Global Demand Shocks, Firm Responses, and Worker Outcomes

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Abstract

This paper studies how the nature of export-demand shocks shapes the adjustment of firms and workers. Using Canadian linked employer–employee data for 2005–2019, I construct firm-specific exposure to global demand shifts during the Great Recession and develop a decomposition of export shocks into destination-wide, product-wide, and firm-specific components. Destination shocks have much larger and more persistent effects than product shocks, reducing firm exports by about 0.7 percent and employment by 0.2 percent per one percent decline in foreign demand, roughly twice the impact of product shocks. Destination shocks also induce firms to diversify across markets, while product shocks lead to scope contraction. Despite firm recovery, workers experience lasting income losses. A one percent drop in destination demand lowers long-run earnings by about 0.3 percent, with product and firm-specific shocks generating effects about half as large. These patterns reflect the spatial correlation of destination shocks, which strike many local employers at once and prolong workers' losses. Although destination shocks account for a smaller share of total demand variation, their per-unit impact is far larger, revealing a structural vulnerability to concentration in a few export markets.

Keywords: export shocks; firm adjustment; worker earnings; Great Recession; local labour markets
JEL Codes: F16, F14, L25, J31, R23

1 Introduction

International trade connects firms and workers to global markets but also exposes them to global downturns. Trade in goods and services accounts for roughly 55–60 percent of GDP across OECD economies, underscoring how strongly production and employment depend on foreign demand (World Bank, 2024). When foreign demand contracts, exporters face lost orders, reduced production, and uncertain employment. The 2008–2009 Great Recession

made this vulnerability clear, as the collapse in global trade forced even the most competitive exporters to scale back activity. Much of what we know about trade shocks comes from import competition, where foreign goods displace domestic output through consumer substitution and industry-level price competition (Autor et al., 2013; Bloom et al., 2015; Pierce and Schott, 2016). Export-demand shocks are structurally different: they reduce firms' order books from foreign buyers, which compresses output, cash flow, and employment at producing firms and their suppliers. The mechanism is production-side and order-driven, not consumer-side substitution.

While trade shocks have been widely studied, most work treats export shocks as a single, undifferentiated phenomenon. Yet a firm's export sales can fall for very different reasons. A product may lose global demand, or a key destination market may fall into recession. These distinct forces create different adjustment paths: product shocks may push firms to narrow their range of goods, whereas destination shocks may lead them to reorient across markets. Whether the source of the shock is sectoral or geographic may therefore determine how strongly firms and workers are affected and how long the effects last. This raises a central question: how do different sources of external demand shocks, by destination, product, or firm-specific exposure, shape the adjustment of firms and the long-run outcomes of their workers?

I study this question using linked employer-employee data that follow all incorporated firms and their workers from 2005 to 2019, combined with detailed export records by product and destination. I construct firm-level exposure to global demand shifts during the Great Recession by interacting each firm's pre-recession export shares with subsequent changes in foreign import demand. This framework isolates variation in external demand that is plausibly exogenous to firm outcomes. My central methodological contribution is to construct a firm-specific export-demand shifter and decompose it into three components: a destination-wide shock (e.g., a partner-country recession), a product-wide shock (e.g., the global collapse in demand for a specific product), and a firm-specific residual. This decomposition identifies

how different sources of external demand affect firms' output, employment, and productivity, and how these shocks transmit to workers' earnings and employment over more than a decade. I also separate each worker's exposure into a local-market average and a firm-level deviation from that average, allowing me to quantify how spatially correlated shocks across nearby employers amplify aggregate effects.

The source of the shock dictates how firms adjust. A one percent decline in *destination demand* reduces firm exports by about 0.7 percent and employment by roughly 0.2 percent in the short run, while an equivalent fall in *product demand* cuts exports by 0.3 percent and employment by 0.1 percent. Destination shocks' effects persist for nearly a decade, whereas product and idiosyncratic effects fade after a few years.

When destination markets contract, firms scale down exports per destination but often maintain or expand the number of markets they serve, reallocating sales toward more stable partners. Value added per worker rises as firms recover through diversification, suggesting efficiency gains among survivors. Product shocks, in contrast, compress scope, leading firms to drop products and reduce sales across destinations. These patterns show that firms recover mainly through reallocation and scope adjustment rather than by returning to their pre-crisis scale.

Firms' recovery contrasts sharply with the experience of their workers. A one percent drop in destination demand for a worker's pre-recession employer lowers a worker's long-run earnings by about 0.3 percent, with losses that persist for more than a decade. Product and idiosyncratic shocks also reduce earnings permanently, though roughly half the size of the destination shocks. These results show that while firms gradually rebuild, many of their original workers do not. The coexistence of firm recovery and worker persistence creates a puzzle for understanding adjustment to external demand shocks.

To better understand this asymmetry, I distinguish between sparse and spatially concentrated shocks. Workers in local markets where many firms face similar destination shocks experience larger and longer-lasting losses, consistent with weaker outside options. The

losses are concentrated among displaced workers who separate from their initial firms, while stayers experience little to no decline. Job loss, rather than within-firm wage adjustment, is the main channel. A worker's outcome aligns more with the average shock in the local market than with their own firm's deviation from that average, confirming that spatially correlated downturns drive most of the long-run earnings losses.

Finally, these results reveal a structural vulnerability for open economies. Destination shocks account for a smaller share of total demand variation but have far larger and more persistent effects per unit of exposure. Aggregate export figures can therefore mask a hidden exposure to correlated destination-specific downturns, which ultimately impose the most persistent costs on workers.

Most evidence on trade shocks comes from import competition, where foreign goods replace domestic output through consumer substitution and price competition (Autor et al., 2013; Bloom et al., 2015; Pierce and Schott, 2016). Existing research on export shocks typically analyses aggregate or product-level demand changes (Berman et al., 2012; Bastos et al., 2018; Mayer et al., 2014) or decomposes them into product-wide and firm-specific components (Garin and Silvério, 2023). When most sellers of a good concentrate sales in the same destination, however, product-level shocks can conflate geographic and sectoral variation, overstating sectoral exposure while masking geographic concentration.

I address this limitation by developing a decomposition of total export-demand shocks into destination-specific, product-specific, and firm-specific components. The destination component captures geographically correlated downturns that product-based approaches cannot isolate. This decomposition reveals that destination shocks drive the largest and most persistent firm responses, leading to sharp reductions in exports, sales, and employment, while product shocks play a smaller role.

The same framework allows me to trace how these shocks transmit to workers. A large literature on import exposure documents persistent earnings losses and slow reallocation in advanced economies (Autor et al., 2013, 2021; Dauth et al., 2014, 2021; Dix-Carneiro

and Kovak, 2017; Hakobyan and McLaren, 2016; Kovak, 2013; Menezes-Filho and Muendler, 2011), yet we know far less about how export-demand contractions affect workers through their employers. Evidence from linked data shows that exporters pay wage premiums (Amiti and Davis, 2011) and that displaced workers from exporting or offshoring firms face long-term earnings losses (Hummels et al., 2014), but it remains unclear which components of external demand drive these outcomes.

By linking the three-way decomposition of firm-level shocks to matched employer-employee records, I show that destination shocks cause the largest and most persistent earnings and employment losses, while product and idiosyncratic shocks also have smaller but lasting effects. This divergence arises because destination shocks are spatially correlated: they hit many local employers at once, compressing workers' outside options. Consistent with this mechanism, the earnings losses are concentrated among workers who leave their initial firms, and local-market shocks explain more of the variation in worker outcomes than firm-specific shocks.

