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ORIGINAL ARTICLE

Labour market rigidity and trade margins

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Abstract

Countries differ, sometimes significantly, regarding their basic labour market structure. Despite the prevalence of theoretical literature, empirical studies examining the impact of labour market rigidity (LMR) on trade is sparse. Existing empirical studies have been limited to aggregate trade flows with cross-sectional estimations; a limited set of countries (e.g. OECD or Latin America) or to the period after 1990. We utilise a gravity model of trade to examine the impact of LMR on exports for 145 countries between 1964 and 2004. We utilise dis-aggregated product-level trade data and decompose total exports into the extensive and the intensive margin to examine this relationship. We also utilise total aggregate international trade relative to domestic sales, which allows for the identification of LMR-trade relationship, even in the presence of multilateral trade resistance controls. Finally, we estimate the effect of LMR on exports (and the margins) by focusing on a sample of European OECD countries via the difference-in-differences estimation. In all cases, we find that a rigid LMR reduces total exports, and this decrease is driven primarily by the intensive margin. Our findings are relevant as recent studies have found the intensive margin to be more important for long-run export growth and especially for developing countries.

W. Charles Sawyer Deceased.
My co-author, who was a dear friend, mentor and a colleague, passed away in June, 2021. I dedicate this article to him.

KEYWORDS
difference-in-differences, exports, extensive and intensive margin, intra-national trade, labour market rigidity, multilateral trade resistance, trade

1 | INTRODUCTION

Employment protection legislation (EPL) is defined as a set of regulations, either legislated or written in labour contracts, that limit an employer's ability to dismiss workers without delay or cost and is designed to enhance worker welfare and prevent discrimination (World Bank, 2017).[1] EPL has been studied for its economic effects in a number of contexts, including its impact on firms and workers. Some studies argue that the net effect of EPL on firm and workers productivity may be positive. EPL can provide stability by moderating employment fluctuations over the business cycle and thereby increase workers' effort. Firms may also increase their investment in human capital to increase labour productivity as an alternative to downsizing (Bassanini et al., 2014). There are, however, several unintended consequences of the legislation. These legislation rigidities (e.g. regulations on wages, benefits, hours worked and firing) can hinder firm's productivity (Martin & Scarpetta, 2011); limit labour market mobility (World Bank, 2017); increase firm's adjustment costs (Griffith & Macartney, 2014); decrease innovation activity (Saint-Paul, 1997); or reduce efficiency in reallocation of workers (Cuñat & Melitz, 2012). For example, strict EPL has been blamed in particular for the poor performance of large-scale labour-intensive manufactures in India, despite its abundance of labour (Dougherty et al., 2011).[2]

Empirical studies examining the impact of EPL on trade is sparse, despite the evidence of large cross-country and cross-sector differences in basic labour market structure.[3] Studies that do exist, however, are limited to aggregate trade data, cross-sectional studies or to the period after 1990. A few studies with a reasonable cross-country and time variation (1960s and beyond) are limited to a few sets of countries (e.g., OECD or Latin America). A longer time frame is important in order to understand the dynamics of such structural reform, as Campos and Nugent (2018) argue, primarily because such reform is implemented slowly and less frequently than other reforms. Although past empirical studies have established that EPL tends to reduce trade flows in general, the nature of this research has left a number of unanswered questions that we attempt to address in this paper.

The purpose of this paper is to examine the effect of EPL on trade flows at a global level. We estimate a gravity model of trade augmented by a global data set on EPL by country. We avoid the distortions of having a limited set of countries and/or a limited set of years. The model is estimated as an unbalanced panel of 145 countries over the time period of 1964–2004. In addition, we estimate the extent to which the changes in trade flows are accounted for depending on changes in the extensive (export diversification) versus intensive (deepening of trade relationships) margins of trade. Adjustment along these margins can have important implications for exports or trade in general. An increase in the extensive margin is known to reduce volatility in the economy and increase productivity (Agosin, 2007), while an increase in the intensive margin is found to be important for export growth and has accounted for the majority of export growth over time (Besedeš & Prusa, 2011; Helpman et al., 2008).

[1]The OECD (1999) lists five types of employment protection: (a) administrative procedures, (b) notice of termination, (c) severance payment, (d) difficulty of dismissal and (e) additional measures for collective dismissal.

[2]India's EPL is regarded as one of the most stringent in the world and can largely be attributed to the stagnant share of manufacturing output in India's GDP over the past couple of decades (OECD, 2017).

[3]Campos and Nugent (2018) mention that labour market reform is one of the most important structural reforms, yet least well understood.

While our estimates are given at an aggregate level, the base data are quite dis-aggregated. It is compiled from the SITC-Revision 2 classification for the 4-digit product level. We perform further tests by dis-aggregating the data in two ways. First, we examine the impact of EPL on trade across country's level of development. Second, we examine this impact across product categories or sectors. In all cases, EPL has a tendency to reduce the volume of trade and the effects are more evident for labour-intensive products. Interestingly, there is not a substantial difference in the impact of EPL for both developed and developing countries. Our findings are robust to both OLS and PPML specifications. In addition, our results indicate that much of the effects occur at the intensive margin of trade as opposed to the more traditional thinking that changes occur more along the extensive margin. This point is reinforced by Fernandes et al. (2018) that find the intensive margin of trade to be much more important than previously realised. Based on these results along the trade margins, we are able to identify the channel via which EPL affects exports. Our findings are relevant as studies (e.g. Besedeš & Prusa, 2011) find intensive margin to be more important for long-run export growth and especially for developing countries. We also utilise gravity regressions with the inclusion of intra-national trade flows, which allows for the identification of time-varying country specific EPL variable within a structural gravity framework even in the presence of time-varying importer and exporter fixed effects, collectively known as the multilateral trade resistance (MTR) controls.[4] As Anderson and van Wincoop (2003) argue, failure to control for such MTRs in gravity estimations leads to biased estimates of the coefficients. To our knowledge, we are the first study to examine the impact of EPL on total aggregate trade that includes intra-national trade flows and appropriately accounts for MTR controls. Our results are robust to such inclusion, and more importantly, it is even stronger.

Finally, we estimate the impact of EPL on trade (and the margins) by conducting a generalised difference-in-differences (DID) method. To do so, we focus on a sample of European OECD countries and divide them into a control and a treatment group. These countries share many observed (or unobservable) similarities that can potentially influence trade flows (such as shared borders, legal system and climate among others) and are (on average) similarly distant from their trade partners. Past studies that examine the impact of EPL on trade have effectively done so without incorporating a control group or by using the rest of the world as a comparison, which can make the estimate vulnerable to omitted variable biases. Our results remain robust; EPL decreases exports, and this decrease is driven primarily by the intensive margin.

The next section of the paper provides institutional details on EPL and clarifies some definitional problems in the existing literature. It also provide a review of the literature on EPL and on the interactions between EPL and trade. The next two sections provide more detail on the data set and the empirical strategy utilised. This is then followed by the presentation of the overall and dis-aggregated results. We then discuss intra-national trade flows and MTR controls. A concluding section summarises the results and provides some avenues for future research on unresolved issues concerning EPL and trade.

2 | BACKGROUND

2.1 | Employment protection legislation and trade

The objective of EPL is to protect workers in some sense from the vagaries of either changes in industrial structure and/or macroeconomic shocks. While the definition of EPL as a policy is clear,

[4]With just international trade flows, such MTR controls do not allow for the identification of the impact of EPL on trade, as this variable is perfectly collinear with and are absorbed by MTR controls.

the language used by economists studying it is not. One frequently sees the term, labour market rigidity (LMR) used interchangeably with EPL. In reality, EPL increases frictions in the labour market. In turn, these frictions can become a source of rigidity that lessens the free flow of labour from one job to another or can create barriers to workers trying to enter the labour market. Thus, LMR is an outcome of EPL but LMR frequently is used as a synonym for EPL. In a similar vein, many papers in the literature study the more specific phenomenon of 'firing costs' which is a subset of EPL and is a major source of LMR. In this paper, we are studying the effects of EPL by using a specific index of regulations similar to those listed above.

While the early literature on EPL focused on macroeconomic outcomes, more recent papers have focused on the effects of EPL at the firm level and in the context of international trade. Cuñat and Melitz (2012) show that low EPL can be a source of comparative advantage and analyse how this plays out when trade is volatile. Almeida and Poole (2017) find that firing costs inhibits the efficient reallocation of workers in response to shocks and encourages firms to retain workers they would otherwise shed, while Helpman and Itskhoki (2010) find such costs to introduce a significant labour market friction that, in turn, affect the degree of comparative advantage and trade flows. A rigid labour market is also known to discourage exit of less productive firms and under-investment in skill-intensive sectors (Poschke, 2009); or lead to high levels of employment in informal sectors or dual markets that are associated with lower size and productivity level (Dougherty et al., 2011). In a recent paper, Fajgelbaum et al. (2020) show that lowering labour market restrictions increase the exports of more productive firms and lowers exports of less productive firms.

