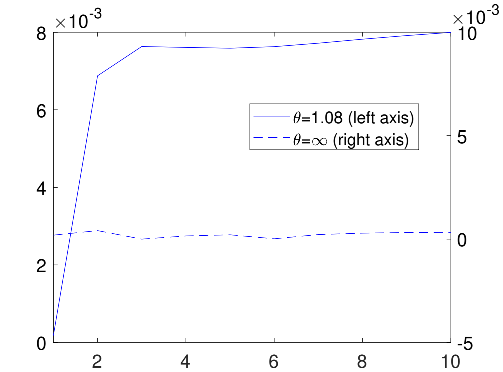
(c) Total firm mass (d) Domestic firm mass

(e) Exporter firm mass (f) Entrant firm mass

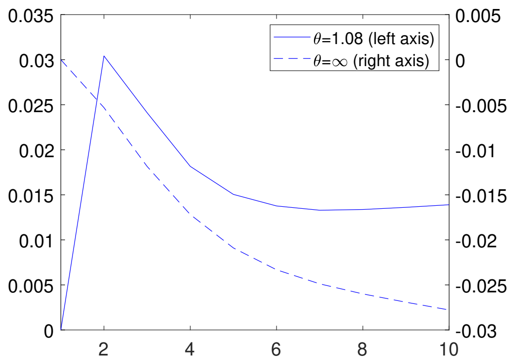
Figure 1: Transition to bilateral reduction in import tariffs. Horizontal axes represent years and vertical axis are percentage deviations from calibrated steady state (prior to multiplication by 100).



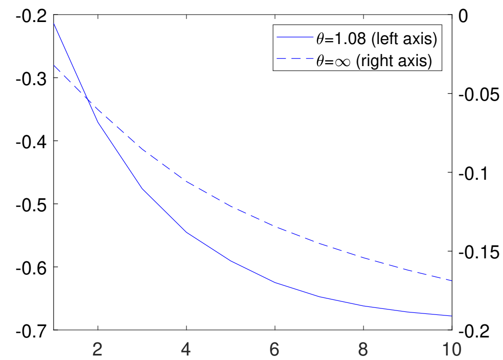
(a) H consumption



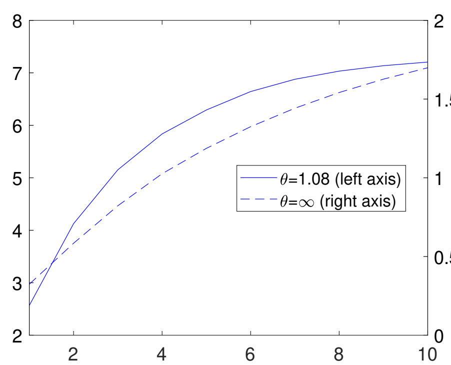
(b) H labour supply



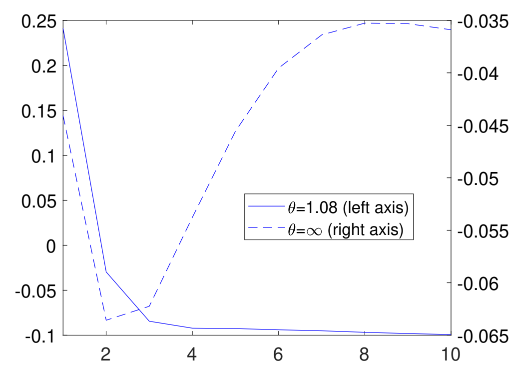
(c) H total firm mass



(d) H domestic firm mass

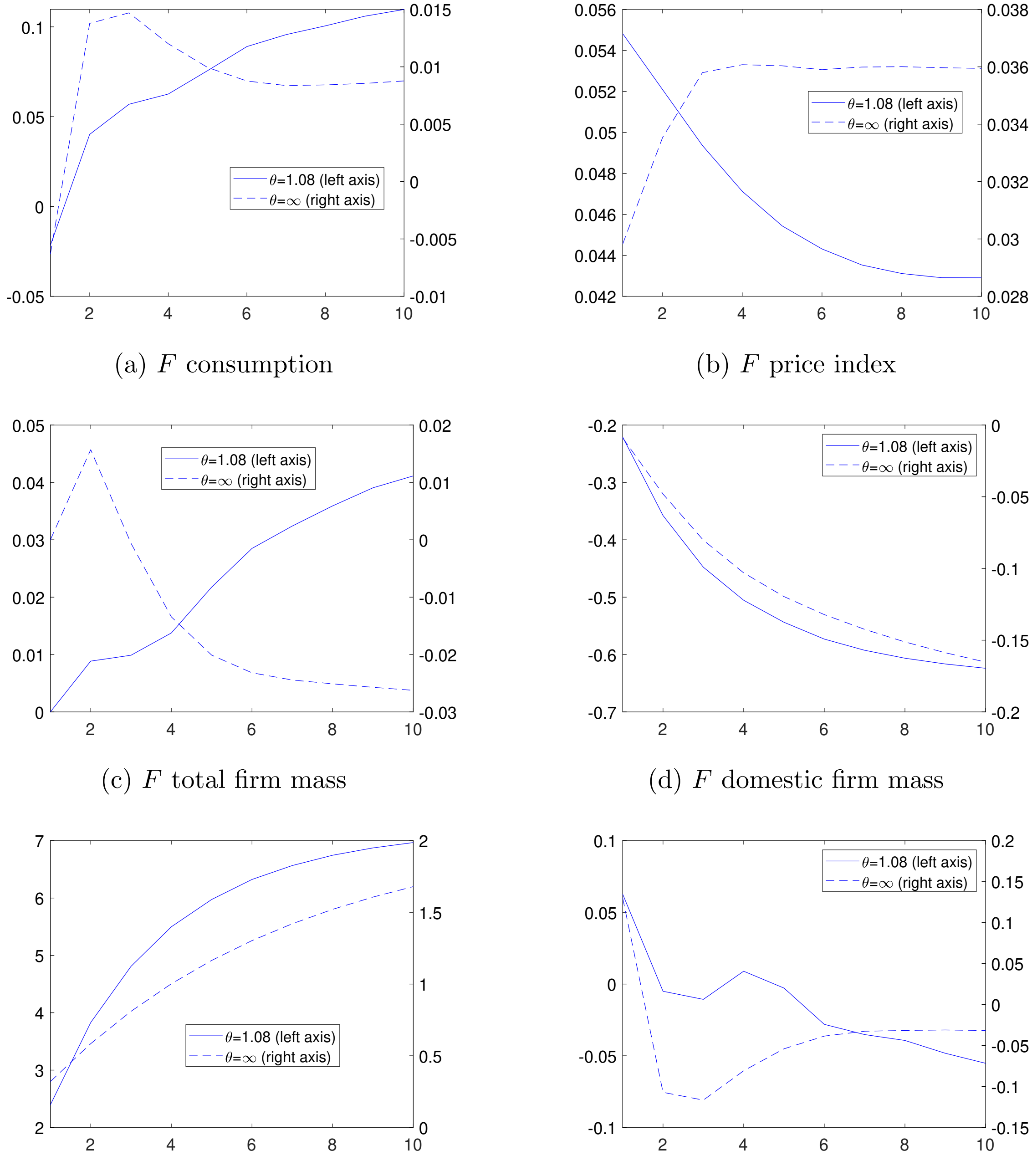


(e) H exporter firm mass



(f) H entrant firm mass

Figure 2: Transition to unilateral reduction in import tariff. Figures for H. Horizontal axes represent years and vertical axis are percentage deviations from calibrated steady state (prior to multiplication by 100).



(a) F consumption

(b) F price index

(c) F total firm mass

(d) F domestic firm mass

(e) F exporter firm mass

(f) F entrant firm mass

Figure 3: Transition to unilateral reduction in import tariff. Figures for F. Horizontal axes represent years and vertical axis are percentage deviations from calibrated steady state (prior to multiplication by 100).

instead drive the intensive margin downwards. In both calibrations, the steady state measure of exporters rises by slightly more in H than F. This is coupled with a larger decline at the intensive margin in the former country than the latter. In C1 for instance, the average exporter-level value of sales abroad for H firms falls by 16%, while it falls by 15% for F, due to a terms of trade effect that raises the price index in F. This then positively affects the profits of F firms. Tax revenues increase in F, while they decrease in H. These effects culminate in the F household reaping more overall benefit from this reform. Notice also that comparing the unilateral steady state effects across C1 and C2 yields similar insights to the bilateral exercise for most variables. As such, we now focus mostly on the differences along the transition.