Theory predicts that exposure to foreign markets induces reallocation, with less productive firms exiting and more productive firms expanding or adjusting scope (Bernard et al., 2007b; Eckel and Neary, 2010; Melitz, 2003). Evidence shows that trade liberalisation raises productivity and shifts activity toward more efficient producers (Bernard et al., 2007a; Bustos, 2011; Lileeva and Trefler, 2010; Pavcnik, 2002). Yet in downturns some firms rationalise by narrowing product lines (Mayer et al., 2014), while others diversify across products or destinations to stabilise activity (Behrens et al., 2013; Kramarz et al., 2020; Vannoorenberghe, 2012; Zouheir et al., 2023). By separating destination- from product-driven shocks, I show that destination shocks tend to trigger geographic diversification, whereas product shocks lead to scope concentration, clarifying why adjustment margins differ across episodes and sectors.

Recent work links granular shocks to aggregate volatility and risk concentration in global trade (di Giovanni et al., 2014; Gabaix, 2011; Kramarz et al., 2020). I extend this perspec-

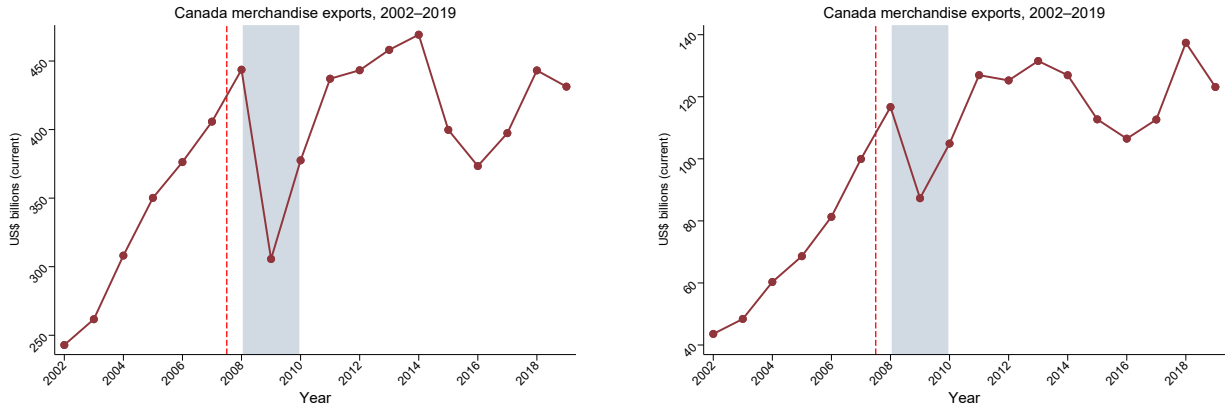
tive by identifying a structural vulnerability in export exposure with direct implications for diversification policy. Most studies focus on short- to medium-term adjustment, whereas I trace firm and worker outcomes over more than a decade. The most persistent losses arise from destination-specific shocks that hit many firms within the same local market. A covariance-variance decomposition shows that these shocks represent only a modest share of total export variance yet generate the deepest and longest scars. This reveals a form of hidden exposure: firms appear stable in aggregate but remain vulnerable to correlated downturns in key markets. The finding links the granular origins of aggregate risk to the persistence of local labour-market decline (Autor et al., 2021; Dauth et al., 2021; Amior and Manning, 2018). It also reframes the role of diversification. Expanding product lines can reduce overall volatility but may not shield firms or workers from destination-wide shocks. True resilience requires geographic diversification that limits dependence on a few major markets and reduces the reach of external contractions (Caselli et al., 2019; Giovanni and Levchenko, 2009; Vannoorenberghe, 2012; Vannoorenberghe et al., 2016).

The next section outlines the Canadian context during the Great Recession. Section 3 describes the linked employer–employee and export data, and Section 4 details the construction and decomposition of the demand shifter. Sections 5 and 6 present the firm- and worker-level results, while Section 7 discusses their implications and Section 8 concludes.

2 Institutional Background: Canada during the Great Recession

The Great Recession of 2008–2009 caused a sharp contraction in global trade often referred to as the "Great Trade Collapse" (Baldwin, 2009). Canada entered the crisis as a small and highly open economy where exports of goods made up just under 30 percent of GDP in 2007 and were concentrated in trade with the United States (Statistics Canada, 2017). The downturn reached Canada mainly through a fall in external demand rather than domestic

financial distress. Figure 1 plots total merchandise exports from 2002 to 2019 including and excluding U.S. exports. Exports grew steadily through 2008, reaching roughly 444 billion U.S. dollars, before dropping by about one-third in 2009. The recovery that followed was slow, with exports returning to their pre-crisis level only by 2011 and remaining volatile afterward.



(a) Total Canadian merchandise exports, 2002–2019.

(b) Canadian non-U.S. merchandise exports, 2002–2019.

Figure 1. Canadian merchandise exports, 2002–2019. Source: Author's calculations from BACI.

About three-quarters of Canadian exports went to the United States before the crisis, and both U.S. and non-U.S. markets contracted sharply in 2009 (Statistics Canada, 2011). Non-U.S. exports also declined in level, even though their share of total exports rose slightly as U.S. demand fell more steeply. This pattern shows that the disruption was global rather than confined to North America. The collapse affected nearly all major product categories, including autos, metals, machinery, and energy. Firms in export-oriented manufacturing and resource industries reduced production and employment as foreign orders fell, and these adjustments spread to local labour markets linked to those sectors. Because demand weakened across most destinations and products at once, the shock was largely external to Canadian exporters.

Canada's banking system remained stable during the crisis. There were no bank failures or bailouts, and credit conditions deteriorated only modestly (IMF, 2010; Bank of Canada,

2010). The absence of a financial crisis means that the contraction was transmitted mainly through trade and production rather than domestic credit channels. This stability makes the Canadian case distinct from the United States, where collapsing credit markets coincided with falling trade and complicated attempts to separate the two channels. It helps isolate the real-side effects of external demand shocks and provides a setting where observed adjustments in firms and workers can be interpreted as responses to foreign demand rather than domestic financial tightening.

Exports increased again in 2010 as global trade recovered, rising by about one-quarter that year. Energy and metals led the increase, while manufacturing and autos recovered more slowly. Growth also varied across destinations: shipments to Asia and Europe rose earlier than those to the United States (OECD, 2011). After 2011, exports stabilized near their pre-crisis level. The period from 2010 to 2013 therefore captures the short-run adjustment to the Great Recession, when firms and industries recovered from the initial collapse but the composition of exports changed little. These years represent the economy's continued response to the same external demand shock, before a new global disturbance emerged in 2014.

Canada is a major exporter of oil, and energy products make up a large share of its merchandise exports. A different episode began in 2014 and 2015 when global oil prices fell from around 100 to below 50 U.S. dollars per barrel (Bank of Canada, 2015). The Canadian dollar depreciated from roughly 0.91 in January 2014 to 0.73 U.S. dollars in December 2015 (Bank of Canada, 2024). The weaker exchange rate supported export volumes but lowered their value in real terms, especially for energy-related products. The effects were concentrated in resource industries and energy-producing provinces, unlike the earlier economy-wide shock. This oil-price collapse marked the start of a new adjustment phase that was distinct from the recovery that ended in 2013. It also explains why the analysis defines the short-run period as ending before 2014, when a new and separate external shock began to influence Canadian trade patterns (Statistics Canada, 2016).

The Canadian experience during the Great Recession offers a clean context for studying external demand shocks. The episode combined a deep, foreign-driven collapse in trade with wide variation across destinations and products, while domestic financial conditions remained stable (IMF, 2010; Bank of Canada, 2010). These features together allow credible identification by providing broad external variation in exposure under stable domestic conditions. The analysis can therefore interpret differences in firm and worker outcomes as responses to external demand rather than to domestic financial factors.