A reasonable summary here is that LMR, and consequently EPL, hinders the ability of firms to adjust to various kinds of (macroeconomic) shocks. It also raises costs which, ceteris-paribus, would reduce the volume of trade. A few studies have also explored this relationship across sectors. Cuñat and Melitz (2012) demonstrate that EPL is less important in capital intensive industries. This implies that EPL may be more important overall in labour-intensive industries which is a point we will consider in the empirical section of the paper.

2.2 | Trade margins

Recent theoretical models of trade have emphasised differences in firm-level productivity and size (Bernard & Jensen, 2004; Eaton et al., 2004). According to this 'new-new trade model', incorporating such firm-level heterogeneity leads to a decomposition of trade into two margins of trade: the number of exporters selling in the destination market or the firm-level extensive margin and the change in the average exports by firms that already export or the firm-level intensive margin (Chaney, 2008; Melitz, 2003). These trade costs, that are categorised into fixed and variable costs, entail that only more productive firms will find it profitable to export as these firms vary based on productivity and that trade costs also vary across destinations.[5] While various studies have incorporated labour market institutions into the heterogeneous firm model, none of these studies, however have examined the impact of labour market institutions on the margins of trade using dis-aggregated product-level trade data. Our study looks specifically at the impact of LMR along these margins. LMR is known to reduce firm's productivity level, which can have important implications along trade margins that can be masked at the aggregate level. For example, in the context of Indian firms, Besley and Burgess (2004) find a negative impact of EPL on output, investment,

[5]Some examples of fixed cost include communication cost, information cost, bureaucratic paperwork costs and marketing cost, while changes in tariff can be viewed as a variable cost.

employment and labour productivity among registered manufacturing firms while Dougherty et al. (2011) find that firms in labour-intensive industries but in flexible labour markets have total factor productivity residuals 14% higher as opposed to counterparts in states with more stringent labour laws.

Changes to these trade margins occur due to different motivations. Dutt et al. (2013) show that a reduction in fixed costs reduces the firm's productivity threshold to enter the export market, resulting in more firm entry, and thus increases the extensive margin. However, the intensive margin decreases as increases in entry, especially of less productive firms, without change in prices leads to a dilution of the market shares for the incumbent firms.[6] This results in lower average productivity and lower average sales, thus the intensive margin decreases. A reduction in variable costs would also increase the extensive margin as the threshold productivity level decreases. As for the intensive margin, there are two opposing effects. There is an increase in revenue for the incumbent firms, hence exports and average exports per firm increases. Second, due to entry of firms with lower productivity and lower sales relative to the incumbents, it decreases the average exports per firm. This result is similar to the one obtained in the Chaney (2008) model, whereby most of the adjustment takes place along the extensive margin.[7] Subsequent work has indicated that the assumption of the distribution of exporters' productivity may be of critical importance in this regard. Dutt et al. (2013) and more recently Fernandes et al. (2018) show that the firm-level heterogeneity common in the new trade models can lead to changes in trade at both margins. Such studies have criticised the Pareto distribution assumption in the Chaney (2008) model as being more tractable than realistic. For example, Sun et al. (2013) find that the Pareto distribution with unbounded productivity is a poor fit for the distribution of Chinese firms. A distribution of exporters that is not Pareto normal may tend to change in trade flows that are more along the intensive margin.[8] Dutt et al. (2013) show that a reduction in variable costs leads to an increase in the intensive margin under two scenarios. The first assumption places an upper bound on firm productivity or a lower bound on marginal costs, the second assumes that lower-productivity firms can have not only higher variable costs but also higher fixed costs. Both of these scenarios limit the market entry for firms, and the intensive margin increases with decreasing variable cost. While our work is agnostic on this point, our use of global data on the effects of EPL on trade flows and the decomposition of these flows into the two relevant margins of trade would represent an improvement in our understanding of how EPL influences trade flows—both in total and by which margin.

3 | METHODOLOGY

3.1 | Log-linear gravity model

Despite the abundance of theoretical literature, empirical studies examining the impact of EPL, or LMR on trade is sparse. Campos and Nugent (2018) suggest lack of data with large coverage while others argue the inability of theory to guide empirics. As pointed out by Huber (2019), empirical

[6]The new entrants, as Dutt et al. (2013) argue, are relatively less productive, or else they would already be exporting and sell less than incumbent firms.

[7]Dutt et al. (2013) find that when productivity (and hence revenue) follow a Pareto distribution, the average does not change as these two effects cancel each other out.

[8]Fernandes et al. (2018) find intensive margin to be an important component in determining trade flows while moving from a Pareto to a log-normal distribution.

studies that do exist either utilise cross-section data with a small number of countries and aggregate exports or often do not control sufficiently for basic gravity controls in a bilateral trade setup. While gravity models are common in the trade literature, they have not been typically employed in the EPL literature, and especially not with dis-aggregated trade data. One such study that utilises both the gravity framework and dis-aggregated trade data, hence similar to our study, is by Huber (2019). However, the primary contribution in our paper is to examine the empirical association between the intensive and extensive export margins and the EPL. Furthermore, we utilise a much more comprehensive index across countries and time while examining this relationship.

The traditional log-linear gravity model of trade augmented with the EPL rigidity index, or the labour market rigidity index and estimated by the Ordinary Least Squares (OLS) method is given as follows:

$$\ln T_{ijt} = \alpha_0 + \alpha_1 LAMRIG_{it} + \beta Z_{ijt} + \sum \alpha_2 EXP_i + \sum \alpha_3 YR_t + \sum \alpha_4 IMP_j{}^{*} YR_t + \epsilon_{ijt} \quad (1)$$

where T_{ijt} represents real bilateral exports from country i (exporter) to country j (importer) in a given year t. Labour Market Legislation Rigidity Index ($LAMRIG_{it}$) is the labour rigidity index for exporter i. It is an index developed by Campos and Nugent (2018) which builds upon the work of Botero et al. (2004). It is an aggregate index, ranging from 0 to 3.5, with higher values reflecting more rigid employment protection laws. The index is measured as 5-year averages from 1950–54 to 2000–04 and covers 145 countries. For example, the index for year 2004 is measured as a 5-year average from 2000 to 2004. A more detailed discussion of this index can be found in the *data* section. Consequently, we utilise export data at 5-year intervals. The average *LAMRIG* value in our sample is 1.49, with the maximum value of 3.5 (Spain in 1980s) and a minimum value of 0 (Australia until 1974).

Z_{ijt} is a vector of control variables commonly incorporated in gravity trade models that serves as proxies for trade costs. These proxies include the natural log of distance between countries i and j, GDP per capita of i and j, population of each country in a country-pair. It also includes bilateral pair dummies such as country pairs using the same currency, having a regional trade agreement, sharing a common language, sharing a common land border or having various types of colonial relationship. EXP_i are comprehensive sets of time-invariant exporter fixed effects that considers any exporter-specific characteristics. Essentially, they account for important geographical, political, cultural or institutional factor that can influence exports and are likely correlated with *LAMRIG*. YR_t are year-specific fixed effects that considers any time-specific common trends or effects (e.g. business cycles, oil price shocks). $IMP_j * YR_t$ represents time-varying importer fixed effects that accounts for the inward 'multilateral trade resistances (MTR)' or its ease of market access as proposed by Anderson and van Wincoop (2003). It also accounts for any other observable and unobserved importer-specific characteristics or policy measures that may influence international trade. For example, it can account for protectionist measures such as average applied tariff rates on imports, manufacturing goods, input markets or any other policies or import-related shocks. A similar time-varying exporter fixed effect is not feasible in this setup since it does not allow for the identification of time-varying variable like $LAMRIG_{it}$. We revisit this issue in Section 6 and explain in detail about its resolution. Finally, the robust standard errors are clustered by country pairs.

Total exports can mask the heterogeneous impact of *LAMRIG* on trade. To uncover this heterogeneity, we utilise the four-digit Standard International Trade Classification (SITC) Revision 2 product-level trade data to construct the extensive and the intensive margins of exports. Total exports T_{ijt} is decomposed into the extensive and intensive margins of exports as follows:

$$\ln T_{ijt} = \ln N_{ijt} + \ln \frac{T_{ijt}}{N_{ijt}} \quad (2)$$

where the product-level extensive margin or export diversification is defined as the log of the number of products that a country i exports to j, N, at a given time t; and the product-level intensive margin or trade intensity is defined as the log of the average volume of exports per product from country i to j over time t, calculated by dividing the total volume of exports (T) by the total number of products exported (N).

According to Dutt et al. (2013), when firms produce differentiated products, these firm-level trade margins translate into product-level trade margins. Therefore, we utilise the product-level trade margin as a proxy for the firm-level trade margin. The methodology we utilise to dis-aggregate total trade flows into the two product-level trade margins is commonly known as the count method and have been adopted by various studies (Bernard et al., 2007; Dutt et al., 2013; Nitsch & Pisu, 2008). We thus contribute to the literature by focusing specifically on the impact of LMR along the extensive and intensive margins of exports.