We first compare the transitions of the unilateral and bilateral exercises for the scenario with labour market power (C1). The world economy takes longer to converge to its new steady state with the unilateral exercise than in the bilateral. The catalyst is the dynamic effect on the F price index, shown in figure 3. The rise in H demand for F exports gives a boom in this index of around 5.5% on impact; this effect is highly persistent; it takes 20 periods to settle at its new steady state. Recall that incumbents upgrading to exporter status reduce their production for the domestic market, in the face of an upward-sloping supply curve. The rise in the F price index softens this hike in variable costs for the productive F firms that upgrade on impact; their contraction in size is more gradual than in the bilateral exercise. The ensuing release of domestic resources, which allows for more marginal F domestic firms to upgrade to export, takes longer. This drives the prolonged adjustment of the overall measure of firms and entrants. Moreover, the higher price index in F pushes-back against F entry value gains, as it increases the expenditures on fixed costs required to start up a new firm. These effects on the F cross-section culminate in a longer adjustment of consumption of the F household. Given this household is the ultimate destination for H exports, its behaviour spills-over to shape the speed of transition for the H cross-section and economy.

We now compare the transition of the unilateral exercise across the scenarios with market power (C1) and perfect competition (C2). Focusing first on F, notice that the quantitative effects are generally more muted in C2, except for the movements in the measure of entrants. Entry jumps almost twice as much on impact in C2 than C1 and settles at a number roughly half as negative relative to its initial steady state. This comes from a smaller rise in the cost of new establishments, given the more moderate effect on the F price index in C2. Stronger entry yields a non-monotonicity in the time path for the measure of all F firms, only present in C2. Consumption of the F household falls on impact in both C1 and C2 given these effects at the cross-section.

However, the non-monotonicity in the total firm measure in C2 induces a similar pattern in F consumption, over-shooting its new steady state in the period after impact given surging profits. These effects then spill-over to impact the H economy. Note though that the comparison of the time paths for H variables in C1 to those in C2 yields broadly similar inferences qualitatively to the same comparison in the bilateral exercise. As in the bilateral exercise, the transition-inclusive welfare gains differ markedly across C1 and C2 for both countries.

Although the qualitative intuition to these trade liberalisation exercises is similar to Jha and Rodriguez-Lopez (2021), we contribute to the literature through quantification. We find the friction of labour market power to have meaningful quantitative effects on the predictions of tariff reduction exercises. This statement holds true both across steady states, as well as comparing variable transitions subsequent to a reform. Motivated by these results, we now turn to study the effect of FDI liberalisation in the same context. Given that multinational firms are widely held to be larger, more productive and influential, we expect results to be similarly significant in the context of lowering taxes on overseas activities.

6.2 FDI Liberalisation

We consider reducing the outward FDI tax rate to zero. Table 5 presents the numerical results from the exercises. Figure 4 illustrates the transition from the bilateral exercise, where figures 5 and 6 give the transition for H and F after the H Government unilaterally sets their FDI tax to zero. We seek to understand the differences between the case with market power (C3) and that with perfect competition in the labour market (C4). We also make some comparisons with the trade liberalisation exercises of the previous section.

We first study the bilateral FDI liberalisation episode. Qualitatively, many of the effects and and inferences are comparable to the trade liberalisation exercise. Looking at the steady state results in 5, the reform incentivises more multinationals, as these firms escape their domestic labour supply curves. This drives an increase in the measure of employers in each country, while at the same time lowering those of domestics and exporters. Given that multinationals are significantly larger than firms of other statuses, the episode reduces the value to entry and thus the creation of new firms in the long run.

Comparing the quantitative estimates across C3 and C4 for the bilateral FDI episode, a pattern emerges. See that many of the changes to the cross-section are similar quantitatively across the two calibrations. Yet the welfare changes are substantially

	Calibration 3 ($\theta = 1.08$)			**Calibration 4 ($\theta \to \infty$)**		
	Bilateral	**Unilateral**		**Bilateral**	**Unilateral**	
Steady state	***H/F***	***H***	***F***	***H/F***	***H***	***F***
Welfare	0.020	0.324	-0.208	0.003	0.013	-0.009
Consumption	0.026	0.374	-0.240	0.003	0.015	-0.010
Disutility	0.025	0.326	-0.213	0.004	0.011	-0.007
Measure D	-0.212	0.363	-0.877	-0.219	-0.121	-0.153
Measure X	-0.250	-0.996	3.940	-0.265	-0.489	0.785
Measure M	0.675	1.567	-0.991	0.702	0.867	-0.162
Measure T	-0.028	0.479	-0.493	-0.039	0.052	-0.095
Measure all	-0.028	0.479	-0.404	-0.039	0.052	-0.094
Measure P	0.095	0.221	-0.059	0.084	0.017	0.065
Measure U	0.068	0.549	-0.132	0.067	0.060	0.037
Average wage	-0.019	0.141	-0.119	0.003	0.010	-0.008
Profits	0.117	0.671	-0.202	0.099	0.188	-0.117
Taxes	-0.620	3.174	-0.989	-0.628	-0.140	-0.302
P index	0.000	0.000	0.030	0.000	0.000	-0.003
W index	0.021	0.266	-0.156	0.003	0.010	-0.008
Transition						
Welfare	0.020	0.284	-0.173	0.003	0.004	-0.002

Table 5: Steady state FDI tax exercises. Numbers are percentage deviations from calibrated steady state (prior to multiplication by 100). Measure P denotes object Ω^P (the mass of producing firms in the relevant country), while measure U is object Ω^U (the mass of varieties utilised in production of the aggregate final good).

different, with C3 predicting gains of 2%, in comparison with 0.3% in C4. This follows for two reasons. Firstly, the number of employers increases as more multinationals from abroad start hiring local workers, an effect which is valued in its own right from a welfare perspective in C3. Secondly, the wage index rises by 2% in C3, in contrast with 0.3% in C4. The same amount of expansion, in terms of firm variables, necessitates a larger increase in wages when the labour supply curves are upward-sloping. Also notice that the welfare gains for the bilateral FDI liberalisation are generally lower than those from the bilateral trade liberalisation. For example, we find 14% gains in the trade exercise with C1 versus 2% gains in the FDI exercise with C3. This follows from the relative sizes of the physical iceberg costs for exporting and FDI — the latter must be substantially larger than the former to match the data. As a consequence, the FDI episode gives fewer gains to output with a higher usage of resources.

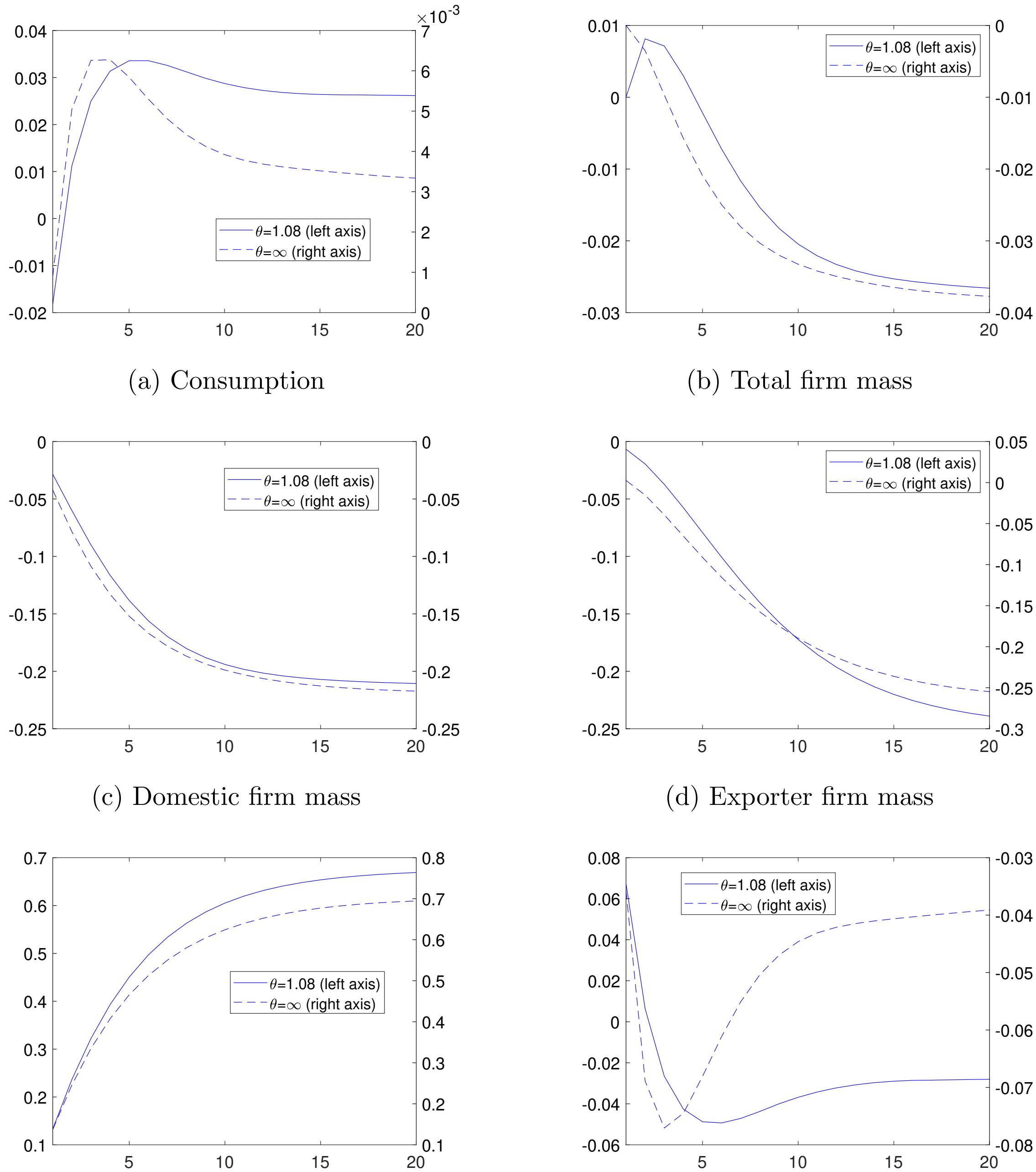
The time to converge to the new steady state is generally longer with the bilateral FDI liberalisation than the trade counterpart of the previous section. For instance, it takes between 10 and 15 years for most variables to settle in the FDI exercise with C3, in contrast with around 5 years in the trade exercise with C1. In the calibrated lifecycle of the firm, although the most productive domestic firms transition immediately to multinational status, many of those with intermediate productivity transit through exporting. These latter firms may spend several periods exporting before again upgrading. The full benefit of the FDI reform involves expansion of some such firms, which inherently takes longer. Also see that the transition time for the bilateral FDI reform across C3 and C4 is roughly the same, whereas it was faster in the bilateral trade episode with C1 than with C2. This comes from the differences between the ways $\widehat{\tau}^X$ and $\widehat{\tau}^M$ are modelled. The former is on the value of import sales, whereas the latter is on overseas profits, meaning the foreign wage bill is a tax deduction. This implies that the FDI tax drops-out of the first order conditions for all static optimisation variables. Consequently, we do not see direct interactions of the FDI tax with firm cost structures conditional on status; it affects only the extensive margin. In contrast, the tariff rate also affects the intensive margin, given it distorts only the sales component of profits directly.