3 Data

This study combines administrative records on Canadian firms and workers with international trade data. On the Canadian side, I use the Canadian Employer-Employee Dynamics Database (CEEDD), which tracks the universe of firms and employees over time. On the international side, I use the Base pour l'Analyse du Commerce International (BACI), which reports harmonized bilateral import flows at the HS6 product level. Linking these sources makes it possible to trace changes in global import demand to firm-level trade activity and, ultimately, to individual worker outcomes. All domestic monetary values are converted to real 2002 Canadian dollars using the national consumer price index. The period of analysis is 2005 to 2019, the final year available in the 2021 CEEDD vintage.

The CEEDD environment links firm-level financial, trade, and geographic information across time. On the financial side, I use the National Accounts Longitudinal Microdata File (NALMF), which provides annual records on sales, payroll, value added, and balance sheet components for all incorporated firms. Export activity is drawn from the Trade by Exporter Characteristics (TEC) file, which reports firm-level transactions by HS8 product and destination country. I harmonize these data to the HS6 level and convert classifications to the HS2002 system to ensure consistency across years. Firm location is recorded at the postal code level, allowing assignment to census divisions and four-digit NAICS industries.

For national tabulations, firms are located by the province of their headquarters in each year. The final sample includes approximately 13,000 firms.

A key feature of CEEDD is its ability to track both firms and workers over time. The linkage is established through employer and employee identifiers embedded in administrative tax records, which allows each worker to be assigned to their employers in a given year. This setup makes it possible to follow a fixed cohort of workers through the full period of analysis, whether they remain with the same firm, switch employers, or exit employment altogether. Worker-level data include annual earnings and basic demographics, drawn from the T4, T1 Family File, and T1 Personal Master File sources.

The BACI database provides the international trade component used to construct the demand shifter. It reports annual bilateral import flows for all reporting countries, disaggregated by HS6 product and recorded in U.S. dollars. BACI is based on UN COMTRADE but applies a reconciliation procedure to harmonize discrepancies between importer and exporter records, yielding a single consistent measure of trade flows across countries and years. I use these data to measure changes in world import demand during the Great Recession, focusing on the period between 2006–2007 and 2009–2010. To ensure that the shifter reflects foreign demand conditions and not outcomes for Canadian firms, I exclude Canadian-origin exports from the calculation of import demand. This ensures that Canadian performance does not mechanically enter the measure of global shocks.

To link BACI to CEEDD, I aggregate firm-level export records to the HS6 level and reclassify them to the HS2002 system to match BACI's product codes. For each firm, I compute the share of its 2005–2007 exports that went to each product-destination pair. These baseline shares are fixed over time and later used to weight changes in global import demand. The resulting firm-level exposure measures are predetermined and form the basis of the demand shifters used throughout the analysis.

Firms sample The firm sample is restricted to continuous exporters between 2005 and 2007 that employed at least one worker in each of those years. Public-sector firms are excluded. I also exclude firms that exported exclusively to the United States during this period, to ensure that exposure reflects shifts in global trade conditions rather than bilateral Canada-US dynamics. These restrictions are necessary to construct a stable, time-invariant measure of each firm's export structure before the shock, ensuring that exposure is not confounded by entry into or exit from exporting during the crisis period. The focus on continuous exporters also helps isolate firms with established trade relationships, for whom shifts in foreign demand are more likely to affect production and employment. Firms remain in the panel for as long as they continue operations. Once a firm exits, it is dropped after its final year of activity. Each firm identifier is treated as a stable unit over time. If an identifier disappears, the firm is assumed to have exited, even if it may have merged with or been absorbed by another entity.

Workers sample The worker sample includes all employees at the selected firms in 2007 who were aged 16 to 65 and received positive T4 earnings in that year. This cohort is tracked through 2019, whether individuals remain with the same firm, move to another employer, or exit employment entirely. Annual earnings are summed across all jobs held in a given year and expressed in real 2002 Canadian dollars. Workers with no recorded employment are assigned zero earnings. Deceased individuals are removed from the panel. Each worker is assigned to a single employer per year, defined as the firm that paid the highest annual earnings.[1] Demographic characteristics including age, sex, and marital status are updated annually. To reduce computational burden, the sample is limited to a simple random 20% draw from the eligible 2007 cohort.

All continuous outcomes are winsorized at the 5th and 95th percentiles. Additional details on outcome construction are provided in Data Appendix B.

[1] If two firms paid equal amounts, the worker is randomly assigned to one of them.

4 Construction and Decomposition of the Demand Shifter

To quantify firms' exposure to the collapse in global trade during the Great Recession, I construct a firm-specific demand shifter that combines each firm's pre-recession export structure with subsequent changes in world import demand. When global imports of a product fall in a destination where a firm used to sell, the firm faces an external demand contraction that is independent of its own actions. The measure follows the standard approach of interacting predetermined firm-level export shares with later import-demand changes across product-destination markets. Using detailed customs data, I interact firms' average export shares across product-destination pairs in 2005-2007 with the corresponding changes in world imports between 2006-07 and 2009-10. The shocks are computed from global import data that exclude Canadian exports, so that domestic firms' behaviour does not influence the shock itself. This time-invariant measure summarizes the external contraction each exporter faced during the crisis.

Identification relies on the exogeneity of the shocks rather than on the exogeneity of the shares. The pre-recession export shares may reflect firms' past productivity, networks, or other unobserved characteristics, and I allow for this endogeneity. What matters for identification is that the changes in world import demand across product-destination markets were driven by the global nature of the Great Recession, not by firm-level factors within Canada. The "leave-out" construction, which removes Canadian exports from the computation of import changes, ensures that the shocks capture external demand movements and are not mechanically correlated with domestic supply conditions.

While this aggregate shifter provides a compact measure of exposure, a central methodological contribution of this paper is to decompose it into its constituent parts. The trade collapse was highly uneven, with large differences across both destinations and product categories. I therefore partition the total demand shifter into three components: a destination-wide term, a product-wide term, and an idiosyncratic residual that is specific to each firm's portfolio. This three-part decomposition extends the two-component approach of Garin and

Silvério (2023). By decomposing the demand shifter itself, rather than statistically partitioning outcomes, I can estimate the separate causal responses to geographic and sectoral shocks in both firms and workers.

4.1 Constructing the Demand Shifter

I construct the demand shifter by combining international trade data with firms' pre-recession export structures. Firms are indexed by j, products by p at the HS6 level, destinations by d at the country level, and years by t. The pre-period is $T_0 = \{2005, 2006, 2007\}$, and the shock window T_1 compares 2006-07 with 2009-10, isolating the steep contraction and partial recovery of world trade during the Great Recession. Averaging over three pre-recession years smooths firm-specific volatility and provides a stable measure of each firm's export composition before the crisis.

For each firm-product-destination triplet, I observe annual export values X_{jpdt} and compute their pre-period mean $\overline{X}_{jpd,05\text{–}07} = \frac{1}{3}\sum_{t=2005}^{2007} X_{jpdt}$ and define the corresponding export share $s_{jpd}^{T_0} = \frac{\overline{X}_{jpd,05\text{–}07}}{\sum_{p',d'} \overline{X}_{jp'd',05\text{–}07}}$. These shares are predetermined with respect to the shock and serve as weights linking international demand changes to each firm's exposure. They may reflect firm-specific productivity, market access, or management choices before the crisis. Identification therefore relies on the exogeneity of the shocks themselves rather than on any randomness in the shares.