3.2 | Poisson specification

Although the log-linear gravity model of trade has been widely employed to examine trade flows, some studies (Flowerdew & Aitkin, 1982; Santos Silva & Tenreyro, 2006) argue that the traditional log-linear gravity model leads to biased and inconsistent estimates in the presence of heteroskedastic residuals. Santos Silva & Tenreyro, 2006 argue that, with heteroskedastic errors, the log-linear transformation leads to errors that will generally be correlated with the control variables. This leads to biased estimates of the true elasticities when using the OLS specification. They propose the Poisson pseudo-maximum likelihood (PPML) estimation as an alternate and preferred procedure, which, due to its multiplicative form, does not force higher-order moments into the residuals. Therefore, this procedure provides consistency for estimates and also allows for heteroskedasticity in the residuals (Santos Silva & Tenreyro, 2006).

Following this methodology, the dependent variable, real exports, enters in levels. Under PPML, the augmented model has the following specification:

$$T_{ijt} = \exp\left(\alpha_0 + \alpha_1 LAMRIG_{it} + \beta Z_{ijt} + \sum \alpha_2 EXP_i + \sum \alpha_3 YR_t + \sum \alpha_4 IMP_j{}^* YR_t\right) + \epsilon_{ijt} \quad (3)$$

In addition to the time-invariant exporter and time-variant importer fixed effects, we also repeat the PPML regressions with a comprehensive set of country-pair fixed effects. These fixed effects consider any time-invariant characteristics common to a country pair. Our results are robust to this specification, but they are omitted for space considerations.[9]

Since PPML is a non-linear specification, the decomposition of total exports, T into the extensive and intensive margins of exports has the following specification:

$$T_{ijt} = N_{ijt}{}^* \frac{T_{ijt}}{N_{ijt}} \quad (4)$$

The extensive margin in our specification is a count variable, and count data are intrinsically heteroskedastic with variance increasing with the mean (Cameron & Trivedi, 2001). We utilise the Wald test for group-wise heteroskedasticity for the residuals in the fixed-effect regression model to confirm the presence of heteroskedasticity for total exports and the intensive margin.

[9]These results are available from the authors upon request.

4 | DATA

4.1 | Labour Market Legislation Rigidity Index (*LAMRIG*)

In their seminal paper, Botero et al. (2004) construct an index of the rigidity of employment protection legislation (EPLI) based on the provisions of labour laws for a cross-section of 85 countries. EPLI is an aggregate index, which is an average of the following four sub-indices that captures various aspect of the labour market institution: (a) cost of increasing hours worked, (b) cost of firing workers, (c) dismissal procedures (restrictions on employers for firing workers) and (d) alternative employment contracts (part time/fixed term vs. regular full time). Each sub-indices in turn is a sum of several individual components.[10] EPLI is a time-invariant index that varies from 0 to 1, with higher values indicating stronger employment protection. EPLI increases frictions in the labour market (e.g. restriction of movements between jobs, or barriers to entry in the labour market), which in turn becomes a source of labour market rigidity (LMR).

With the objective of improving data coverage across countries and over time, Campos and Nugent (2018) develop a de-jure index of labour market regulation rigidity (*LAMRIG*) for 145 countries from 1950 to 2004. They construct *LAMRIG* based on two main foundations: Botero et al. (2004) index (EPLI) and labour laws found in NATLEX and other sources.[11] As outlined in Campos and Nugent (2018), after the labour laws are obtained for a particular country, the various provisions of these laws and regulations are then used to construct measures of each of the 36 individual components and sub-indices for that country according to the coding scheme identified by Botero et al. (2004).[12] Most of the individual components are scored on a 0–1 basis based on 'Yes'-'No' answers to questions about the presence of certain restrictive provisions. These are then averaged into the four sub-indices as listed in the EPLI. The sub-indices are then aggregated into a single aggregate index, *LAMRIG*, which is comparable to the EPLI. In fact, one can view *LAMRIG* as an extension to the EPLI index across countries and through time.[13] The authors maintain that they are agnostic on whether higher *LAMRIG* score is either 'good' or 'bad'. However, they state that given the considerable evidence suggesting that higher scores are associated with higher informality or unemployment rates and lower labour force participation rates, they use the term 'reform' to refer to a reduction in these indexes.

In this paper, we utilise *LAMRIG* as a proxy for LMR, which was provided to us by one of the authors—Nauro F. Campos. *LAMRIG*, an aggregate index, ranges from 0 to 3.5, with higher values

[10]For example, the alternative employment contracts measure the existence and cost of alternatives to the standard employment contract. This sub-index is computed as the average of: (a) a dummy variable equal to one if part-time workers enjoy the mandatory benefits of full-time workers; (b) a dummy variable equal to one if terminating part-time workers is at least as costly as terminating full time workers; (c) a dummy variable equal to one if fixed-term contracts are only allowed for fixed-term tasks; and (d) the normalised maximum duration of fixed-term contracts.

[11]NATLEX, the International Labor Organisation (ILO) depository of labor laws, covers more than 150 countries. It is freely available at http://natlex.ilo.org/. It is maintained by the International Labor Organisation (ILO)'s International Labor Standards Department and has extensive and detailed records of most labor laws of more than 150 countries since the late 1940s. They also utilise the World Law Guide (LEXADIN at www.lexadin.nl). LEXADIN is organised by country (and within each country there are relevant entries under 'Labor law').

[12]Campos and Nugent (2018) focused on the entries from the following categories (sub-categories in parenthesis) from NATLEX: (a) Conditions of work (Hours of work, weekly rest and paid leave), (b) Employment security, termination of employment, (c) Conditions of employment (Labor contracts, Wages and Personnel management) and (d) General provisions (Labor codes, general labor and employment acts). The information is then used to construct a measure consistent with the EPLI index in covering their four sub-indices: alternative employment contracts, cost of increasing hours worked, cost of firing workers, and dismissal procedures.

[13]Please refer to Campos and Nugent (2018) for the detailed description of the 5 steps of the *LAMRIG* construction.

TABLE 1 *LAMRIG* over time.

	All countries		OECD countries		Non-OECD countries	
	(1)	(2)	(3)	(4)	(5)	(6)
Year	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
1964	1.144	0.734	0.742	0.742	1.451	0.566
1969	1.275	0.633	0.937	0.758	1.453	0.474
1974	1.384	0.574	1.140	0.734	1.481	0.469
1979	1.481	0.571	1.438	0.846	1.496	0.439
1984	1.510	0.584	1.539	0.895	1.500	0.432
1989	1.540	0.544	1.618	0.791	1.514	0.436
1994	1.594	0.482	1.666	0.641	1.571	0.421
1999	1.605	0.452	1.658	0.568	1.587	0.409
2004	1.584	0.455	1.639	0.573	1.567	0.413
1960–2004	1.491	0.558	1.491	0.558	1.526	0.440

Note: *LAMRIG* of a country in a given year is a 5-year average of the index. For example, USA has *LAMRIG* of 0.653 in 2004, which is a 5-year average of the index from 2000 to 2004. In column 1, mean of *LAMRIG* of 1.144 captures the average *LAMRIG* of all countries in the sample for the year 1964. Similarly, in column 3, mean of *LAMRIG* of 0.742 captures the average *LAMRIG* of all the OECD countries in the sample for the year of 1964.

reflecting more rigid employment protection laws. The index is measured as 5-year averages, and ranges from 1960–64 to 2000–04 and covers 145 countries.[14] For example, *LAMRIG* for the United States in 1994 is 0.653, which is measured as a 5-year average from 1990 to 94. Column 1, in Table 1, presents the average *LAMRIG* scores of *all* countries in the sample across each timeframe in the data set. Notably, it suggests that the index is indeed slow moving, reinforcing the claim by Campos and Nugent (2018) that a longer time frame or coverage of the index becomes pertinent to tease out any variation and to understand the cause and effect of and dynamics of such structural reform. Interestingly, column 1 also suggests that the index has (on average) increased over time, while the standard deviation (column 2) of *LAMRIG* through time has decreased. Although it provides some useful information about the index over time, such aggregation can mask heterogeneity in the index across countries. Appendix Table A1 suggests that there exists considerable heterogeneity in *LAMRIG* scores across countries and through time. Some countries (such as Portugal and France) exhibit significant changes in *LAMRIG* across time, while others (e.g. Oman and Turkey) experience minimal changes over the entire period. Column 3 in Table 1 presents the average *LAMRIG* of OECD countries in the sample through time, while columns 5 pertains to non-OECD countries. While the non-OECD countries start out with an average LAMRIG that is twice as large (1.451 compared to 0.742 in year 1964), the average *LAMRIG* for OECD countries increases substantially over time. In fact, the average *LAMRIG* for the entire sample across both groups are similar.[15] In summary, there are interesting differences in *LAMRIG* over time as well as across countries and across groupings.