We now consider the unilateral FDI exercise: focusing firstly on the steady states. The liberalising country benefits at the other's expense, given that the instrument is an outward tax on FDI. This differs from the unilateral trade exercise where there were mutual gains, by virtue of a tariff representing an inward tax on imports. Moreover the unilateral FDI reform is much more powerful quantitatively than the bilateral FDI reform, in the presence of labour market power. The upward-sloping labour supply curves give rise to an amplification effect. When H liberalises, a large rise in the value of becoming an H multinational ensues. More H multinationals are created; since this reform is unilateral, there is no reciprocal increase in the presence of F multinationals in H; the value for H entrants booms. This leads to an increase in production costs in H, forcing F multinationals to downgrade their status to become exporters. This effect is amplified by the fact that these F firms are now forced to bunch their production for both the H and F markets onto the one supply curve. This raises these downgrading firms' marginal costs of production and causes a further contraction in F firms' output. These effects lower the profits F firms generate and domestic labour income. This culminates in steady state welfare gains (losses) that are of magnitude 16 times (10 times) larger for H (for F) than the bilateral FDI welfare gains. This contrasts with the competitive labour markets case in C4, in which no such amplification effect is present, where the gains (losses) are 4.3 times (3 times) larger for H (for F) than the bilateral FDI gains.

There are some substantial differences between the predictions of C3 and C4 along the transition from the unilateral FDI reform. First, consider the time paths of variables relating to H. The measure of H exporting firms drops on impact and then continues to drop until all such firms are eradicated in C3; H exporters are unable to compete given the immense rise in domestic costs. Many of these displaced exporters downgrade to domestic status, with the associated measure rising by 18% on impact before eventually settling at 37%. The rise in entry along the transition is profound — the measure doubles on impact before reaching its new steady state around 50%. The H cross-sectional changes are much milder in the context of C4. Exporters remain in the new steady state, with their number roughly halved. The measure of domestic firms moves in the opposite direction to C3, declining given a much higher transition probability of these firms to multinational status, in addition to a higher exit rate.

Now we consider how the transitions of F variables differ across C3 and C4 in the unilateral FDI exercise. As H entry surges on impact in C3, the measure of F multinationals drops immediately by around 20%; it continues to contract until they all disappear. As these multinationals downsize, they release resources in the F final goods market, temporarily lowering their price and hence the fixed cost for F entrants. These effects aggregate to give a decline in F consumption on impact, then an increase for four periods before decreasing again. Instead in C4, the decline in the measure of F multinationals is more gradual. It drops only slightly on impact before eventually settling at 16% below initial steady state. The short-term rise in F consumption on impact is followed by a monotonic decline to the new steady state.

Taken together, the results of this section and the previous on trade liberalisation bring several points to light. Firstly, overwhelmingly, the treatment of the labour market matters quantitatively when evaluating openness reforms — the numbers are generally larger in the face of labour market power. Secondly, this friction can interact with the nature of the reform being evaluated, for instance unilateral predictions can differ from bilateral. Finally, the friction can interact with the environment of the model, with extra non-linearity coming through an FDI choice potentially impacting the transition path after a reform.

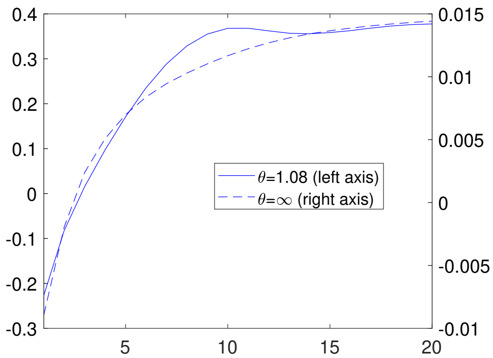


(a) Consumption (b) Total firm mass

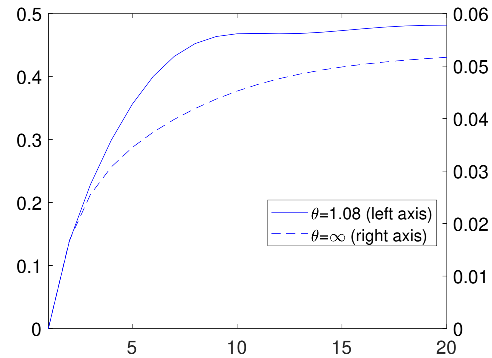
(c) Domestic firm mass (d) Exporter firm mass

(e) Multinational firm mass (f) Entrant firm mass

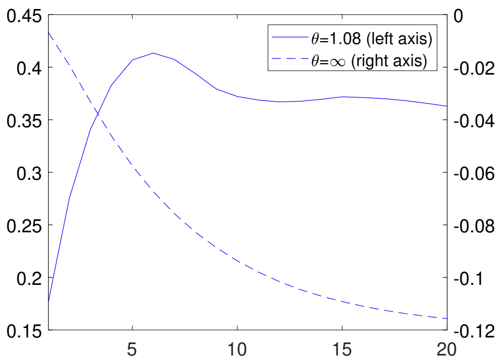
Figure 4: Transition to bilateral reduction in FDI taxes. Horizontal axes represent years and vertical axis are percentage deviations from calibrated steady state (prior to multiplication by 100).