Global demand shocks are measured using BACI data on world imports of product p by destination d, denoted M_{pdt}. To ensure that the variation reflects external demand conditions rather than the behaviour of Canadian exporters, I exclude Canadian exports when computing global import demand. This step prevents domestic supply movements from influencing the measured shocks and isolates variation driven by foreign demand conditions. I then compute the symmetric growth rate[2] in foreign demand between the pre- and post-crisis

[2]The symmetric growth rate treats expansions and contractions of equal magnitude symmetrically and remains defined even when trade flows approach zero. This property is especially useful for product-destination cells that temporarily lose or gain trade during large global shocks, for which logarithmic differences would

windows, $\Delta M_{pd}^{T_1} = \frac{\sum_{t\in\{2009,2010\}} M_{pdt} - \sum_{t\in\{2006,2007\}} M_{pdt}}{\left(\sum_{t\in\{2009,2010\}} M_{pdt} + \sum_{t\in\{2006,2007\}} M_{pdt}\right)\times\frac{1}{2}}$.

Firm-level exposure is the weighted average of these product-destination shocks:

$$X_j = \sum_{p,d} s_{jpd}^{T_0} \Delta M_{pd}^{T_1}. \tag{1}$$

A negative value of X_j indicates that a firm's export destinations and products experienced, on average, a decline in foreign demand. Because both the shares and demand shocks are defined before the outcome period, the shifter is time-invariant and reflects predetermined exposure to external demand shocks.

Although this aggregate measure captures the overall contraction in foreign demand faced by Canadian exporters, it conceals distinct sources of variation. The Great Recession caused a broad contraction in trade across advanced economies and product categories. Firms exporting the same goods to the same destinations therefore faced correlated shocks from both destination-specific downturns and global product-level declines. Aggregating these forces into a single measure provides a comprehensive view of exposure, yet it also blends the geographic and sectoral channels through which trade contractions spread. To clarify this structure, I decompose the total demand shifter into destination-wide, product-wide, and firm-specific components. This separation distinguishes common movements across markets and products from the residual variation unique to each firm's export mix, allowing a clearer view of how external shocks transmit through firms and workers.

4.2 Decomposition of the Demand Shifter

I decompose the total demand shifter into destination-wide, product-wide, and idiosyncratic (residual) components that together account for its variation across firms. This decomposition separates shocks that are common to all products within a destination, shocks that are common to all destinations importing a product, and the residual variation specific to

be undefined or biased.

each product-destination pair. It allows separate estimation of how geographic and sectoral shocks contribute to firms' overall exposure.

The destination-wide component captures changes shared by all products sold in the same foreign market, while the product-wide component captures shifts common to a product across destinations. For each destination d and product p, I aggregate the product-destination shocks using pre-recession Canadian export shares:

$$\Delta M_{\cdot d}^{T_1} = \sum_p \omega_{p|d}^{T_0} \Delta M_{pd}^{T_1}, \quad \Delta M_{p\cdot}^{T_1} = \sum_d \nu_{d|p}^{T_0} \Delta M_{pd}^{T_1}.$$

Here, $\omega_{p|d}^{T_0}$ is the share of product p within Canada's exports to destination d, and $\nu_{d|p}^{T_0}$ is the share of destination d within Canada's exports of product p, both computed over 2005–07.[3] Firm-level exposure to each component is given by

$$X_j^{dest} = \sum_d s_{jd}^{T_0} \Delta M_{\cdot d}^{T_1}, \quad X_j^{prod} = \sum_p s_{jp}^{T_0} \Delta M_{p\cdot}^{T_1},$$

where $s_{jd}^{T_0}$ and $s_{jp}^{T_0}$ are the pre-recession shares of firm j's exports by destination and product, respectively. These two terms represent the firm's exposure to geographic and sectoral components of the trade collapse.

The remaining component isolates variation specific to each product-destination pair after removing the broader destination and product movements. I define this idiosyncratic term as $\Delta M_{pd}^{idio} = \Delta M_{pd}^{T_1} - \Delta M_{\cdot d}^{T_1} - \Delta M_{p\cdot}^{T_1}$ and compute firm-level exposure as

$$X_j^{idio} = \sum_{p,d} s_{jpd}^{T_0} \Delta M_{pd}^{idio}.$$

This identity partitions the total shifter into destination-wide, product-wide, and firm-specific components that together describe the structure of external demand shocks faced by

[3] Weighting by Canada's pre-recession export shares ensures that each aggregate reflects the importance of destinations and products in Canada's trade portfolio. Without these weights, shocks in markets where Canada has little exposure would disproportionately influence the common components.

Canadian exporters. The first term captures shocks that are shared among all firms selling to the same markets, the second captures shocks shared across exporters of similar products, and the third isolates residual variation that is unique to each firm's portfolio. In later analysis, I estimate the separate effects of these components on firms and workers to identify whether external downturns propagate mainly through geography-specific or product-specific channels, or through idiosyncratic exposure within individual firms.

For scale and dispersion, Appendix Figure A.12 shows the distributions of destination-wide and product-wide import-demand changes. The destination margin displays a tighter spread and a right-skewed tail, which turns left-skewed once weighted by Canadian export shares. The product margin shows a more moderate and symmetric pattern. Appendix Table A.11 reports summary statistics for the weighted and unweighted changes.

5 Firm-level Analysis

5.1 Empirical Strategy

I examine how exposure to external demand shocks affects firm outcomes over time. Each firm faces a distinct portfolio of products and destinations that were affected to different degrees during the Great Recession. Identification relies on the assumption that global import-demand changes are exogenous to individual Canadian firms, while pre-crisis export shares are predetermined weights that link these shocks to firm exposure. The resulting variation reflects differences in export composition that existed before the downturn, not domestic decisions made during the crisis.

The baseline specification estimates the effects of time-invariant exposure on annual firm outcomes:

$$Y_{jt} = \alpha_t + \beta_t^{tot} X_j + \gamma Z_j + \lambda_{p(j)t} + \varepsilon_{jt}, \tag{2}$$

where Y_{jt} is a firm-level outcome. The coefficients β_t^{tot} trace dynamic responses relative to

the 2007 baseline, and α_t are year fixed effects. The term X_j is the time-invariant demand shifter based on pre-crisis export shares and world import-demand changes. The pre-period U.S. export share Z_j enters linearly to absorb level differences in U.S. orientation, and $\lambda_{p(j)t}$ are province-by-year fixed effects that capture regional economic shocks. All regressions are unweighted, with standard errors clustered by industry × province. When outcomes are in levels, I divide the coefficient estimates by the pre-crisis sample mean of the dependent variable, so the reported estimates can be interpreted as semi-elasticities with respect to changes in external demand.

Identification relies on variation in how predetermined export structures exposed firms to global import-demand shocks that were exogenous to individual Canadian firms. The key assumption is that changes in foreign demand across products and destinations are not correlated with unobserved, time-varying determinants of firm outcomes. Pre-crisis export shares serve only as fixed weights that map these external shocks to the firm level. Province-by-year fixed effects absorb macroeconomic and policy shocks that are common to firms within a region, and the pre-period U.S. export share captures level differences in firms' reliance on the U.S. market.