A very few labour law rigidity indexes exist that have a reasonable cross-country and time coverage dating back to the late 1980s or beyond. However, these studies are limited to two regions: OECD

[14]Although *LAMRIG* starts from 1950 to 54, we use the index from 1964 due to the data constraint on exports (which starts from 1962 on wards).

[15]It is also worth noting that the standard deviation for OECD countries (column 4) increases over time, while that of non-OECD (column 6) countries remain fairly consistent.

(Blanchard & Wolfers, 2000) and Latin America (Heckman & Pages, 2004). Forteza and Rama (2006) and Rama and Artecona (2000) present a well-known alternative index which is based on the ILO conventions signed by each country. The index has good coverage of more than one hundred countries and over time. However, a major disadvantage of this index, according to Campos and Nugent (2018), is its' static nature with almost no variation over time.[16] Other notable sources exist (e.g. Aleksynska & Schindler, 2011), however, data on countries outside of the two regions (OECD and Latin America) are rather limited in time coverage.

4.2 | Gravity control variables

We utilise an unbalanced panel with 145 countries for the time period 1964–2004 at 5-year intervals. The common gravity control variables such as distance, common border, language and colonial ties are collected from the 'Center for Prospective Studies and International Information (CEPII)'.[17] Appendix Table A3 provides the list of the gravity control variables along with it's definition. The dis-aggregated product-level trade data under the SITC-Revision 2 classification at the 4-digit product level is retrieved from Feenstra et al. (2005).[18] For the year 2004, they use the data from the United Nations Commodity Trade Statistics (UN COMTRADE) database. The SITC classification comprises of approximately 790 product categories. There exists product-level trade data at finer levels of dis-aggregation (6-digit), however, this data set starts from 1995, which would exclude a rich set of trade and *LAMRIG* data.

5 | RESULTS

5.1 | Labour market rigidity (LMR) and trade margins

Results from Table 2, Column 1 shows that countries experience statistically and economically significant declines in total aggregate exports due to a unit increase in *LAMRIG* (and consequently LMR). This finding is robust across both the OLS and PPML specifications. The RESET test, utilised to test for model specification error, provides no evidence against the PPML specification, however, the OLS specification fails the test.[19] Under the PPML specification (Column 4), a unit increase in *LAMRIG* is correlated with a decrease in total aggregate exports of approximately 22%.[20] While a unit increase in *LAMRIG* is fairly large, a more appropriate interpretation would be in terms of a change in the standard deviation. A one standard deviation (0.558 in our sample) increase in *LAMRIG* is associated with a decrease in total exports of 13%.[21] Our finding is consistent with studies that associate a rigid labour market with adverse firm activity, thereby depressing exports. Some examples include a reduction in employment adjustment, which in turn increases firm's adjustment costs (Griffith & Macartney, 2014); decrease in innovation activity

[16]Its static nature comes from the fact that primarily as once any or all such conventions have been signed, they are unlikely to change.

[17]Available at http://www.cepii.fr/CEPII/en/welcome.asp.

[18]The correlation between total exports and *LAMRIG* is – 0.06, between the extensive margin and *LAMRIG* is – 0.03 and – 0.06 between the intensive margin and *LAMRIG*.

[19]The PPML specification passes the RESET test at 10%, 5% and 1% significance level, respectively.

[20]Marginal effects are reported in this section. The formula used in the calculation of the marginal effect using PPML estimation is: $e^{(-0.25)} - 1 = -22\%$. The baseline gravity variables are reported in the results. Other control variables, when significant, have signs consistent with the previous literature.

[21]The formula used in the calculation of the marginal effect using PPML estimation, and with a one standard deviation increase is: $e^{(-0.25*0.558)} - 1 = -13\%$.

TABLE 2 Trade margins and labour market rigidity.

	OLS			PPML		
	Total Trade	Extensive Margin	Intensive Margin	Total Trade	Extensive Margin	Intensive Margin
Dependent variable$_{ijt}$	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
LAMRIG (*it*)	−0.22***	−0.04***	−0.17***	−0.25***	−0.03***	−0.18**
	(0.03)	(0.01)	(0.02)	(0.06)	(0.01)	(0.08)
Log distance	−1.29***	−0.81***	−0.48***	−0.67***	−0.50***	−0.10**
	(0.02)	(0.01)	(0.01)	(0.03)	(0.01)	(0.04)
Log real GDP per capita (exporter)	0.81***	0.40***	0.41***	0.75***	0.17***	0.58***
	(0.03)	(0.01)	(0.02)	(0.05)	(0.01)	(0.07)
Adjusted R^2	0.73	0.78	0.56	0.94	0.80	0.73
Number of observations	88,681	88,681	88,681	88,681	88,681	88,681

Note: Dependent variables are in logs under the OLS specification (columns 1–3) and are in levels under the PPML specification (columns 4–6). All estimates are obtained with year, exporter and importer-year fixed effects. Additional gravity control variables are included but not reported in the table. Variables such as Log real GDP per capita (importer) is absorbed in the importer-year fixed effect. Robust standard errors, clustered by country pairs, are in parentheses. *** $p<.01$, ** $p<.05$, * $p<.10$. The R^2 value for the PPML estimation is a pseudo-R^2, hence not directly comparable to the adjusted R^2 produced by OLS estimation. Interpret with caution.

(Saint-Paul, 1997); or reduced efficiency in reallocation of workers in response to idiosyncratic shocks (Cuñat & Melitz, 2012).

A rigid labour market is known to reduce firm's productivity level and costs. Therefore, it can have important consequences along the trade margins that would otherwise be masked due to aggregation of trade. As we turn to our results along the margins of trade, it is evident that the decrease in total exports is driven primarily by the intensive margin. These results are robust across the OLS and PPML specifications. Under the PPML specification, a one standard deviation increase in *LAMRIG* decreases the extensive margin only marginally (1.7%). Our results are in line with Poschke (2009) who finds that a rigid EPL (and consequently a rigid LMR) discourages entry/exit of less productive firms.[22] However, the intensive margin decreases by approximately 10%. Our results provide evidence to the argument presented by Dougherty et al. (2011) that strict regulation may result in very few large firms concentrating most of the total market production, or a disproportionately large share of smaller, less productive firms as these regulations act as a barrier to becoming large. Some theoretical studies associate the intensive margin with a high variable-trade-cost elasticity, compared with the extensive margin, which may also help explain the disparity in response to a rigid labour market along these margins.[23]

Based on the theoretical predictions of Dutt et al. (2013), as previously discussed, our results suggest that changes in *LAMRIG* represents a variable cost. After all, *LAMRIG* does change over time, albeit slowly. In line with the theoretical prediction, an increase in variable cost leads to a decrease in firm's revenue, and with limited entry/exit of firms, the intensive margin decreases. These findings have important implications for countries with a rigid labour market, especially given the importance of the intensive margin for long-run export growth.

[22]Poschke (2009) develops a model that accounts for firm dynamics and where firms receive idiosyncratic productivity shocks. Under this model, rigid EPL reduces firm value and discourages entry and exit of less productive firms.
[23]Please refer to the theoretical predictions of (Kortum et al., 2011; Ruhl, 2008).

5.2 | Sector-specific goods and trade margins

Is this decrease in total exports, and specifically the intensive margin, primarily driven by labour-intensive goods? It is fair to assume that a rigid LMR affects labour more than other factors of production (capital). If unit labour costs increase with more stringent LMR, it is reasonable to assume that increase in labour cost should affect firms with higher labour shares the most. Thus, the impact is expected to be more pronounced on the labour-intensive production or manufacturing sector.[24]

Next, we examine whether the negative impact on exports of LMR is primarily driven by labour-intensive goods. The United Nations Conference on Trade and Development (2002) categorises total tradable products into 5 categories: primary commodities, labour-intensive and resource-based manufactures, manufactures with low skill and technology intensity, manufactures with medium skill and technology intensity and manufactures with high skill and technology intensity. This categorization is based on the SITC Revision 2 classification at the 3-digit level. A detailed listing of labour-intensive and resource-based manufactures, our proxy for labour and resource intensive products (LRIP), is listed in Appendix Table A4.

Table 3 provides results under the PPML specification for a sample with only labour and resource-intensive goods. Based on our results, it is clear that total aggregation masks important sector-specific dynamics. A one standard deviation increase in *LAMRIG* is correlated with a decrease in total aggregate exports of LRIP by approximately 22% (compared to 13% for all products in Table 2, Column 4). The extensive margin decreases only marginally (1.1%), while the intensive margin decreases by approximately 23% (compared to 10% for all products in Table 2, Column 6). We find that labour-intensive goods are more vulnerable to the LMR, which is driven primarily by the intensive margin.