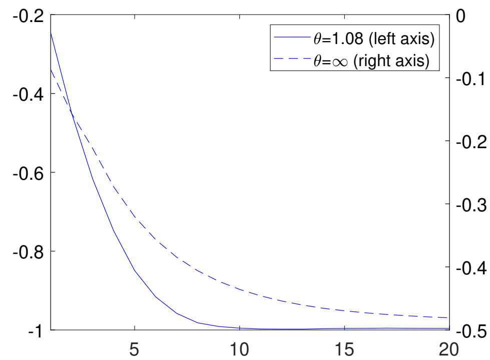
(a) H consumption



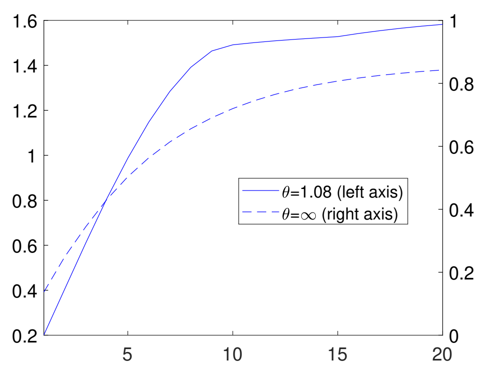
(b) H total firm mass



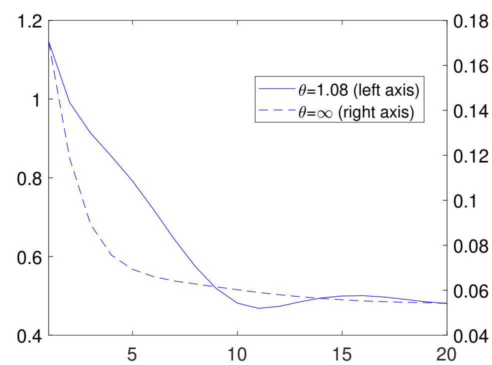
(c) H domestic firm mass



(d) H exporter firm mass

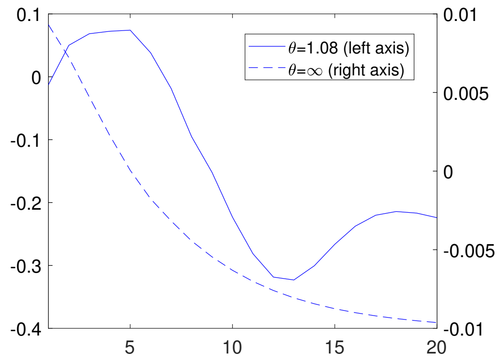


(e) H multinational firm mass

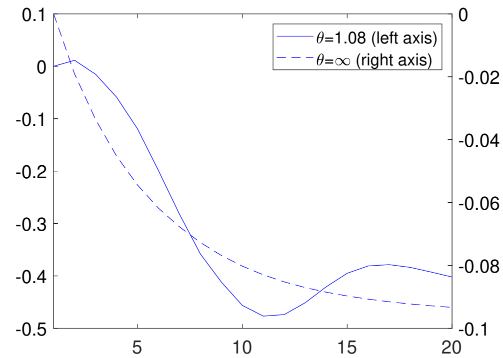


(f) H entrant firm mass

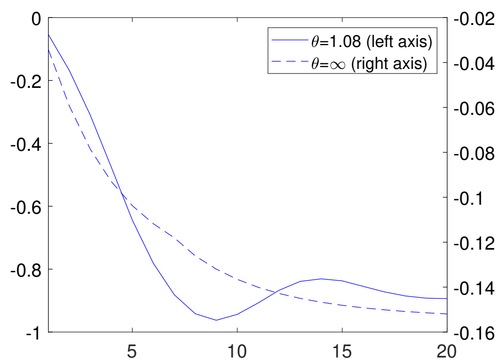
Figure 5: Transition to unilateral reduction in FDI tax. Figures for H. Horizontal axes represent years and vertical axis are percentage deviations from calibrated steady state (prior to multiplication by 100).



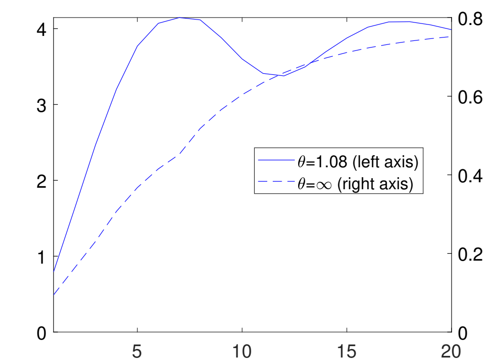
(a) F consumption



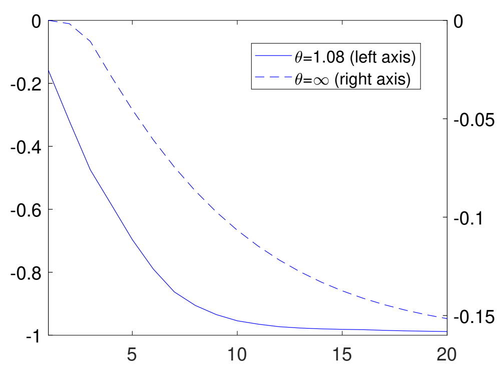
(b) F total firm mass



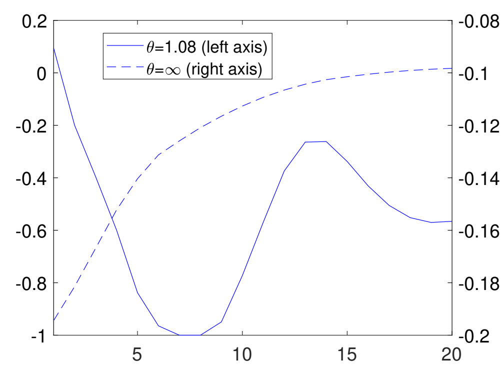
(c) F domestic firm mass



(d) F exporter firm mass



(e) F multinational firm mass



(f) F entrant firm mass

Figure 6: Transition to unilateral reduction in FDI tax. Figures for F. Horizontal axes represent years and vertical axis are percentage deviations from calibrated steady state (prior to multiplication by 100).

7 Robustness

In this section, we consider robustness on the employer love of variety control parameter η. To do so, we consider quantitative exercises in the context of four more sets of calibrated parameters; in all four configurations, employers have market power ($\theta = 1.08$).[20]

- Calibration 5 (C5): FDI is prohibitively costly and $\eta = 0.5$.
- Calibration 6 (C6): FDI is prohibitively costly and $\eta = 1.0$.
- Calibration 7 (C7): FDI is not prohibitively costly and $\eta = 0.5$.
- Calibration 8 (C8): FDI is not prohibitively costly and $\eta = 1.0$.

The model is always re-calibrated to keep the key moments constant, such that reliable inferences can be made. A positive value of the η parameter lowers the importance of the love of employer variety channel in shaping the welfare effects of reforms. Recall that when $\eta = 1$, this effect ceases to exist, meaning that labour market power has a purely distortive effect on the world economy, through wage mark-downs. For ease of interpretation, we focus on comparing the steady state effects of the reform in what follows. The robustness results for the trade liberalisation episode are listed in table 6, while those for the FDI exercises are in table 7.

Firstly we study the effect of varying η on the results of the bilateral trade liberalisation. As η increases, labour supply becomes less reactive to the reform; the household's expansion in labour income is curtailed. Consider a comparison of the results of C1 with C5. Under C5, the reform gives a substantially smaller rise in consumption of 7 percentage points. This brings smaller expansion in the demand for intermediate goods and value to firm creation, causing the drop in the measure of entrants to double. Fewer resources expended on entry allows for a larger increase in the measure of exporters. The increase in the measure of varieties in the final goods aggregator drops from 86% to 76%, while the rise in employer variety falls considerably from 10% to 4%. These effects culminate in welfare gains from the liberalisation when $\eta = 0.5$ that are over 60% lower than when $\eta = 0$.

Next compare the bilateral trade results of C5 with C6. The reform in the latter induces an increase in consumption almost 3 percentage points lower than the former; smaller markets in each country drive a smaller response in the measure of exporters. The welfare gains in C6 are 5.5%. Although this number is much lower than the 14%

[20] We defer details regarding parameters and moments for each of these new calibrations to appendix C.

gains in C1, notice that C6 still offers gains that are over 5 times larger than those in the perfectly competitive scenario of C2. This follows due to the love of variety effect in final goods production. The cross-sectional effects in C6 yield a 67% rise in the measure of these varieties, in contrast with 25% in C2.

	Calibration 1 $(\boldsymbol{\theta = 1.08, \eta = 0.00})$			**Calibration 5** $(\boldsymbol{\theta = 1.08, \eta = 0.50})$			**Calibration 6** $(\boldsymbol{\theta = 1.08, \eta = 1.00})$		
	Bilateral	**Unilateral**		**Bilateral**	**Unilateral**		**Bilateral**	**Unilateral**	
Steady state	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$
Welfare	0.136	0.048	0.101	0.078	0.045	0.093	0.055	0.036	0.071
Consumption	0.160	0.056	0.113	0.091	0.053	0.102	0.064	0.042	0.078
Disutility	0.150	0.050	0.074	0.086	0.050	0.057	0.057	0.038	0.041
Measure D	-0.796	-0.691	-0.647	-0.826	-0.708	-0.676	-0.753	-0.605	-0.575
Measure X	9.452	7.347	7.179	10.761	8.812	8.546	8.341	6.548	6.289
Measure T	-0.052	-0.104	-0.075	-0.119	0.004	0.014	-0.119	0.001	0.007
Measure all	0.103	0.015	0.040	0.039	0.004	0.014	0.018	0.002	0.007
Measure P	0.103	0.015	0.040	0.039	0.004	0.014	0.018	0.002	0.007
Measure U	0.857	0.593	0.630	0.785	0.598	0.626	0.669	0.493	0.518
Average wage	0.072	0.035	0.089	0.062	0.040	0.104	0.050	0.033	0.090
Profits	0.459	0.256	1.652	0.292	0.230	1.938	0.270	0.202	1.781
Taxes	-1.000	-1.000	7.698	-1.000	-1.000	9.000	-1.000	-1.000	6.783
P index	0.000	0.000	0.045	0.000	0.000	0.057	0.000	0.000	0.052
W index	0.124	0.042	0.109	0.071	0.041	0.107	0.049	0.033	0.090

Table 6: Numerical results for robustness on η parameter with trade liberalisation exercises.