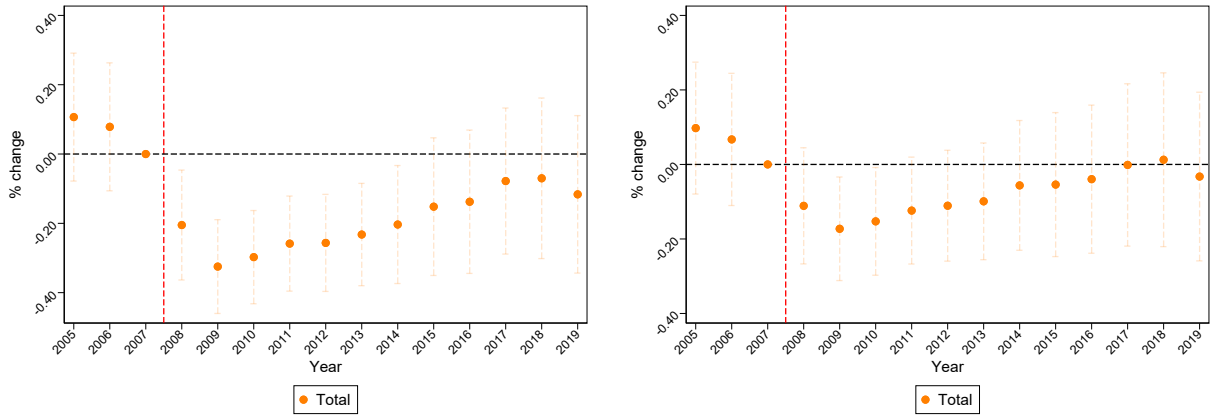
To disentangle the mechanisms, I then estimate a model that decomposes total exposure into destination-, product-, and idiosyncratic components:

$$Y_{jt} = \alpha_t + \beta_t^{dest} X_j^{dest} + \beta_t^{prod} X_j^{prod} + \beta_t^{idio} X_j^{idio} + \gamma Z_j + \lambda_{p(j)t} + \varepsilon_{jt}. \tag{3}$$

Estimating these components jointly accounts for correlations among exposure measures and isolates how each dimension of external demand affects firm outcomes. The coefficients trace how shocks that are common across destinations, common across products, and idiosyncratic to specific product-destination cells propagate to firms. Comparing the two sets of estimates shows whether the aggregate exposure masks heterogeneous responses to broad market-wide shocks or firm-specific disturbances.

5.2 Aggregate Exposure: Dynamic Effects on Firm Outcomes

Figure 2 shows the dynamic effects of the total demand shock on exports and sales. Both drop sharply after the contraction and remain below their 2007 levels. By 2009, exports fall by about 0.32 percent for each one percent decline in demand, while sales drop by 0.17 percent. The effects persist through the short run and fade gradually, with near full recovery by 2019.



(a) Exports **(b)** Sales

Figure 2. Dynamic response to the external demand shifter with 2007 baseline and 95% CIs. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates from equation (2) by pre-period means. Regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province×4-digit industry level. Appendix Figure A.1 plots the level coefficient estimates.

Table 1 reports the corresponding elasticities for exports, sales, employment, payroll, and value added across three windows: 2009–2013 (short run), 2014–2019 (long run), and 2008–2019 (full event). Employment and payroll each fall by about 0.13 percent in the short run before recovering, while value added declines by 0.17 percent, similar to sales.[4] These patterns indicate that firms adjusted broadly across all margins rather than along a single channel. Most of the contraction occurred within the first six years, followed by gradual recovery. The short-run export elasticity is slightly larger than that estimated for Portuguese firms by Garin and Silvério (2023), likely reflecting Canada's higher exposure to

[4]Appendix Table A.1 reports results including 2008 and estimates in dollars or units. The results are similar.

foreign demand.[5] With the exception of exports, Canadian firms largely recovered by the end of the 2010s.

Comparable evidence from Nordic exporters supports this interpretation. Zouheir et al. (2023) find that Swedish firms recovered quickly, while Finnish exporters experienced a slower rebound, consistent with differences in external demand exposure. This variation underscores that recovery paths depend more on the geography of demand than on firms' internal margins.

Table 1. Average elasticities of firm outcomes with respect to total demand change

	2014–2019	2009–2013	2008–2019
Exports	-0.188***	-0.336***	-0.256***
	(0.071)	(0.043)	(0.051)
Sales	-0.083	-0.187***	-0.133***
	(0.070)	(0.041)	(0.050)
Employment	-0.040	-0.125***	-0.078**
	(0.049)	(0.034)	(0.037)
Payroll	-0.030	-0.126***	-0.072*
	(0.058)	(0.039)	(0.043)
Value added	-0.038	-0.174***	-0.105**
	(0.065)	(0.044)	(0.048)

Notes: Elasticities per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (2), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level. Appendix Table A.1 provides the estimates in levels.

Table 2 summarises how firms adjusted their export structure and productivity margins. The number of products and destinations each fell sharply in the short run, with elasticities around 0.10 and 0.08, and recovered only partially, stabilising near 0.07–0.08. Exports per product and per destination declined more, with elasticities between 0.25 and 0.40, showing that the contraction operated mainly through the intensive margin. Similar evidence from Argentina's 2001–2002 crisis shows that most of the trade decline occurred within continuing exporters rather than through market exit (Gopinath and Neiman, 2014).

Value added per worker fell modestly in the short run, by about 0.09 percent, and re-

[5] Garin and Silvério (2023) report estimates for 2009–2011; see Appendix Table A.1 for comparable results.

mained flat afterwards, suggesting limited productivity gains during recovery. Standard models predict that downturns reallocate resources toward more productive firms, but this pattern does not appear here. The result aligns with U.S. evidence that the Great Recession generated weaker productivity reallocation than earlier downturns (Foster et al., 2016). Overall, Canadian exporters adjusted mainly by rationalising their export portfolios, cutting products and destinations, while maintaining stable efficiency per worker.

Table 2. Average elasticities of firm adjustment margins with respect to total demand change

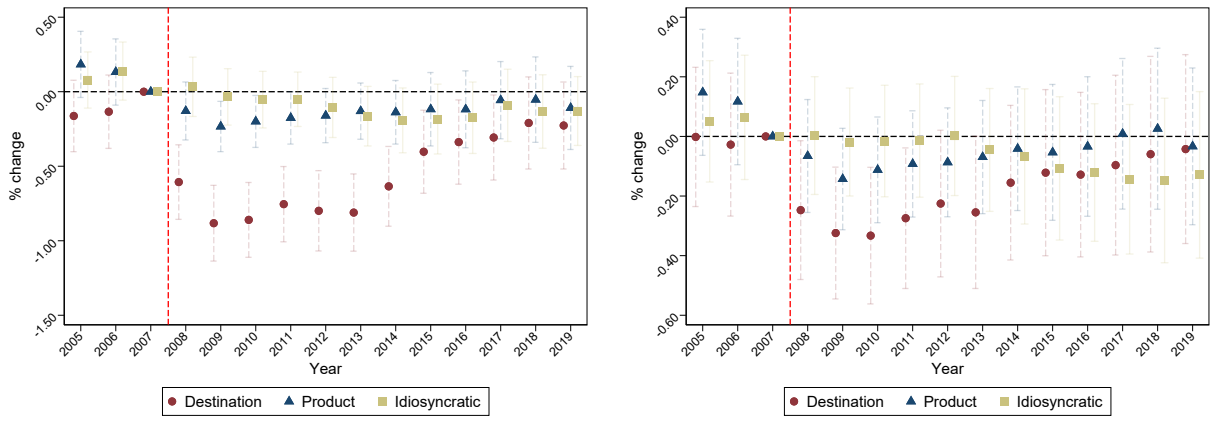
	2014–2019	2009–2013	2008–2019
No. of products exported	-0.073**	-0.097***	-0.081***
	(0.032)	(0.023)	(0.025)
No. of destinations	-0.075*	-0.080***	-0.076**
	(0.039)	(0.029)	(0.030)
Exports per product	-0.249***	-0.353***	-0.299***
	(0.071)	(0.047)	(0.054)
Exports per destination	-0.210**	-0.402***	-0.298***
	(0.066)	(0.045)	(0.050)
Value added per worker	0.004	-0.088***	-0.042*
	(0.030)	(0.022)	(0.022)

Notes: Elasticities per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (2), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level. Appendix Table A.2 provides the estimates in levels.