Are other sectors vulnerable to the LMR? We explore this issue by examining the impact of LMR on all the 'other' product categories except the labour-intensive and resource-based manufactures, which we label as 'non-labor & resource intensive goods' (non-LRIP). We present our findings in Table 3 (columns 4–6). Although the impact on these sectors is relatively small compared to the labour-intensive sector, LMR still affects trade in these sectors negatively and in a significant manner. We find that the negative impact on exports due to LMR is not exclusive to labour-intensive goods. Focusing once again on the PPML results, a one standard deviation increase in *LAMRIG* decreases total trade on these sectors by about 11% (compared to 22% for LRIP), while the intensive margin decreases by approximately 9% (compared to 23% for LRIP).

5.3 | Developed vs. developing countries

Does total aggregate exports (and the margins) behave differently for countries that are relatively high income versus those that are relatively low income? Can a high-income country absorb the negative impact of labour market rigidity relatively better compared to its low-income counterpart? A plausible argument is that high-income countries, with its infrastructure in place along with its institutional efficiency is better equipped to mitigate the negative impact of these labour market rigidities on exports. Consequently, past studies that are limited to OECD countries might have understated the impact of LMR on trade. To examine this potential heterogeneous impact of LMR on exports, we categorise the countries in our sample into two groups: developed and developing countries. Countries are classified as developed if they are labelled as high-income by the OECD. The World Integrated Trade Solutions

[24]Studies (for example, Cuñat & Melitz, 2012) has shown that firms subjected to a more rigid EPL tend to export more capital-intensive goods.

TABLE 3 Labour market rigidity and sector-specific goods.

	LRIP			Non-LRIP		
	Total Trade	Extensive Margin	Intensive Margin	Total Trade	Extensive Margin	Intensive Margin
Dependent variable$_{ijt}$	(1)	(2)	(3)	(4)	(5)	(6)
LAMRIG (*it*)	−0.45***	−0.02**	−0.46***	−0.21***	−0.02**	−0.16**
	(0.10)	(0.01)	(0.11)	(0.05)	(0.01)	(0.07)
Log distance	−0.78***	−0.47***	−0.49**	−0.66***	−0.50***	−0.11**
	(0.04)	(0.01)	(0.03)	(0.03)	(0.01)	(0.04)
Log real GDP per capita (exporter)	0.17*	0.09***	0.27**	0.84***	0.20***	0.59***
	(0.09)	(0.01)	(0.12)	(0.04)	(0.01)	(0.07)
Pseudo R^2	0.91	0.70	0.74	0.94	0.80	0.72
Number of observations	67,723	67,723	67,723	86,809	86,809	86,809

Note: Dependent variables are in levels under the PPML specification. Only the products that are 'labor & resource intensive' goods (LRIP) are included in the regression for LRIP. Non-LRIP contains all the 'other' products besides LRIP. All estimates are obtained with year, exporter and importer-year fixed effects. Additional gravity control variables are included but not reported in the table. Variables such as Log real GDP per capita (importer) is absorbed in the importer-year fixed effect. Robust standard errors, clustered by country pairs, are in parentheses. *** $p<.01$, ** $p<.05$, * $p<.10$. The pseudo R^2 value for the PPML estimation is not directly comparable to the adjusted R^2 produced by OLS estimation. Interpret with caution.

Database (2013) provides us with the list of 34 countries (listed in Appendix Table A2) classified as high income or developed. The rest of the exporters in the sample are categorised as developing countries.[25]

In Table 4, with the PPML specification, our sample includes only the developed countries. We find that a one standard deviation increase in *LAMRIG* decreases total exports by approximately 7% (compared to 13% for all countries in Table 2, Column 4). Again, the decrease is driven exclusively by the intensive margin (7% for developed countries compared to 10% for all countries). These findings suggest that the effects of LMR are not significantly different between developed and developing countries. The negative impact of LMR on the intensive margin is especially relevant for developing countries, primarily since these countries would have had significantly higher export growth were they able to improve their performance with respect to the intensive margin.

6 | INTRA-NATIONAL AND INTERNATIONAL TRADE FLOWS

6.1 | Multilateral trade resistance

In addition to the 'bilateral' trade resistance or the barriers to trade between country i and j, trade flows between countries are also determined by 'multilateral' trade resistance (MTR). MTR captures the barrier that countries i and j face in their trade with all of their trading partners.[26] The so-called 'new' version of the gravity model, developed by Anderson and van Wincoop (2003) argues that

[25]Low and middle-income economies tend to have stricter hiring and redundancy rules, as Almeida and Poole (2017) point out, partially due to the lack of effective mechanisms to protect the income of workers in case of job loss.

[26]Essentially, MTR captures the fact that bilateral trade between two countries depends also on how isolated or remote each country is from the rest of the world.

TABLE 4 Developed countries and trade margins.

PPML specification			
	Total	**Extensive**	**Intensive**
	Trade	**Margin**	**Margin**
Dependent variable$_{ijt}$	**(1)**	**(2)**	**(3)**
LAMRIG (*it*)	−0.13***	0.01	−0.13***
	(0.03)	(0.01)	(0.03)
Log distance	−0.68***	−0.43***	−0.38***
	(0.04)	(0.02)	(0.03)
Log real GDP per capita (exporter)	0.67***	0.25***	0.66***
	(0.05)	(0.02)	(0.07)
Pseudo R^2	0.96	0.80	0.86
Number of observations	36,790	36,790	36,790

Note: Dependent variables are in levels under the PPML specification. Only 'developed' countries are included in the regression OECD 2007. All estimates are obtained with year, exporter and importer-year fixed effects. Additional gravity control variables are included but not reported in the table. Variables such as Log real GDP per capita (importer) is absorbed in the importer-year fixed effect. Robust standard errors, clustered by country pairs, are in parentheses. *** $p < .01$, ** $p < .05$, * $p < .10$. The pseudo R^2 value for the PPML estimation is not directly comparable to the adjusted R^2 produced by OLS estimation. Interpret with caution.

more multilaterally remote countries would trade more with each other, and failure to account for such unobservable MTR controls leads to biased estimates of the coefficients. In a panel data context, the literature has typically utilised time variant country-specific fixed effects (time invariant in a cross-section context) as a proxy for the MTR term. However, as Head and Mayer (2014) point out, implementation of such fixed effects does not allow for the identification of variables that are also country-specific and vary with time (such as *LAMRIG*), as they are perfectly collinear with and absorbed by such fixed effects. Additionally, when a trade equation is estimated with such time varying importer and exporter fixed effects, programs such as Stata can still report estimates with standard errors. However, these estimates will be meaningless.

6.2 | Intra-national trade flows

Recent studies such as Heid et al. (2021) and Beverelli et al. (2018) provide a theoretically consistent adjustment to gravity estimations as a solution. They argue that gravity regressions be estimated with data that also includes 'intra-national' trade flows (non-exported domestic production) in order to allow for the identification of variables like *LAMRIG*. Although the trade-relevant variable only applies to international trade flows, the fixed effects are defined for both international as well as intra-national observations.[27] [28] Including intra-national trade data in gravity equation, as Beverelli

[27]Please refer to Heid et al. (2021) and Beverelli et al. (2018) for a detailed discussion of the identification strategy associated with country specific variables with MTR controls based upon the inclusion of intra-national trade flows for both cross-section and panel data context.

[28]Some studies such as Anderson and Marcouiller (2002) construct bilateral variables of interest as a combination of the importer and on the exporter side. Although this approach can allow estimation with exporter & importer fixed effects, as Beverelli et al. (2018) argue, it does not allow for direct identification of the impact of such variables on international trade and poses a challenge with the interpretation of such estimates on trade.

et al. (2018) point out, ensures consistency with the gravity theory; leads to theoretically consistent identification of the effects of bilateral policies; and enables to capture the effects of globalisation on international trade. They further argue that the database needs to include consistently constructed international and intra-national manufacturing trade flows.[29] International trade flows is represented by total manufacturing exports, while intra-national trade flows are calculated as the difference between total manufacturing production and total manufacturing exports. Both variables are reported on a gross basis to ensure consistency between international and intra-national trade flows.[30]

6.3 | Results

To identify the impact of LMR on trade flows with MTR controls, we utilise an aggregate panel data set with international and intra-national manufacturing trade flows for 69 countries over the period 1986–2006. This data set is available from Yotov et al. (2016), which was constructed and provided to them by Thomas Zylkin. Since our variable of interest is only available for every 5-year interval, we utilise this data set from 1989 to 2004, at 5-year intervals (*LAMRIG* data does not cover the year 1986).[31]

In Table 5, Column 1, the dependent variable includes only aggregate total manufacturing exports for these 69 countries. The impact of increased LMR on total manufacturing trade flows is fairly similar to the one obtained in Table 2 (PPML specification). In order to identify the impact of LMR on trade flows with MTR controls, we include both international and intra-national trade flows in the dependent variable in Columns 2–3. In Column 2, the variable 'International' is a dummy variable that equals to one for international trade flows and zero otherwise. The variable 'Lamrig International' is an interaction between our LMR index-*LAMRIG* and the International dummy variable, which captures the impact of LMR on international trade. As the interaction term is equal to zero for intra-national trade, the inclusion of these two variables allow for the identification of the impact of LMR on international trade relative to internal trade even with MTR controls, which applies to both international and intra-national trade flows.[32] We also include a series of time-varying border or international dummies, which according to Beverelli et al. (2018) are designed to capture any globalisation effects, such as technology and innovation. Omission of such dummy variables is known to lead to biased estimates.[33] Results from Column 2 indicate that border has a significant impact on international trade and as a result of globalisation, has fallen over time. Focusing our attention on the interaction term (Lamrig International) in Column 2, the impact of LMR on trade is robust, but more importantly, even bigger in magnitude with the inclusion of

[29]Availability of reliable data on intra-national trade flows led Beverelli et al. (2018) to the use of data on total manufacturing observations.