Although increasing η from 0 to 1 leads the bilateral trade exercise welfare gains to fall by 60%, the effect on the gains from the unilateral exercise are much slighter. The liberalising country's gains fall from 4.8% in C1 to 3.6% in C6, while those for the non-liberalising country fall from 10% to 7%. The reasoning follows from examining the relative sizes of the changes in the measure of producing firms and the measure of varieties utilised in final goods aggregation. The rise in the former is much more prominent in the bilateral exercise of C1 than the unilateral. The ratio of the rise in Ω^P to that of Ω^U in the bilateral reform of C1 is around 1/9, while it is around 1/40 in the unilateral. Love of variety in the final good drives relatively more of the action in the unilateral reform, giving a smaller role for the η parameter. As such, the labour market friction is still robustly significant when compared with the perfectly competitive alternative.

	Calibration 3 ($\boldsymbol{\theta = 1.08, \eta = 0.00}$)			Calibration 7 ($\boldsymbol{\theta = 1.08, \eta = 0.50}$)			Calibration 8 ($\boldsymbol{\theta = 1.08, \eta = 1.00}$)		
	Bilateral	**Unilateral**		**Bilateral**	**Unilateral**		**Bilateral**	**Unilateral**	
Steady state	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$	$\boldsymbol{H/F}$	$\boldsymbol{H}$	$\boldsymbol{F}$
Welfare	0.020	0.324	-0.208	-0.032	0.188	-0.162	-0.029	0.152	-0.144
Consumption	0.026	0.374	-0.240	-0.038	0.212	-0.187	-0.035	0.171	-0.166
Disutility	0.025	0.326	-0.213	-0.039	0.154	-0.164	-0.035	0.118	-0.142
Measure D	-0.212	0.363	-0.877	-0.219	0.046	-0.802	-0.171	0.026	-0.754
Measure X	-0.250	-0.996	3.940	-0.578	-0.999	7.704	-0.475	-0.999	6.873
Measure M	0.675	1.567	-0.991	0.614	1.558	-0.961	0.437	1.403	-0.930
Measure T	-0.028	0.479	-0.493	-0.084	0.267	-0.421	-0.071	0.162	-0.382
Measure all	-0.028	0.479	-0.404	-0.084	0.268	-0.332	-0.071	0.230	-0.298
Measure P	0.095	0.221	-0.059	0.026	0.074	-0.034	0.012	0.040	-0.019
Measure U	0.068	0.549	-0.132	-0.002	0.434	-0.079	-0.013	0.389	-0.069
Average wage	-0.019	0.141	-0.119	-0.033	0.100	-0.095	-0.027	0.089	-0.093
Profits	0.117	0.671	-0.202	0.043	0.539	-0.065	0.070	0.451	-0.181
Taxes	-0.620	3.174	-0.989	-0.796	4.490	-0.980	-0.718	4.128	-0.949
P index	0.000	0.000	0.030	0.000	0.000	0.029	0.000	0.000	0.017
W index	0.021	0.266	-0.156	-0.032	0.127	-0.113	-0.030	0.097	-0.104

Table 7: Numerical results for robustness on η parameter with FDI liberalisation exercises.

Now we turn to consider the bilateral FDI liberalisation. Consider the reform in C3 — the importance of the love of variety in final goods and that of employment is reversed from the trade exercises. In particular, the latter increases by more than the former. More multinationals from abroad increase the set of employers for local workers. However, the strength of this extensive margin effect disincentivises entry, leading to a relatively smaller expansion of the varieties in final goods. This gives rise to the striking result of this exercises — that the bilateral FDI reform leads to welfare losses for values of $\eta = 0.5$ and $\eta = 1$. See that in C7 and C8, the measure of firms in final goods aggregation falls by 0.2% and 1.3%, respectively. Although the measure of producing firms rises in each scenario, this matters less for welfare in the case of C7 and not at all in C8.

The decline in welfare from the bilateral FDI liberalisation in C7 and C8 is surprising. One usually expects the presence of more FDI to be a positive from an efficiency perspective. More insight can be garnered from paying close attention to the physical iceberg cost of FDI that we leverage here to match the FDI sales intensity in the data. Recall from table 2 that a large value of this parameter is needed to match this moment —- 1.9 in the case of C3. This parameter can be thought of as a productivity loss associated with activities like local compliance costs for overseas subsidiaries' operations. A large increase in FDI activity brings with it considerable wasted labour resources through this parameter. As a result, when the employer variety benefit of FDI is downplayed with a positive η, these reforms can be a negative from a normative perspective. The productivity drain is sufficiently large that efficiency would be raised by re-allocating these resources away from multinationals and towards domestically-incorporated firms. From some extra numerical exercises, we verified the importance of this parameter by setting it to unity, meaning no productivity losses and re-ran the η exercises discussed above. Indeed we find that, even for $\eta = 1$, the bilateral FDI liberalisation would lead to a welfare gain in the context of labour market power. A calibration that is closer to the data dramatically reduces the desirability of multinational activity. This result is interesting in its own right and will receive more attention in future iterations of this work. This conclusion that more FDI is undesirable with low θ and $\eta > 0$ differs markedly from the perfectly competitive alternative C4, where the bilateral reform offers a small positive increase in welfare.

We lastly comment on the robustness exercises for the unilateral FDI reform. Recall from C3 that this exercise yields results of a more Machiavellian nature, where the liberalising country benefits at the cost of the non-liberalising country. These results hold up qualitatively when increasing η. Note that raising this parameter tends to have a disproportionally large effect on the welfare gains of the liberalising country — they are roughly halved when moving from $\eta = 0$ to $\eta = 1$. The losses to the non-liberalising country fall in magnitude only by about one quarter. Much of this asymmetry can be understood by looking at the effect on entry in each country. The the rise in the measure of entrants in H decreases from 48% to 16% as we move from C3 to C8. The predominant source of losses in F are coming from the boom in H multinationals' local presence. See that the rise in the measure of M firms from H doesn't change much quantitatively in moving from C3 to C8, meaning that the adverse effect on F entry is barely mitigated. Again comparing with the perfectly competitive C4, the model with market power still delivers welfare gains (losses) to H (F) that are over 10 times larger in magnitude.

In summary, the results of this section offer evidence that labour market power has a robustly quantitatively significant influence on the effect of openness reforms. These conclusions are based on policy experiments, that are carefully conducted, by re-calibrating the model with each change in the η parameter. This robustness conclusion holds across all different specifications of the model and all types of reforms.

8 Concluding Remarks

This paper takes a first step towards rigorous quantification of labour market power's effect on open economy reforms. We take a standard dynamic model with heterogeneous firms that draw idiosyncratic shocks and embed the feature of monopsonistic employers. Parameters are disciplined with cross-sectional data on the firm distribution. We evaluate both trade tariff reductions and tax reforms on the profits of multinational firms. The model is sufficiently parsimonious to facilitate the study of these reforms along the transition path. Productive firms have strong incentive to undertake horizontal FDI in this model, as it allows for lower variable production costs.

Our findings suggest that the model gives remarkably different predictions to policy reforms, when compared with a standard model with perfectly competitive labour markets. This follows for both steady state and transitional comparisons. We dissect market power's influence through running a variety of different policy exercises. Studying the trade reform exercises highlights how the scale in terms of country adoption of reforms shapes market power's impact. Bilateral trade reforms tend to converge faster to a higher steady state with market power. Unilateral trade liberalisations tend to have a more similar speed of convergence across the two labour market specifications, yet the quantitative changes in the short and long run remain very different. Running the FDI liberalisation exercises highlights how the nature of the policy itself dictates monopsony power's significance. While the import tariff affects both intensive and extensive margin export decisions, levying the FDI tax on profits primarily affects the extensive margin. While the quantitative differences remain stark across the competition structures, the FDI reform time paths look more more similar in shape than in the trade exercises. Our robustness analysis shows that the love of variety in employers channel drives a big component of the differences in model predictions, but strong contrasts still remain in its absence.

This paper leaves space for many interesting extensions. Extending our framework to a multi-country setting would allow for comparison with a large body of other works in the quantitative trade area. Including vertical FDI could lead to a variety of new insights, as this friction likely affects the organisation of supply chains in a significant way. Generally these advances would require moving to a calibration with an asymmetric country setup, which could also facilitate discussion about inequality, both within and across countries. Given the implications for both policy and our scientific understanding of institutional features of the labour market, it is hoped that our work paves the way for many more studies in the area.