These aggregate adjustments combine shocks that differ in scope. To identify which types of shocks drive these responses, I next decompose exposure into destination-, product-, and firm-specific components.

5.3 Decomposing Destination, Product, and Firm-Specific Shocks

Figure 3 shows the dynamic effects of decomposing total exposure into destination-, product-, and firm-specific components. Firms respond most strongly to destination shocks, moderately to product shocks, and only weakly to idiosyncratic ones. Geographically correlated contractions were therefore the main driver of firm-level export adjustment during the Great Recession.



(a) Exports **(b)** Sales

Figure 3. Dynamic responses by shock component (destination, product, firm-specific) with 2007 baseline and 95% CIs. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates from equation (3) by pre-period means. Regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province×4-digit industry level. Appendix Figure A.2 plots the level coefficient estimates.

Table 3 reports the average elasticities over 2009–2013, 2014–2019, and 2008–2019. A one percent fall in destination demand reduces exports by about 0.72 percent and sales by 0.27 percent in the short run, with part of the decline persisting over time (long-run export elasticity of 0.25). Product shocks show smaller effects: 0.29 for exports and 0.19 for sales in the short run, and 0.20 for exports in the long run. Idiosyncratic shocks lower exports by about 0.18 percent, consistent with firm-specific downsizing rather than broad contraction.

Destination shocks also led to clear differences across other outcomes. Employment, payroll, and value added each fell between 0.22 and 0.29 percent for every one-percent drop in destination demand. Payroll and value added later recovered, but employment showed a persistent decline significant at 90 percent. Product shocks had smaller short-run effects (0.11–0.16 percent) with no long-run change, and idiosyncratic shocks had no measurable effect on these aggregates despite reducing exports.

The absence of broad payroll or employment effects from firm-specific shocks suggests that firms do not adjust through mass layoffs or wage cuts but through selective separations. This pattern is consistent with U.S. evidence showing limited pass-through of firm revenue

Table 3. Average elasticities of firm outcomes by shock component

	2014–2019	2009–2013	2008–2019
Panel A. Destination-level component			
Exports	-0.254***	-0.722***	-0.470***
	(0.097)	(0.082)	(0.077)
Sales	-0.091	-0.273***	-0.179**
	(0.103)	(0.071)	(0.075)
Employment	-0.146*	-0.251***	-0.191***
	(0.079)	(0.060)	(0.061)
Payroll	-0.096	-0.228***	-0.154**
	(0.093)	(0.069)	(0.072)
Value added	-0.018	-0.291***	-0.151*
	(0.103)	(0.076)	(0.078)
Panel B. Product-level component			
Exports	-0.204**	-0.285***	-0.240***
	(0.089)	(0.053)	(0.065)
Sales	-0.110	-0.189***	-0.146**
	(0.082)	(0.051)	(0.060)
Employment	-0.024	-0.105**	-0.059
	(0.058)	(0.041)	(0.044)
Payroll	-0.025	-0.114**	-0.062
	(0.069)	(0.046)	(0.052)
Value added	-0.050	-0.165***	-0.106*
	(0.080)	(0.052)	(0.059)
Panel C. Idiosyncratic component			
Exports	-0.223***	-0.154***	-0.179***
	(0.082)	(0.059)	(0.063)
Sales	-0.158*	-0.057	-0.105
	(0.096)	(0.060)	(0.068)
Employment	-0.042	-0.004	-0.025
	(0.074)	(0.050)	(0.055)
Payroll	-0.038	0.001	-0.019
	(0.085)	(0.057)	(0.063)
Value added	-0.037	-0.003	-0.018
	(0.095)	(0.063)	(0.070)

Notes: Elasticities per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (3), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level. Appendix Table A.3 provides the estimates in levels.

shocks to continuing employees' earnings (Juhn et al., 2018). The results imply that adjustment operates through selective turnover or constrained hiring rather than across-the-board reductions, a channel explored further in the worker-level analysis.

Table 4. Average elasticities of firm adjustment margins by shock component

	2009–2013	2014–2019	2008–2019
Panel A. Destination-level component			
No. of products exported	0.031	-0.032	-0.003
	(0.054)	(0.060)	(0.051)
No. of destinations	0.271***	0.343***	0.288***
	(0.053)	(0.064)	(0.052)
Exports per product	-0.773***	-0.352***	-0.552***
	(0.120)	(0.114)	(0.109)
Exports per destination	-1.049***	-0.563***	-0.774***
	(0.101)	(0.102)	(0.091)
Value added per worker	-0.044	0.135**	0.040
	(0.049)	(0.058)	(0.046)
Panel B. Product-level component			
No. of products exported	-0.134***	-0.093**	-0.106***
	(0.026)	(0.036)	(0.028)
No. of destinations	-0.168***	-0.162***	-0.159***
	(0.036)	(0.047)	(0.038)
Exports per product	-0.299***	-0.262***	-0.280***
	(0.066)	(0.099)	(0.077)
Exports per destination	-0.311***	-0.175**	-0.239***
	(0.052)	(0.084)	(0.062)
Value added per worker	-0.110***	-0.028	-0.069**
	(0.025)	(0.038)	(0.028)
Panel C. Idiosyncratic component			
No. of products exported	-0.015	-0.065	-0.043
	(0.037)	(0.051)	(0.038)
No. of destinations	-0.010	-0.065	-0.036
	(0.042)	(0.059)	(0.044)
Exports per product	-0.202**	-0.293***	-0.240***
	(0.095)	(0.103)	(0.092)
Exports per destination	-0.148**	-0.246***	-0.192***
	(0.064)	(0.084)	(0.066)
Value added per worker	0.019	0.053	0.034
	(0.041)	(0.051)	(0.040)

Notes: Elasticities per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (3), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level. Appendix Table A.4 provides the estimates in levels.

The decomposition also reveals contrasting adjustment strategies. On the extensive margin, destination shocks prompted diversification: a one percent decline in destination demand increased the number of export destinations by 0.27–0.34 percent, as firms sought new markets to offset lost demand. Product shocks, by contrast, led firms to narrow their product

scope, reducing exported products by about 0.13 percent. These results, summarised in Table 4, reconcile findings in the diversification literature. Some studies find that negative shocks induce firms to focus on core lines (Mayer et al., 2021), while others show diversification as a form of resilience. For instance, Zouheir et al. (2023) find that Swedish exporters expanded both market and product scope after the 2007-2014 downturn, whereas Finnish firms contracted. The evidence here suggests that these outcomes depend on the type of shock: geographic contractions trigger market diversification, while product shocks induce consolidation.

On the intensive margin, the responses align with this pattern. For destination shocks, a one percent decline in demand causes exports per destination to fall by about 1.05 percent, larger than the total export decline of 0.72 percent, consistent with firms entering less profitable markets. Over time, exports per destination partially recover, and value added per worker rises by about 0.14 percent, consistent with reallocation toward more productive markets once new relationships stabilise. This refines the aggregate "non-cleansing" finding in Foster et al. (2016): the Great Recession appears to have been cleansing only for firms that undertook costly geographic reallocation. This mechanism also aligns with Zouheir et al. (2023), who find that diversification among Swedish exporters was linked to subsequent productivity gains. These results do not show which destinations firms entered, but prior work suggests that productivity effects depend on destination characteristics. Firms expanding into richer destinations tend to upgrade quality and skill intensity (Verhoogen, 2008; Brambilla et al., 2012), whereas those diversifying into lower-income markets often see the opposite (Cilekoglu, 2024). This suggests that the nature of new destinations mediates whether diversification improves productivity or simply sustains capacity.