[30]Heid et al. (2021) mention that while it is tempting to obtain aggregate domestic production as the difference between GDP and total exports, they do not recommend this approach due to the inconsistency between the measure of GDP as value added and the measure of total exports as gross value.

[31]As mentioned before, our variable of interest is only available for every 5-year intervals. Yotov et al. (2016) confirm that gravity estimates obtained with 3- and 5-year interval trade data are very similar, while estimations performed with panel samples pooled over consecutive years produce suspicious estimates of the trade cost elasticity parameters.

[32]Please refer to Beverelli et al. (2018) for a detailed discussion for the inclusion of these variables and identification strategies.

[33]Due to perfect collinearity with the rest of the fixed effects, it is not possible to estimate these international border dummies for all the years in the sample. International border dummy for year 2004, International 2004 is dropped from specification. Hence, the estimated coefficients of the other border/international dummy variables, according to Yotov et al. (2016) can be interpreted relative to the corresponding estimate for the year 2004, which is essentially the 'International' dummy. Therefore, the coefficient on international dummies decrease over time.

TABLE 5 International and intranational trade—MTR controls.

	(1)	(2)	(3)
LAMRIG (*it*)	−0.20***		
	(0.06)		
International		−2.39***	
		(0.19)	
Lamrig International		−0.85***	−0.20*
		(0.09)	(0.11)
International 1989		−0.39***	−0.56***
		(0.06)	(0.04)
International 1994		−0.15***	−0.35***
		(0.04)	(0.03)
International 1999		−0.05	−0.13***
		(0.02)	(0.02)
Log distance	−0.65***	−0.49***	
	(0.03)	(0.05)	
Log real GDP per capita (exporter)	0.72***		
	(0.13)		
Log real GDP per capita (importer)	0.73***		
	(0.10)		
Intra-national trade flows		Yes	Yes
Year effects	Yes		
Exporter and Importer fixed effects	Yes		
Exporter-year and Importer-year fixed effects		Yes	Yes
Country-pair fixed effects			Yes
Pseudo R^2	0.93	0.98	0.99
Number of observations	17,076	17,457	17,205

Note: Dependent variables are in levels under the PPML specification. Data set is obtained from Yotov et al. (2016) consisting of aggregate manufacturing sector for 69 countries. Dependent variable in columns 2–3 contain intra-national and international trade flows. Additional gravity control variables are included but not reported in the table. Robust standard errors, clustered by country pairs, are in parentheses. *** $p<.01$, ** $p<.05$, * $p<.10$. The R^2 value for the PPML estimation is a pseudo-R^2, hence not directly comparable to the R^2 produced by OLS estimation. Interpret with caution.

MTRs and intra-national trade flows. A one standard deviation increase in *LAMRIG* is correlated with a decrease in total manufacturing exports of approximately 36% relative to intra-national manufacturing trade flows.[34]

Beverelli et al. (2018) argue for the inclusion of country-pair fixed effects to comprehensively control for all observable and unobservable bilateral trade frictions, and as demonstrated by Baier and Bergstrand (2007), to mitigate possible endogeneity concerns with respect to the bilateral policy

[34]The formula used in the calculation of the marginal effect using PPML estimation, with a one standard deviation of is: $e^{(-0.85*0.53)} - 1 = -36\%$.

covariates in gravity equations.[35] Column 3 reports the results with the inclusion of country-pair fixed effects. Our estimate of *LAMRIG* on trade is now smaller in magnitude and has lower statistical significance. As Beverelli et al. (2018) point out, the natural explanation for such result in the presence of the country-pair fixed effects is that the identification of the effects of variables such as *LAMRIG* is due to the time variation of the variable. Such variation, given the short sample period and the slow-moving nature of the variable, is not very large. Essentially, on average, the time variation in the *LAMRIG* over the period of investigation is not enough for identification purposes.[36] Nonetheless, it is rather encouraging that we obtain negative effects of LMR on trade, even in a very demanding panel setting with such a rich structure of fixed effects.

6.4 | Industry-level trade margins

The use of intra-national and international data set in aggregate form entails that we cannot examine the impact along the trade margins. To address this issue, we utilise another data set—the International Trade and Production Database for Estimation (ITPD-E), which we obtained from Borchert et al. (2021). This data set is constructed at the industry level covering the broad sectors of agriculture, mining and energy, manufacturing and services. The ITPD-E data set provides information for 243 countries, 170 industries which includes 26 industries in agriculture, 7 in mining and energy, 120 in manufacturing, and 17 in services and includes both intra-national (domestic) as well as bilateral or international trade flows. Although the data set covers the years 2000–2016, we are only able to use the information from the year 2004 due to the data limitation of our variable of interest (*LAMRIG*). Hence, we utilise a cross-section data, where we use industry-level trade data (as opposed to product-level trade data) to construct the extensive and the intensive margins of exports at both the intra-national and international level. We must acknowledge that trade margins at the industry level can greatly reduce variation that is prevalent in a highly dis-aggregated product-level trade data. The results are summarised in Table 6. We examine the relationship utilising 'all sectors' and one with only 'manufacturing' sector. In the cross-section context, time-invariant exporter and importer fixed effect serve as MTR controls. Although bilateral country-pair fixed effects cannot be implemented in cross-section data, we include standard country pair gravity controls to reduce the scope for omitted variable bias. Our results remain robust- increase in *LAMRIG* reduces trade and is primarily driven by the intensive margin.

7 | LABOUR MARKET RIGIDITY AND TRADE MARGINS—AN ESTIMATE OF CAUSAL RELATIONSHIP

Thus far, we have presented a robust and negative correlational evidence between LMR and exports, which is driven almost exclusively by the intensive margin. In this section, we estimate the relationship of LMR on exports (and the margins) by conducting a generalised difference-in-differences (DID) analysis. To do so, we focus on a sample of OECD countries. It is reasonable to assume that OECD

[35]According to Beverelli et al. (2018), this method should deliver proper estimates without the need to use instrumental variables, should there be any endogeneity concerns.

[36]Beverelli et al. (2018) find a large and significant impact of institution on international trade relative to intra-national trade flows without the inclusion of country-pair fixed effects. However, once they account for country-pair fixed effects, the magnitude and significance with the OLS specification decrease greatly. Additionally, with the PPML specification and country-pair fixed effects, the average impact of institution is not significant.

TABLE 6 International and intra-national trade: ITPD-E data set.

	All sectors			Manufacturing only		
	Total Trade	Extensive Margin	Intensive Margin	Total Trade	Extensive Margin	Intensive Margin
Dependent variable$_{ijt}$	(1)	(2)	(3)	(4)	(5)	(6)
International	−2.31***	1.89***	−2.41***	−1.73***	1.73***	−1.78***
	(0.14)	(0.29)	(0.17)	(0.18)	(0.30)	(0.19)
Lamrig international	−0.90***	−0.43**	−1.00***	−0.84***	−0.33*	−1.02***
	(0.06)	(0.17)	(0.08)	(0.09)	(0.18)	(0.08)
Log distance	−0.61***	−0.37***	−0.69***	−0.60***	−0.36***	−0.66***
	(0.04)	(0.01)	(0.04)	(0.05)	(0.01)	(0.05)
Intra-national trade flows	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-year & Importer-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.99	0.68	0.92	0.97	0.62	0.86
Number of observations	21,975	21,975	21,975	21,591	21,591	21,591

Note: Dependent variables are in levels under the PPML specification. Data set is obtained from Borchert et al. (2021) for the year '2004'. Dependent variable contains both intra-national and international trade flows. Country-pair fixed effects cannot be implemented in cross-section data. Additional gravity control variables are included but not reported in the table. Robust standard errors, clustered by country pairs, are in parentheses. *** $p<.01$, ** $p<.05$, * $p<.10$. The R^2 value for the PPML estimation is a pseudo-R^2, hence not directly comparable to the R^2 produced by OLS estimation. Interpret with caution.

countries are similar with each other compared to the rest of the world. After-all, entry into the OECD is not a simple formality but is contingent upon a rigorous review process. According to OECD (2017), member or prospective countries must demonstrate strict commitment to the values of democracy based on the rule of law and human rights, and adherence to open and transparent market-economy principles. Within this group, we focus on the European OECD countries.[37] In addition to shared borders and close proximity, these countries also share many unobserved similarities that can affect trade flows (such as trade costs, institutional factors, climate and cultural and regional factors among others). They are also similarly distant from other trade partners and have similar domestic policies. These similarities among the countries in the sample enables us to better examine the impact of LMR on trade flows by accounting for unobserved characteristics that may be time variant or otherwise.