Appendices

A Optimal Controls for Firm Problem

In what follows, we derive the optimal control variables contained in array $k_t(z_t, s_t)$ for each firm status. To simplify the notation, the firm's state will be denoted $\varphi_t = (z_t, s_t)$ in what follows. In the case of a domestic firm, we reduce their choice of $k_t(\varphi_t)$ to a wage choice problem of the form

$$\pi_t(z_t, D) = \max_{w_t(\varphi_t)} p_t(\varphi_t)q_t(\varphi_t) - w_t(\varphi_t)n_t(\varphi_t)$$

subject to constraints

$$\begin{aligned} q_t(\varphi_t) &= A_t P_t^{\sigma} p_t(\varphi_t)^{-\sigma} \\ y_t(\varphi_t) &= z_t n_t(\varphi_t) \\ y_t(\varphi_t) &= q_t(\varphi_t) \\ n_t(\varphi_t) &= B_t w_t(\varphi_t)^{\theta} \end{aligned}$$

which are the demand curve from the H final goods producer, the domestic production function, market clearing condition and labour supply function. Note that these constraints imply four variables: $q_t(\varphi_t)$, $y_t(\varphi_t)$, $n_t(\varphi_t)$ and $p_t(\varphi_t)$. Using these constraints and then maximising over the H wage gives solution

$$w_t(\varphi_t) = \left(\frac{1+\theta}{\theta}\right)^{-\frac{\sigma}{\theta+\sigma}} \left(\frac{\sigma}{\sigma-1}\right)^{-\frac{\sigma}{\theta+\sigma}} \left(\frac{A_t P_t^{\sigma}}{B_t}\right)^{\frac{1}{\theta+\sigma}} z_t^{\frac{\sigma-1}{\theta+\sigma}}.$$

In the case of an exporting firm, it chooses $k_t(\varphi_t)$ through solving the problem

$$\pi_t(z_t, X) = \max_{n_t^D(\varphi_t), n_t^X(\varphi_t)} p_t(\varphi_t)q_t(\varphi_t) + p_t^*(\varphi_t)q_t^*(\varphi_t) - w_t(\varphi_t)n_t(\varphi_t)$$

where it is written in terms of the labour for domestic and export production $n_t^D(\varphi_t)$ and $n_t^X(\varphi_t)$. The problem is subject to constraints

$$
\begin{aligned}
q_t(\varphi_t) &= A_t P_t^{\sigma} p_t(\varphi_t)^{-\sigma} \\
q_t^*(\varphi_t) &= A_t^* P_t^{*\sigma} \widehat{\tau}^{X*(-\sigma)} p_t^*(\varphi_t)^{-\sigma} \\
y_t(\varphi_t) &= z_t n_t^D(\varphi_t) \\
y_t^*(\varphi_t) &= z_t n_t^X(\varphi_t) \\
y_t(\varphi_t) &= q_t(\varphi_t) \\
y_t^*(\varphi_t) &= \tau^X q_t^*(\varphi_t) \\
n_t(\varphi_t) &= B_t w_t(\varphi_t)^{\theta} \\
n_t(\varphi_t) &= n_t^D(\varphi_t) + n_t^X(\varphi_t)
\end{aligned}
$$

where recall that τ^X is a physical iceberg cost of production, while $\widehat{\tau}^{X*}$ is the tariff levied by the F government. See that these 8 constraints give 8 unknowns: $p_t(\varphi_t)$, $q_t(\varphi_t)$, $p_t^*(\varphi_t)$, $q_t^*(\varphi_t)$, $y_t(\varphi_t)$, $y_t^*(\varphi_t)$, $n_t(\varphi_t)$ and $w_t(\varphi_t)$. We then take FOCs with respect to $n_t^D(\varphi_t)$ and $n_t^X(\varphi_t)$. This yields

$$
\begin{aligned}
n_t^X(\varphi_t) =& n_t^D(\varphi_t) \frac{A_t^* P_t^{*\sigma} \widehat{\tau}^{X*(-\sigma)}}{A_t P_t^{\sigma}} \tau^{X(1-\sigma)} \\
n_t^D(\varphi_t) =& \left(1 + \frac{A_t^* P_t^{*\sigma} \widehat{\tau}^{X*(-\sigma)}}{A_t P_t^{\sigma}} \tau^{X(1-\sigma)}\right)^{\frac{-\sigma}{\theta+\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\frac{\theta\sigma}{\theta+\sigma}} \left(\frac{1}{A_t P_t^{\sigma}}\right)^{-\frac{\theta}{\theta+\sigma}} \times \\
& \left(\frac{\theta}{1+\theta}\right)^{\frac{\theta\sigma}{\theta+\sigma}} B_t^{\frac{\sigma}{\theta+\sigma}} z_t^{\frac{(\sigma-1)\theta}{\theta+\sigma}}
\end{aligned}
$$

In the case of a multinational firm, its choice of controls is reduced to the problem

$$
\pi_t(z_t, M) = \max_{n_t(\varphi_t), n_t^{M*}(\varphi_t)} p_t(\varphi_t) q_t(\varphi_t) + p_t^*(\varphi_t) q_t^*(\varphi_t) - w_t(\varphi_t) n_t(\varphi_t) - w_t^*(\varphi_t) n_t^{M*}(\varphi_t)
$$

subject to the constraints

$$
\begin{aligned}
q_t(\varphi_t) &= A_t P_t^{\sigma} p_t(\varphi_t)^{-\sigma} \\
q_t^*(\varphi_t) &= A_t^* P_t^{*\sigma} p_t^*(\varphi_t)^{-\sigma} \\
y_t(\varphi_t) &= z_t n_t(\varphi_t) \\
y_t^*(\varphi_t) &= z_t n_t^{M*}(\varphi_t) \\
y_t(\varphi_t) &= q_t(\varphi_t) \\
y_t^*(\varphi_t) &= \tau^M q_t^*(\varphi_t) \\
n_t(\varphi_t) &= B_t w_t(\varphi_t)^{\theta} \\
n_t^{M*}(\varphi_t) &= B_t^* w_t^*(\varphi_t)^{\theta}
\end{aligned}
$$

where recall $\tau^M > 1$ is an iceberg productivity loss from producing in the foreign subsidiary. Notice that again the optimisation will be over variables $n_t(\varphi_t)$ and $n_t^{M*}(\varphi_t)$, while the 8 constraints imply 8 other variables: $q_t(\varphi_t)$, $p_t(\varphi_t)$, $q_t^*(\varphi_t)$, $p_t^*(\varphi_t)$, $y_t(\varphi_t)$, $y_t^*(\varphi_t)$, $w_t(\varphi_t)$ and $w_t^*(\varphi_t)$. This problem yields solution

$$
\begin{aligned}
n_t(\varphi_t) &= \left(\frac{\sigma-1}{\sigma}\right)^{\frac{\sigma\theta}{\sigma+\theta}} \left(\frac{1}{A_t P_t^{\sigma}}\right)^{-\frac{\theta}{\sigma+\theta}} \left(\frac{\theta}{1+\theta}\right)^{\frac{\sigma\theta}{\sigma+\theta}} B_t^{\frac{\sigma}{\sigma+\theta}} z^{\frac{\theta(\sigma-1)}{\sigma+\theta}} \\
n_t^{M*}(\varphi_t) &= \left(\frac{\sigma-1}{\sigma}\right)^{\frac{\sigma\theta}{\sigma+\theta}} \left(\frac{1}{A_t^* P_t^{*\sigma}}\right)^{-\frac{\theta}{\sigma+\theta}} \left(\frac{\theta}{1+\theta}\right)^{\frac{\sigma\theta}{\sigma+\theta}} (B_t^*)^{\frac{\sigma}{\sigma+\theta}} \left(\frac{z}{\tau^M}\right)^{\frac{\theta(\sigma-1)}{\sigma+\theta}}.
\end{aligned}
$$

B Computational Algorithms

Steady State

Calibrated Steady State

For the computation of the steady state in the calibration step (note that aggregate objects are stationary and so their time subscripts are omitted):

1. Fix the W and W^* indices to unity (we will adjust the fixed costs of entry to make this consistent with free entry later). In what follows, variables with hats will denote conjectures in the computations. Conjecture objects $\widehat{A}$, $\widehat{A}^*$, $\widehat{\Omega}^P$ and $\widehat{\Omega}^{P*}$ — the demand shifters for final output in H, F, the mass of producing firms in H and F respectively. Recall that the final good in H is the numéraire and since the two countries are symmetric, it follows that $P = P^* = 1$.
2. Solve the incumbent firm's Bellman equation (12). This step yields their value function as well policy functions for price, employment, discrete choice and

wage policy functions. All these objects are functions of the firm's state space. Solve this part of the problem using value function iteration.