For product shocks, adjustments were more limited. A one percent fall in product demand reduces the number of exported products by 0.13 percent and exports per product and per destination by 0.26–0.31 percent. The long-run decline in exports per destination, about 0.18 percent, is smaller than that for exports per product, about 0.26 percent, indicating

consolidation along surviving product lines rather than broad re-entry. Value added per worker falls by roughly 0.11 percent before stabilising, suggesting that adjustment maintained operations rather than improved efficiency. This contrast between modest productivity gains from destination shocks and flat effects from product shocks reinforces the view that the Great Recession was not, on average, productivity-enhancing (Foster et al., 2016).

These elasticities correspond to one-percent changes in each component but do not sum to the total effect because each component contributes differently to the variance of external demand. Appendix Figure A.3 overlays the weighted responses of each component on the total response for exports and sales. Appendix Table A.5 reports the decomposition weights.

By the end of the 2010s, firms had largely recovered in both scale and scope. Exports and sales rebounded, product and destination counts stabilised, and productivity per worker returned close to pre-crisis levels. The results point to a temporary reallocation in which firms adjusted their market mix and export intensity but gradually rebuilt as global demand recovered.

6 Worker-level Analysis

6.1 Empirical Strategy

The worker analysis mirrors the firm specification but measures exposure through the 2007 employer. Each worker is linked to their pre-crisis firm $j(i)$, and I estimate how predetermined employer exposure to external demand affects subsequent earnings and employment. I follow the 2007 cohort of workers through 2019 to trace how the pre-crisis shocks influenced their long-run outcomes. I estimate both a model using total exposure and one that decomposes it into destination, product, and idiosyncratic components:

$$Y_{it} = \alpha_t + \theta_t^{tot} X_{j(i)} + \boldsymbol{\lambda}_{it} + \varepsilon_{it}, \tag{4}$$

$$Y_{it} = \alpha_t + \theta_t^{dest} X_{j(i)}^{dest} + \theta_t^{prod} X_{j(i)}^{prod} + \theta_t^{idio} X_{j(i)}^{idio} + \boldsymbol{\lambda}_{it} + \varepsilon_{it}. \tag{5}$$

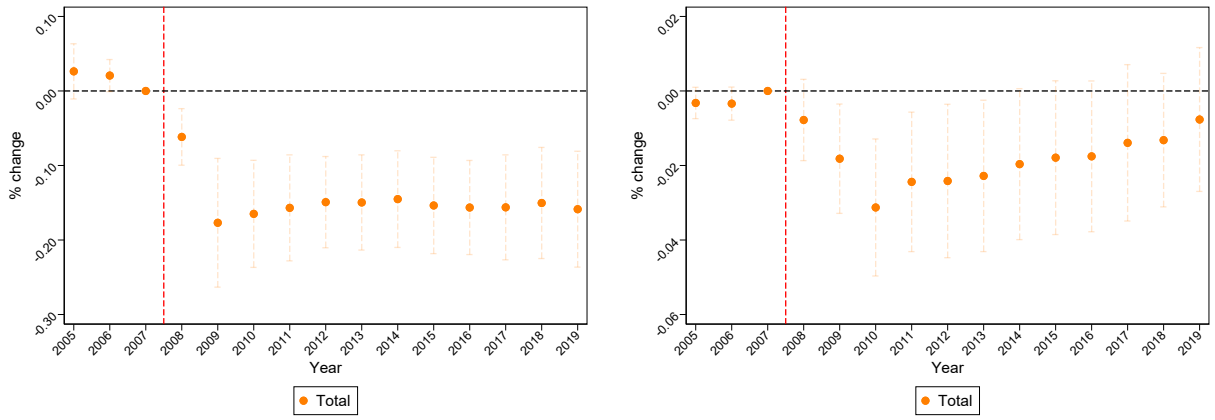
Here Y_{it} denotes annual worker outcomes, and the coefficients θ_t trace how these outcomes evolve relative to 2007. The vector $\boldsymbol{\lambda}_{it}$ includes several layers of fixed effects. Firm fixed effects, defined by each worker's 2007 employer, capture time-invariant firm characteristics such as average wage levels and productivity. The firm's province $\times$ year fixed effects absorb shocks to the local market of the original employer, while the worker's province $\times$ year fixed effects capture shocks in the worker's current region of residence and account for mobility across provinces. Time-varying demographic fixed effects for age, sex, and marital status, together with experience $\times$ year fixed effects, control for life-cycle and compositional differences. Standard errors are clustered by industry $\times$ province. This specification absorbs the main sources of aggregate and regional variation and ensures that comparisons are drawn among workers facing similar economic environments.

Identification relies on the exogeneity of external demand shocks, conditional on the full set of fixed effects that absorb firm and regional heterogeneity. Because exposure is determined by workers' 2007 employers and measured before the downturn, post-2007 differences in outcomes capture how external shocks propagated through those firms. The fixed effects structure removes time-invariant differences across firms and time-varying shocks at both the employer and regional levels, ensuring that identification comes from variation in external demand rather than endogenous mobility or contemporaneous firm conditions.

6.2 Total Exposure: Dynamic Effects on Worker Outcomes

Figure 4 shows how workers' T4 earnings and employment respond to firms' total exposure to external demand shocks. Both fall sharply during the initial years of the Great Recession. Earnings drop steeply in 2009 and stay well below pre-recession levels for the next decade, showing persistent scarring consistent with the long-term earnings losses observed after job displacement (Jacobson et al., 1993; Schmieder et al., 2023). Employment also declines early,

indicating that part of the earnings loss reflects separations rather than temporary pay cuts. Unlike earnings, employment gradually recovers and returns close to pre-recession levels by the end of the 2010s.



(a) Earnings **(b)** Employment

Figure 4. Dynamic response of worker outcomes to the external demand shifter with 2007 baseline and 95% CIs. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates from equation (4) by pre-period means. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province. Appendix Figure A.4 plots the level coefficient estimates.

Table 5 reports average elasticities for 2009–2013, 2014–2019, and the full 2008–2019 window. A one percent fall in a worker's 2007-employer export demand lowers annual earnings by about 0.17 percent in both periods, indicating persistent income losses throughout. This elasticity is smaller than the 25 percent loss found by Jacobson et al. (1993), which reflects large separations in mass-layoff events, while the estimates here capture marginal exposure to trade shocks. Still, the persistence of losses mirrors results from import competition, where adverse income effects last a decade or more (Autor et al., 2013, 2014; Dix-Carneiro and Kovak, 2017). Employment falls by roughly two percentage points in the short run and 1.3 points (although, statistically insignificant) in the long run, consistent with near-complete recovery by 2019.