7.1 | Difference-in-difference estimation

The DID approach makes use of treatment and control groups to obtain an appropriate counterfactual to estimate a causal effect. It is designed to estimate the effect of a specific intervention or treatment by comparing the changes in outcomes over time between a population that is subjected to a programme (the treatment group) and a population that is not (the control group). In a traditional DID setup, the treatment or the intervention is distinct and discrete. For example, in the context of gravity model of trade, Cho et al. (2022) utilise this approach to examine the impact of free trade agreements (FTA) on trade flows, where a country's period of entry into an FTA is the treatment. The DID approach is challenging with continuous variables, and specifically arduous if it is a macroeconomic variable.

[37]Table A2 provides the list of such countries.

In our setup, the treatment variable (the LMR index or *LAMRIG*) is continuous and by no means distinct as every country in the sample has a non-zero *LAMRIG* (Australia until 1974 being the only exception). Although slow moving, *LAMRIG* fluctuates through time for any given country with few exceptions. This situation requires some creative measures to divide the sample into the treatment and the control group, as well as to define an appropriate intervention or treatment.

To create the treatment and control group in our sample of European OECD countries, we rely on changes in *LAMRIG* over time. We first generate a variable, *δLAMRIG*, which captures absolute change in *LAMRIG* for countries across two time-period.[38] We then categorise the treatment group as countries that experience a 'large' change in *LAMRIG* at some point in time. A change in *LAMRIG* is considered 'large' (in a given time-period) when the value of that change lies in the 90^{th} percentile or higher of the distribution of *δLAMRIG*. This large change corresponds to *δLAMRIG* value of greater than 0.507. Therefore, $Treated_i$ or the treatment group represents a dummy variable, which equals 1 for countries that experience such large changes at any given point in time and 0 otherwise. Additionally, all the countries in the treatment group experience a large *increase* in *LAMRIG* (as opposed to a large decrease) while exceeding this threshold.[39] Countries that do not experience such 'large' changes in *LAMRIG* at any point in time is defined as the control group. Countries in the control group experience significantly less changes in *LAMRIG* over time. For example, the average *δLAMRIG* for the treatment group is 0.23, while that for the control group is only 0.09. This further highlights the slow-moving nature of the index over time. The list of countries in the treatment and the control group are presented in Appendix Table A2.

To estimate the impact of LMR on trade flows, we employ the PPML specification following the DID estimation as proposed by Card and Krueger (1994):

$$T_{ijt} = \exp\Big(\alpha_0 + \beta_1 Treated_i + \beta_2 Intervention_{it} + \beta_3 Treated_i{}^* Intervention_{it} + \beta Z_{ijt} + \sum \alpha_1 EXP_i + \sum \alpha_2 YR_t + \sum \alpha_3 IMP_j{}^* YR_t\Big) + \epsilon_{ijt} \quad (5)$$

We then define $Intervention_{it}$ as a dummy variable that takes the value of 1 when a country first exceeds *δLAMRIG* value of 0.507. Once a country exceeds this threshold, the dummy variable takes a value of 1 throughout the remainder of the time period. $Treated_i{}^* Intervention_{it}$ is a dummy variable that takes the value of 1 when the outcome is observed in the treatment group and after the intervention, and 0 otherwise. Therefore β_3 is the difference-in-difference coefficient, and our coefficient of interest. In our setup, β_3 captures the difference between countries that experience a 'large' change in *LAMRIG* at some point in time (the intervention), compared to the countries (or control group) that never experience such 'large' changes in *LAMRIG*.

7.2 | Results

We present our findings in Table 7. $Treated_i{}^* Intervention_{it}$, which is the DID coefficient, is negative and statistically significant for total trade flows (Column 1). Countries that experience large increase in their *LAMRIG* over time experience a decrease in total aggregate exports by approximately 10.4%

[38]For example, *LAMRIG* for Austria in 1969 is 0.24, and 0.80 in year 1974. This corresponds to a value of 0.56 for *δLAMRIG* for Austria in year 1974.

[39]One exception is the Czech Republic. Although it meets the criteria of having $LAMRIG - Diff$ greater than 0.507, it is the only country that experiences a large *decrease* in *LAMRIG*. Furthermore, *LAMRIG* for the Czech Republic is constant for majority of the time-period before experiencing a large decrease. We therefore exclude the Czech Republic from the treatment group and the sample.

compared with the control group or countries that do not ever experience such large changes. In line with our previous findings, this decrease in total exports is driven primarily by the intensive margin (Column 3). The intensive margin decreases by approximately 16%. These results are similar in magnitude compared with the impact of LMR on developed economies (Table 4). Therefore, we are now able to provide some evidence of causal relationship between labour market rigidity and trade (and the margins), in addition to the robust correlational evidence presented before.

7.3 | Event study

An event study is utilised to examine the potential differences between the treatment and control groups at different points in time, and before and after the intervention. Consequently, an event study can be viewed as a difference-in-difference estimation that examines the difference in trade flows across the treatment and control groups for each time-period relative to the baseline difference in time-period immediately before the intervention. To conduct an event study and to construct an event study graph, we generate lags and leads for the time-period of intervention. We replace the $Treated_i$, $Intervention_{it}$ and $Treated_i{}^{*} Intervention_{it}$ variables in Equation (5) with a dummy variable for the time-period of intervention along with its' lags and leads over various time-periods. Our reference category is the time-period right before the intervention.

As mentioned previously, we utilise an unbalanced panel from 1964 to 2004 at 5-year intervals resulting in a total of only 9 such time-periods. As such, the difference between two time-periods in our data set is 5 years. Again, this limitation is due to the *LAMRIG* variable, which is measured as 5-year averages. We present our findings in Figure 1. In line with our previous results, we find that large changes in *LAMRIG* reduces total exports for a given country. Estimate for the time-period before the treatment (or 10 years leading up to the intervention) is statistically insignificant at the 5% significance level and close to 0 between the treatment and control groups as compared to the reference time-period (5 years prior to the treatment). All estimates from the year of intervention (year 0 in the graph) and beyond are statistically significant and negative. The treatment group experiences an 8% decrease in exports compared to the control group in the year of treatment, while this difference increases to 11%, 10 years after the treatment.

TABLE 7 Difference-in-difference estimation.

	Total trade	Extensive margin	Intensive margin
Dependent variable$_{ijt}$	**(1)**	**(2)**	**(3)**
$Treated_i$ * $Intervention_{it}$	−0.11***	0.08***	−0.17***
	(0.04)	(0.01)	(0.04)
Log distance	−0.71***	−0.28***	−0.60***
	(0.08)	(0.03)	(0.08)
Log real GDP per capita (exporter)	0.55***	0.24***	0.26**
	(0.09)	(0.02)	(0.11)
Pseudo R^2	0.96	0.82	0.90
Number of observations	26,325	26,325	26,325

Note: Dependent variables are in levels. All estimates are obtained with year, exporter and importer-year fixed effects. Additional gravity control variables are included but not reported in the table. Variables such as Log real GDP per capita (importer) is absorbed in the importer-year fixed effect, while the '$Treated_i$' variable is absorbed in the exporter fixed effect. '$Intervention_{it}$' is dropped due to collinearity. Robust standard errors, clustered by country pairs, are in parentheses. *** $p < .01$, ** $p < .05$, * $p < .10$.