3. Solve the entrant's problem (15) using the value function obtained from step 2 and assuming the fixed entry cost $f^T = 0$ (this is a free parameter given the fixed W above). After obtaining entry value v^T, set $f^T = v^T$.

4. Find the steady state cross-sectional distribution of H and F firms: normalising to have a unit measure of each set of firms. Do this by firstly re-writing the cross-sectional law of motion in equation (16) in matrix notation as

$$\mu_t = \zeta_t \mu_t + M_t^T G^T \tag{18}$$

where μ_t the vector of the measure of firms across the state space and ζ_t is a Markov transition matrix that depends on the productivity process for incumbents, their equilibrium discrete choices and the stochastic process for the sunk cost draws. We can then find the invariant stationary distribution through inverting the steady state version of equation (18) as $\widetilde{\mu} = \widetilde{M}^T (I - \zeta)^{-1} G^T$. Here I is the identity matrix, $\widetilde{\mu}$ is the stationary distribution and $\widetilde{M}^T$ is the measure of entrants that normalises the overall firm measure to unity (giving the stationary distribution).

5. Find variable averages implied by the stationary distribution found in step 4.

6. Find the measures of firms using the linearity of the stationary measure such that the definition of the wage indices hold in each country as given in equation (9). Recall that these indices are set equal to unity as per the normalisation above. Note that this step utilises the average employment levels found using the stationary distribution, in step 5.

7. Aggregate using the variable averages and firm measures, found in step 6.

8. Compute the following metrics of distance

$$\begin{aligned} \Delta^A &= |\widehat{A} - A| \\ \Delta^{A*} &= |\widehat{A}^* - A^*| \\ \Delta^{MP} &= |\widehat{\Omega}^P - \Omega^P| \\ \Delta^{MP*} &= |\widehat{\Omega}^{P*} - \Omega^{P*}|. \end{aligned} \tag{19}$$

See that the first two objects in the set of equations in (19) represent the distance of the conjectured demand shifter from the supply of final goods implied from the previous step in H and F respectively. The second two equations give the distance of the conjectured masses of producers from those implied in H and F respectively. If $\max(\Delta^A, \Delta^{A*}, \Delta^{MP}, \Delta^{MP*})$ is sufficiently small, then stop. Otherwise update the conjectures $\widehat{A}$, $\widehat{A}^*$, $\widehat{\Omega}^P$ and $\widehat{\Omega}^{P*}$, return to step 2 above and repeat until convergence. Once converged, compute the list of equilibrium objects in equation (17) for this calibrated steady state. Label this list of objects Γ_0.

Counterfactual Steady State

When running a counterfactual, use the following procedure:

A Conjecture objects $\widehat{A}, \widehat{A}^*, \widehat{P}^*, \widehat{W}$, $\widehat{W}^*$, $\widehat{\Omega}^P$ and $\widehat{\Omega}^{P*}$. Notice that now we now need to solve endogenously for the price of final goods in F and the two wage indices.

B As in step 2 in the calibration procedure, solve the incumbent firm's Bellman equation using value function iteration.

C Solve the entrant's problem (15) using the value function obtained from step B and the fixed cost of entry implied by step 3 of the calibration procedure.

D As in step 4 of the calibration procedure, find the stationary cross-section of firms.

E As in step 5 of the calibration procedure, find the averages of variables using the stationary distribution.

F Similarly to step 6 of the calibration procedure, find the measures of firms implied by the current wage index conjectures $\widehat{W}$ and $\widehat{W}^*$.

G As in step 7 of the calibration procedure, aggregate using the measures of firms found in step F.

H Compute the metrics of distance of (19) in the calibration procedure, as well as

$$\Delta^{P*} = |\widehat{A}^* - C^* - L^*|$$
$$\Delta^{W} = |v^T|$$
$$\Delta^{W*} = |v^{T*}|$$

where the top equation is the difference between the conjectured final output in F and aggregate demand, while the second and third are the distances of the free entry conditions from holding. If $\max(\Delta^A, \Delta^{A*}, \Delta^{MP}, \Delta^{MP*}, \Delta^{P*}, \Delta^W, \Delta^{W*})$ is sufficiently small, then stop. Otherwise update the conjectured objects

$\widehat{A}, \widehat{A}^*, \widehat{\Omega}^P, \widehat{\Omega}^{P*}, \widehat{P}^*, \widehat{W}, \widehat{W}^*$, return to step B and repeat until convergence. Once stopped, compute the list of objects in (17) for this steady state, label this list $\Gamma_{\widehat{\mathcal{T}}}$

Transition Dynamics

One uses the economies given by Γ_0 and Γ_1 as boundary conditions for the simulation, which starts at time $t = 1$. After having solved for the two steady states, follow the procedure below.

a Conjecture the length of time to convergence, label this number $\widehat{\mathcal{T}} \in \mathbb{N}$.

b Conjecture time paths for aggregate variables $\{\widehat{\Gamma}_t\}_{t=1}^{\widehat{\mathcal{T}}-1}$ where

$$\widehat{\Gamma}_t \equiv (\widehat{A}_t, \widehat{A}_t^*, \widehat{P}_t^*, \widehat{W}_t, \widehat{W}_t^*, \widehat{\Omega}_t^P, \widehat{\Omega}_t^{P*}, \widehat{M}_t^T, \widehat{M}_t^{T*}).$$

Notice that now we need to also conjecture the masses of entrants in each country.

c Take $v_{\widehat{\mathcal{T}}}(z, s)$ to be the endpoint for the H incumbent value function. This serves as the continuation value for the final period of the transition. Iterate backwards on the firm Bellman equation (12) to the initial period. This gives a sequence $\{v_t(z, s)\}_{t=1}^{\widehat{\mathcal{T}}-1}$. Do the same for the F firms.

d Using the sequence $\{v_t(z, s)\}_{t=1}^{\widehat{\mathcal{T}}-1}$, iterate backwards on the entrant Bellman equation (15). This gives a sequence of entry values $\{v_t^T\}_{t=1}^{\widehat{\mathcal{T}}-1}$. Do the same for F firms.

e Using the policy functions found in c and d, as well as μ_0 from list Γ_0 as a starting point, iterate forwards on the law of motion (18) to obtain a sequence of cross-sectional measures $\{\mu_t(z, s)\}_{t=1}^{\widehat{\mathcal{T}}-1}$. Do the same for the F firms.

f Compute the following sequence of distance metrics $\{\Delta_t\}_{t=1}^{\widehat{\mathcal{T}}-1}$

$$\Delta_t = (\Delta_t^A, \Delta_t^{A*}, \Delta_t^{P*}, \Delta_t^W, \Delta_t^{W*}, \Delta_t^{MP}, \Delta_t^{MP*}, \Delta_t^M, \Delta_t^{M*})$$

where

$$\begin{aligned}
\Delta_t^A &= |\widehat{A}_t - A_t| \\
\Delta_t^{A*} &= |\widehat{A}_t^* - A_t^*| \\
\Delta_t^{P*} &= |\widehat{A}_t^* - C_t^* - F_t^*| \\
\Delta_t^W &= |\widehat{W}_t - W_t| \\
\Delta_t^{W*} &= |\widehat{W}_t^* - W_t^*| \\
\Delta_t^{MP} &= |\widehat{\Omega}_t^P - \Omega_t^P| \\
\Delta_t^{MP*} &= |\widehat{\Omega}_t^{P*} - \Omega_t^{P*}| \\
\Delta_t^M &= |v_t^T| \\
\Delta_t^{M*} &= |v_t^{T*}|
\end{aligned}$$

are the time-varying versions of distance metrics defined for the steady states. Note we also consider Δ_t^W and Δ_t^{W*} along the transition since we no longer normalise the cross-sectional measure. If $\max_t\{\max \Delta_t\}_{t=1}^{\widehat{\mathcal{T}}-1}$ is sufficiently small then stop. Otherwise, update the sequences of $\{\widehat{\Gamma}_t\}_{t=1}^{\widehat{\mathcal{T}}-1}$, return to step c and repeat.

g Check to see if the system has converged by time $\widehat{\mathcal{T}}$. If not, update your guess of $\widehat{\mathcal{T}}$, return to step b and repeat until convergence.

C Calibration Details for Robustness

Table 8 gives the parameter values from the calibration procedures. Table 9 then gives details regarding the moments from the calibration variants in the robustness section.

D Data Appendix

The following procedure is used to classify firms as domestic, exporter or multinational.

1. Download and combine the Compustat Fundamentals Annual and Historical Segment datasets.
2. Match firms in the two datasets using their global company key (GVKEY).

Parameter		C5	C6	C7	C8	Target
		Calibration				
Sunk cost of entry	f^T	0.411	0.464	0.413	0.472	Unit wage
Sunk cost of (D, X) mean	$\widehat{f}^{X,D}$	0.032	0.039	0.035	0.036	Transition (D, X)
Fixed cost of X	$f^{X,C}$	0.017	0.021	0.017	0.019	Transition (X, X)
Sunk cost variability	σ_f	1.200	3.000	2.000	2.000	Transition (X, E)
Fixed cost	f^C	0.391	0.363	0.390	0.360	Exit rate
Physical iceberg cost X	τ^X	1.320	1.332	1.262	1.265	Export intensity
Export tariff	$\widehat{\tau}^X$	1.120	1.110	1.160	1.165	Taxes/Output C1
Sunk cost of (D, M) mean	$\widehat{f}^{M,D}$			0.236	0.281	Transition (D, M)
Sunk cost of (X, M) mean	$\widehat{f}^{M,X}$			0.222	0.272	Transition (X, M)
Sunk cost of (M, X) mean	$\widehat{f}^{X,M}$			0.090	0.118	Transition (M, X)
Fixed cost of M	$f^{M,C}$			0.114	0.136	Transition (M, M)
Physical iceberg cost M	τ^M			1.856	1.855	FDI sales intensity
FDI tax	$\widehat{\tau}^M$			0.011	0.010	Taxes/Output C1

Table 8: Parameters calibrated inside the model. Fixed costs are expressed as a fraction of total final output.

		Calibration			Calibration		
Moment	**Data**	**C5**	**C6**	**Data**	**C7**	**C8**	**Source**
Transition (D, X)	0.011	0.014	0.017	0.011	0.013	0.018	Compustat
Transition (X, X)	0.872	0.881	0.820	0.820	0.833	0.789	Compustat
Transition (X, E)	0.074	0.020	0.030	0.070	0.062	0.064	Compustat
Exit rate	0.110	0.100	0.121	0.120	0.121	0.147	Literature
Export intensity	0.157	0.157	0.159	0.157	0.158	0.154	Compustat
Taxes/Output $\widehat{\tau}^X$	0.002	0.002	0.002	0.002	0.002	0.002	C1
Transition (D, M)				0.022	0.024	0.025	Compustat
Transition (X, M)				0.060	0.054	0.060	Compustat
Transition (M, X)				0.004	0.001	0.001	Compustat
Transition (M, M)				0.890	0.886	0.886	Compustat
FDI sales intensity				0.299	0.300	0.300	Compustat
Taxes/Output $\widehat{\tau}^M$				0.002	0.002	0.002	C1

Table 9: Data moments and model counterparts for robustness exercises. Note that we report separate data moments for C5 and C6, which are conditional on firms that do not transition to multinational status.

3. Identify U.S. and foreign firms. A firm is classified as a U.S. firm is both its foreign incorporation code (FIC) and company headquarters code (LOC) are for the U.S as in Fillat and Garetto (2015). If a company is identified as having been a U.S. firm at any point in its data history, we classify it as a U.S. firm, (to ensure that re-incorporated U.S. firms aren't treated as foreign). Otherwise it is classed as a foreign firm.
4. Drop any foreign firms.
5. Drop any observations that are not denoted in U.S. Dollars.
6. Eliminate double-counting of information in firm-years.
7. Drop any observations before 1979 and after 2018.
8. Drop firms with SIC codes over the ranges (SIC $\geq$ 4900 & SIC $\leq$ 4999, regulated firms) | (SIC $\geq$ 6000 & SIC $\leq$ 6999, financial firms) | (SIC $\geq$ 9000, public service firms).
9. Determine if a given firm-year contains the reporting of geographical segments or not. If so, drop the business segments reported. Otherwise keep the business segments reported.
10. Check if a DATADATE-GVKEY combination reports the same segment multiple times (using the variable SID to identify segments).
11. Check if any firms report the obsolete total geographic segment (GEOTP = 1), if so drop them.
12. Classify firms as domestics, exporters and multinationals. A firm is a multinational if they report an overseas geographical segment (with a maximum value of the variable GEOTP = 3) and have a positive value of sales. A firm is an exporter if they report export sales and no overseas geographical segment (they may have reported geographic segments with a maximum value of GEOTP = 2 or they may only have reported business segments with export income). All other firms are classified as domestics.
13. Replace a data item with a missing value if it has a data code reported.
14. Aggregate the information for firm-years across all the remaining segments present. Create new foreign variables for the overseas (GEOTP = 3) segments to distinguish them from domestic activities (i.e. now there is a sales variable and a foreign sales variable for a given firm-year).
15. Keep only one observation per firm year: drop all the segment-level variables and just keep the aggregates.

16. Adjust for temporary downward foreign status changes. As in Fillat and Garetto (2015), if a firm's status drops for a single time period, we adjust the observation. Specifically, we look at at firm's status for time $t-1$ and $t+1$ and compare with their status at time t. If they were an exporter in $t-1$ and $t+1$ but their status dropped to domestic at time t, I adjust to make them an exporter at time t. Similarly if their status dropped from multinational at $t-1$ and $t+1$ to exporter or domestic at time t, we replace the t status with multinational.

References

Alessandria, George and Horag Choi, "Do sunk costs of exporting matter for net export dynamics?," *The Quarterly Journal of Economics*, 2007, *122* (1), 289–336.

_ , _ , and Kim J Ruhl, "Trade adjustment dynamics and the welfare gains from trade," *Journal of International Economics*, 2021, *131*, 103458.

Arkolakis, Costas, Natalia Ramondo, Andrés Rodríguez-Clare, and Stephen Yeaple, "Innovation and production in the global economy," *American Economic Review*, 2018, *108* (8), 2128–73.

Berger, David, Kyle Herkenhoff, and Simon Mongey, "Labor Market Power," *American Economic Review*, 2022, (1147).

Blanchard, Olivier and Francesco Giavazzi, "Macroeconomic effects of regulation and deregulation in goods and labor markets," *The Quarterly journal of economics*, 2003, *118* (3), 879–907.

Cooper, Russell W and John C Haltiwanger, "On the nature of capital adjustment costs," *The Review of Economic Studies*, 2006, *73* (3), 611–633.

Corbae, Dean and Pablo D'Erasmo, "Reorganization or liquidation: Bankruptcy choice and firm dynamics," *The Review of Economic Studies*, 2021, *88* (5), 2239–2274.

Decker, Ryan A, John Haltiwanger, Ron S Jarmin, and Javier Miranda, "Declining business dynamism: What we know and the way forward," *American Economic Review*, 2016, *106* (5), 203–07.

Egger, Hartmut, Udo Kreickemeier, Christoph Moser, and Jens Wrona, "Exporting and Offshoring with Monopsonistic Competition," *The Economic Journal*, May 2022, *132* (644), 1449–1488.

Fillat, José L and Stefania Garetto, "Risk, returns, and multinational production," *The Quarterly Journal of Economics*, 2015, *130* (4), 2027–2073.

Helpman, Elhanan, Marc J Melitz, and Stephen R Yeaple, "Export versus FDI with heterogeneous firms," *American economic review*, 2004, *94* (1), 300–316.

Hopenhayn, Hugo and Richard Rogerson, "Job turnover and policy evaluation: A general equilibrium analysis," *Journal of political Economy*, 1993, *101* (5), 915–938.

Jha, Priyaranjan and Antonio Rodriguez-Lopez, "Monopsonistic labor markets and international trade," *European Economic Review*, 2021, *140*, 103939.

_ **and** _ , "Minimum Wage and Employer Variety," 2022.

MacKenzie, Gaelan, "Trade and Market Power in Product and Labor Markets," 2019. University of Toronto.

Naidu, Suresh, Eric A Posner, and E Glen Weyl, "Antitrust Remedies for Labor Market Power," *Harvard Law Review*, 2018, *132*, 536–601.

Ruhl, Kim J and Jonathan L Willis, "New exporter dynamics," *International Economic Review*, 2017, *58* (3), 703–726.

Spencer, Adam Hal, "Policy effects of international taxation on firm dynamics and capital structure," *The Review of Economic Studies*, 2022, *89* (4), 2149–2200.

Tauchen, George, "Finite state markov-chain approximations to univariate and vector autoregressions," *Economics letters*, 1986, *20* (2), 177–181.

Tian, Can, "Firm-level entry and exit dynamics over the business cycles," *European Economic Review*, 2018, *102*, 298–326.

Webber, Douglas A, "Firm market power and the earnings distribution," *Labour Economics*, 2015, *35*, 123–134.

Yeh, Chen, Claudia Macaluso, and Brad Hershbein, "Monopsony in the US Labor Market," *American Economic Review*, July 2022, *112* (7), 2099–2138.