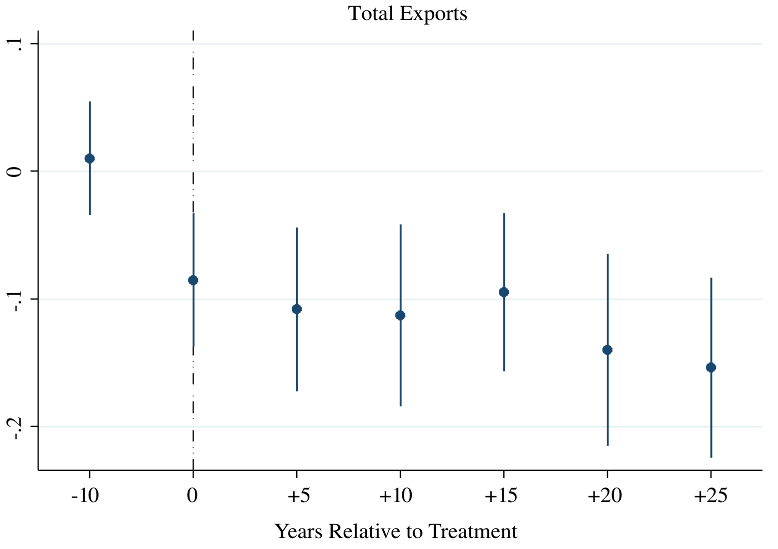

FIGURE 1 *Total exports* Notes: −5 is the reference group or the comparison time period. A horizontal line at 0, or the start of the event helps us visualise the impact of the event across time periods relative to the reference group. [Colour figure can be viewed at wileyonlinelibrary.com]

We must point out that an event study is primarily designed for annual or quarterly data and without strong limitations in time periods. Therefore, our situation may not be ideal for an event study. For example, most of the intervention for the countries in the treatment group occur during the 1970s, which gives us only 2 time-periods (or 10 years) before the treatment. In an ideal setting for an event study, there will be sufficient number of treated units for each time-period. With very few treated units at a given time-period, it is recommended to bin the relative time-periods and assume constant treatment effects within the bin. As such, we assume a constant treatment effects for such prior time-periods.

8 | DISCUSSION, EXTENSION AND LIMITATIONS

The purpose of the paper was to provide empirical results on how EPL, and consequently LMR affects trade flows on a global basis. The previous literature on LMR and trade was focused on aggregate trade flows for a single country or a limited set of countries. A gravity model of trade augmented by an EPL variable was estimated for world trade for 4-digit SITC product categories. Controlling for the usual factors in the literature, we find that LMR depresses the volume of trade on a global basis. Furthermore, we decomposed the data in two ways. First, we show that the effects of LMR are more pronounced for labour-intensive products. We also find that the effects are not significantly different for developing and developed countries. The issue of how these changes in trade flows occur is covered considering the extensive versus intensive margins of trade. We find that most of the adjustments from LMR occurs at the intensive margin. Finally, we estimate a causal effect of LMR on trade using the generalised DID approach with a sample of European OECD countries. Our results remain robust.

Our results still leave some questions unanswered. Our results are dependent on one definition of https://www.overleaf.com/project/619d5a5914f0b05f65bdf955 LMR. The *LAMRIG* data set is an index of EPL. To that extent the results may be influenced by two things. Many of the papers in the literature focus not on EPL overall as defined above but more narrowly focus on firing costs which is a subset of EPL. It would be optimal to have both other EPL data sets to use and/or restrict the analysis to firing costs both to confirm these results and perhaps determine how different aspects of EPL affect trade flows. A further limitation of *LAMRIG* is that the data set is truncated in 2004. Future research on these issues using another EPL data set will be forthcoming. In a policy sense, there seems to be a growing sense that EPL as a policy may carry a number of costs that are not immediately obvious. The macroeconomic costs are well documented and recent literature indicates that there is a substantial cost in terms of resource misallocation, loss of productivity and slower economic growth. Previous research and our results indicate there are other costs in terms of international trade. This may be particularly true for the developing countries which are least capable of bearing that cost.

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DATA AVAILABILITY STATEMENT

Annual data are collected from various sources. The common gravity control variables such as distance, common border, language, and colonial ties are collected from the "Center for Prospective Studies and International Information (CEPII)" (link: http://www.cepii.fr/CEPII/en/welcome.asp). The dis-aggregated product level trade data under the SITC-Revision 2 classification at the 4-digit product level is retrieved from Feenstra et al. (2005). For the year 2004, they use the data from the United Nations Commodity Trade Statis-tics (UN COMTRADE) database. Our main variable of interest, *LAMRIG* is provided to us by one of the authors of the index-Campos & Nugent, 2018. The aggregate panel data-set with international and intra-national manufacturing trade flows for 69 countries over the period 1986–2006 was retrieved from Yotov et al. (2016), which was constructed and provided to them by Thomas Zylkin. Lastly, the International Trade and Production Database for Estimation (ITPD-E) was obtained from Borchert et al. (2021).

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APPENDIX A

TABLE A1 Heterogeneity in *LAMRIG* across countries.

Year	Portugal	France	Ireland	Poland	Oman	Turkey
1964	0.066	0.194	0.068	2.500	–	1.740
1969	0.315	0.618	0.257	2.500	–	1.740
1974	1.279	0.968	0.487	2.500	–	1.740
1979	2.295	1.451	0.717	2.500	1.260	1.740
1984	2.295	1.935	0.947	2.500	1.260	1.740
1989	2.394	1.861	0.947	2.500	1.260	1.740
1994	2.492	2.233	0.933	2.320	1.260	1.740
1999	2.426	2.233	1.028	2.320	1.300	1.740
2004	2.426	2.233	0.899	2.100	1.330	1.690

Note: *LAMRIG* of a country in a given year is a 5-year average of the index. For example, Portugal has *LAMRIG* of 2.426 in 2004, which is a 5-year average of the index from 2000 to 2004.

TABLE A2 List of developed countries.

Australia	Austria[a,b]	Belgium[a,b]	Canada
Chile	Denmark[a,b]	Estonia[a,c]	
Finland[a,b]	France[a,c]	Germany[a,c]	Greece[a,b]
Hungary[a,c]	Iceland[a,c]	Ireland[a,c]	Israel
Italy[a,b]	Japan	Korea, Rep.	Luxembourg[a,c]
Mexico	Netherlands[a,c]	New Zealand	Norway[a,b]
Poland[a,c]	Portugal[a,b]	Slovak Republic[a,c]	Slovenia[a,c]
Spain[a,b]	Sweden[a,b]	Switzerland[a,c]	Turkey[a,c]
United Kingdom[a,b]	United States		

Source: World Integrated Trade Solutions Database (2013).

[a]Denotes the list of European OECD countries.

[b]Denotes countries in the treatment group.

[c]Denotes countries in the control group.

TABLE A3 Data appendix.

Trade data is collected from Feenstra et al. (2005). The dis-aggregated product-level trade data is based on the SITC-Revision 2 classification at the 4-digit product level. Data for control variables are from the 'Center for Prospective Studies and International Information (CEPII)'. (http://www.cepii.fr/CEPII/fr/bddmodele/presentation.asp?id = 6)
LAMRIG it: Obtained from one of the authors of the index- Nauro F. Campos
Total exports: Real value of exports (free on board, FOB) from exporter i to importer j, measured in millions of US dollars
Extensive margin: Number of products exported from country i to country j

(Continues)

TABLE A3 (Continued)

Intensive margin: Volume of exports (in millions of US dollars) per product from country i to country j
Distance: Log of the distance between country i and country j
Population: Thousands of people (measured in logs for empirical analysis)
Real GDP per capita: Log of annual real GDP per capita
Strict currency union: Equal to 1 if each country in a bilateral trading relationship share a common currency at time t
Common language: Equal to 1 if each country in a bilateral trading relationship share a common language
Regional trade agreement: Equal to 1 if each country in a bilateral trading relationship have a RTA at time t
Common border: Equal to 1 if each country in a bilateral trading relationship share a border
Colony: Equal to 1 if each country in a bilateral trading relationship were ever in a colonial relationship
Common colony: Equal to 1 if both country has a common coloniser post 1945
Current colony: Equal to 1 if both country are currently in a colonial relationship

TABLE A4 Product classification for labour and resource intensive products.

SITC Code	Product name (SITC nomenclature)
846	Undergarments, knitted or crocheted
612	Manufactures of leather or of composition leather, n.e.s.
844	Undergarments of textile fabrics
655	Knitted or crocheted fabrics
821	Furniture and parts thereof
843	Outer garments, women's, of textile fabrics
635	Wood manufactures, n.e.s.
847	Clothing accessories of textile fabrics
657	Special textile fabrics and related products
664	Glass
642	Paper and paperboard, cut to size or shape
845	Outer garments and other articles, knitted
842	Outer garments, men's, of textile fabrics
633	Cork manufactures
611	Leather
658	Made-up articles, wholly or chiefly of textile materials
894	Baby carriages and toys
831	Travel goods, handbags, briefcases, purses and sheaths
656	Tulle, lace, embroidery, and small wares
663	Mineral manufactures, n.e.s.
848	Articles of apparel and clothing accessories, non-textile
641	Paper and paperboard
653	Fabrics, woven, of man-made fibres
634	Veneers, plywood, improved or reconstituted wood
665	Glassware
851	Footwear

TABLE A4 (Continued)

SITC Code	Product name (SITC nomenclature)
654	Textile fabrics, woven, other than cotton man-made fibres
667	Pearls, precious & semi-precious stones, unworked/worked
652	Cotton fabrics, woven
662	Clay construction and refractory construction materials
661	Lime, cement, and fabricated construction materials
651	Textile yarn
666	Pottery
659	Floor coverings
613	Fur skins, tanned or dressed, pieces or cuttings of fur skin