Overall, firms regained pre-crisis employment and sales, but workers suffered lasting earnings losses. Re-employment softened the initial hit but did not offset wage penalties

Table 5. Average elasticities of worker outcomes with respect to firms' total demand shifter

	2009–2013	2014–2019	2008–2019
Earnings	-0.175***	-0.169***	-0.164***
	(0.039)	(0.037)	(0.036)
Employment	-0.022**	-0.013	-0.016*
	(0.009)	(0.010)	(0.009)

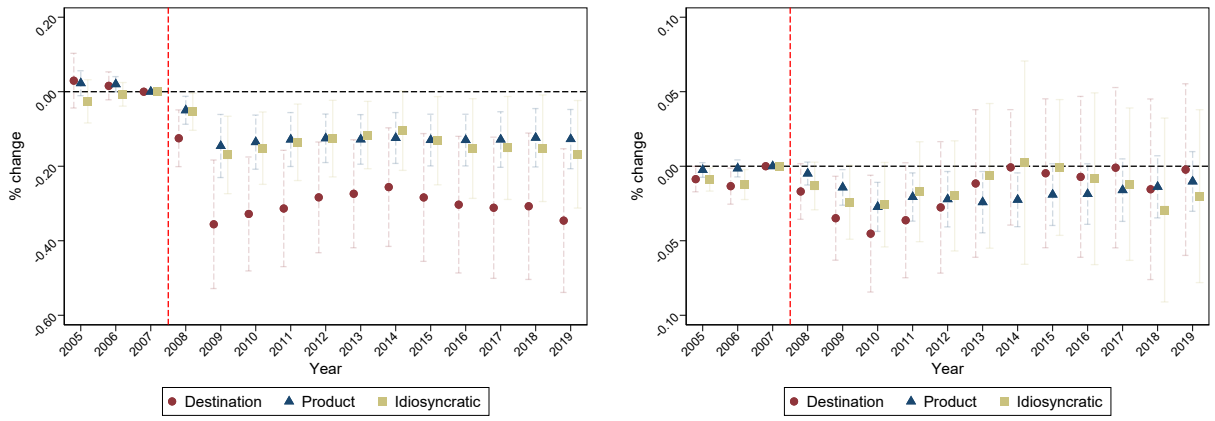
Notes: Elasticities per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (4), and subtracting the pre-period average from the corresponding year period average. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province. Appendix Table 5 provides the estimates in levels.

from early displacement. The pattern matches evidence that workers affected by trade shocks often move into lower-paying or less stable jobs (Hummels et al., 2014), leading to long-term income scarring even after macro recovery (Schmieder et al., 2023). The Great Recession's external demand collapse was therefore temporary for firms but left enduring distributional costs for workers.

6.3 Decomposing Destination, Product, and Firm-Specific Shocks

Figure 5 shows how workers' T4 earnings and employment respond when firms' total exposure is decomposed into destination-, product-, and firm-specific components. Table 6 reports the corresponding elasticities for 2009-2013, 2014-2019, and 2008-2019. The results reveal clear differences in how workers adjust to each type of shock.

Destination-wide shocks cause the largest and most persistent losses. A one percent fall in destination demand lowers annual earnings by about 0.33 percent in both periods, with no sign of recovery after a decade. Employment responses are small and imprecise, consistent with limited short-run separations and full re-employment over time. Product shocks also generate lasting earnings declines, with elasticities around 0.14-0.15 and short-run employment losses near 0.02 that disappear later. Idiosyncratic shocks have similar earnings effects (about 0.13) but no measurable impact on employment. The magnitude of this elasticity aligns with the 10-15 percent pass-through of idiosyncratic export shocks to



(a) Earnings **(b)** Employment

Figure 5. Dynamic response of worker outcomes by shock component (destination, product, firm-specific) with 2007 baseline and 95% CIs. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates from equation (5) by pre-period means. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province. Appendix Figure A.5 plots the level coefficient estimates.

incumbent wages estimated by Garin and Silvério (2023).

Compared with the firm-level results, a clear asymmetry emerges. Idiosyncratic shocks have little effect on firm employment or payroll but still produce meaningful and persistent worker losses. This pattern reflects selective adjustment within firms rather than wage cuts. Firm-specific downturns lead to separations concentrated among lower-earning employees, while higher-earning incumbents remain. The next subsection confirms that these losses are concentrated among leavers, while stayers show no decline and even small long-run gains. This mirrors findings from offshoring, where aggregate losses conceal large, lasting earnings declines among displaced workers (Hummels et al., 2014).

Broad external shocks, especially destination-wide contractions, cause the deepest and most persistent worker losses, while firm-specific shocks create individual-level risk even when aggregate firm outcomes are stable. Aggregating these shocks into a single exposure measure would mask these distinctions and understate the role of common shocks in shaping income risk.

Appendix Table A.5 reports the decomposition weights of each shock component for the

Table 6. Average elasticities of worker outcomes by shock component

	2009–2013	2014–2019	2008–2019
Panel A. Destination-level component			
Earnings	-0.326***	-0.316***	-0.306***
	(0.076)	(0.087)	(0.077)
Employment	-0.024	0.002	-0.010
	(0.018)	(0.025)	(0.020)
Panel B. Product-level component			
Earnings	-0.147***	-0.141***	-0.137***
	(0.037)	(0.037)	(0.035)
Employment	-0.020**	-0.015*	-0.016***
	(0.008)	(0.009)	(0.008)
Panel C. Firm-specific component			
Earnings	-0.129***	-0.132**	-0.123**
	(0.045)	(0.060)	(0.050)
Employment	-0.012	-0.004	-0.008
	(0.015)	(0.027)	(0.020)

Notes: Elasticities per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (5), and subtracting the pre-period average from the corresponding year period average. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province. Appendix Table A.7 provides the estimates in levels.

worker sample, summarising how much each type of demand variation contributes to total worker exposure.

6.4 Local Market versus Firm-Level Exposure and Worker Mobility

The previous results show that common external contractions, especially destination-wide ones, cause large and persistent worker earnings losses. These shocks also affect firms, raising the question of whether the transmission operates mainly through a worker's own employer or through broader local labour-market conditions. To separate these channels, I decompose each firm's exposure into a *local market average* and a *firm-specific deviation*. For each firm j in market m, let $X_j = \bar{X}_m + (X_j - \bar{X}_m)$, where $\bar{X}_m$ is the average exposure among firms in the same census division-by-four-digit industry market[6], and $(X_j - \bar{X}_m)$ is the firm-specific

[6]I obtain the market average shock by taking the average shock of firms operating within market m weighted by their pre-recession employment shares so that the average reflects firm size within the market.

deviation.

To ensure comparability with the baseline worker analysis, I integrate this decomposition directly into the dynamic specification in Equations 4 and 5, retaining the same fixed-effects structure. I estimate this specification twice. First, I apply the decomposition to the total exposure X_j to distinguish firm-specific and market-wide components of the overall shock. Second, I repeat the same procedure for the decomposed shocks, applying the market-firm separation separately to the destination-wide and product-wide components. Both versions maintain the same dynamic structure and full vector of fixed effects used in the main worker regressions. This specification isolates how shocks to the broader local market and firm-specific exposure jointly shape workers outcomes.

Appendix Figures A.7 and A.9 show the dynamic effects of the market and firm components of total, destination, and product exposure. Appendix Table A.8 reports the elasticities. Across all shock types, persistent earnings losses stem from the market component, not from firm deviations. For total exposure, a one percent fall in local market demand lowers annual earnings by about 0.23-0.24 percent in both the short and long run, with short-run employment losses of roughly three percentage points. Firm-specific deviations have small and statistically insignificant effects on either outcome. These results support an outside-option mechanism: shocks spread through labour-market competition, and workers are more sensitive to aggregate than firm-specific exposure (Carballo and Mansfield, 2025).

The same pattern appears for destination and product shocks. For destination shocks, a one percent drop in market demand reduces earnings by 0.43-0.46 percent, while firm deviations explain little of this effect. Product shocks show smaller but persistent earnings losses of 0.17-0.18 percent from the market component, with no contribution from firm-specific exposure. Employment responses are again short-lived and concentrated in the market component. Together, these results indicate that broad shocks hitting many firms within the same market or product space drive most of the observed earnings losses by depressing workers' outside options and weakening local wage competition (Garin and Silvério, 2023).

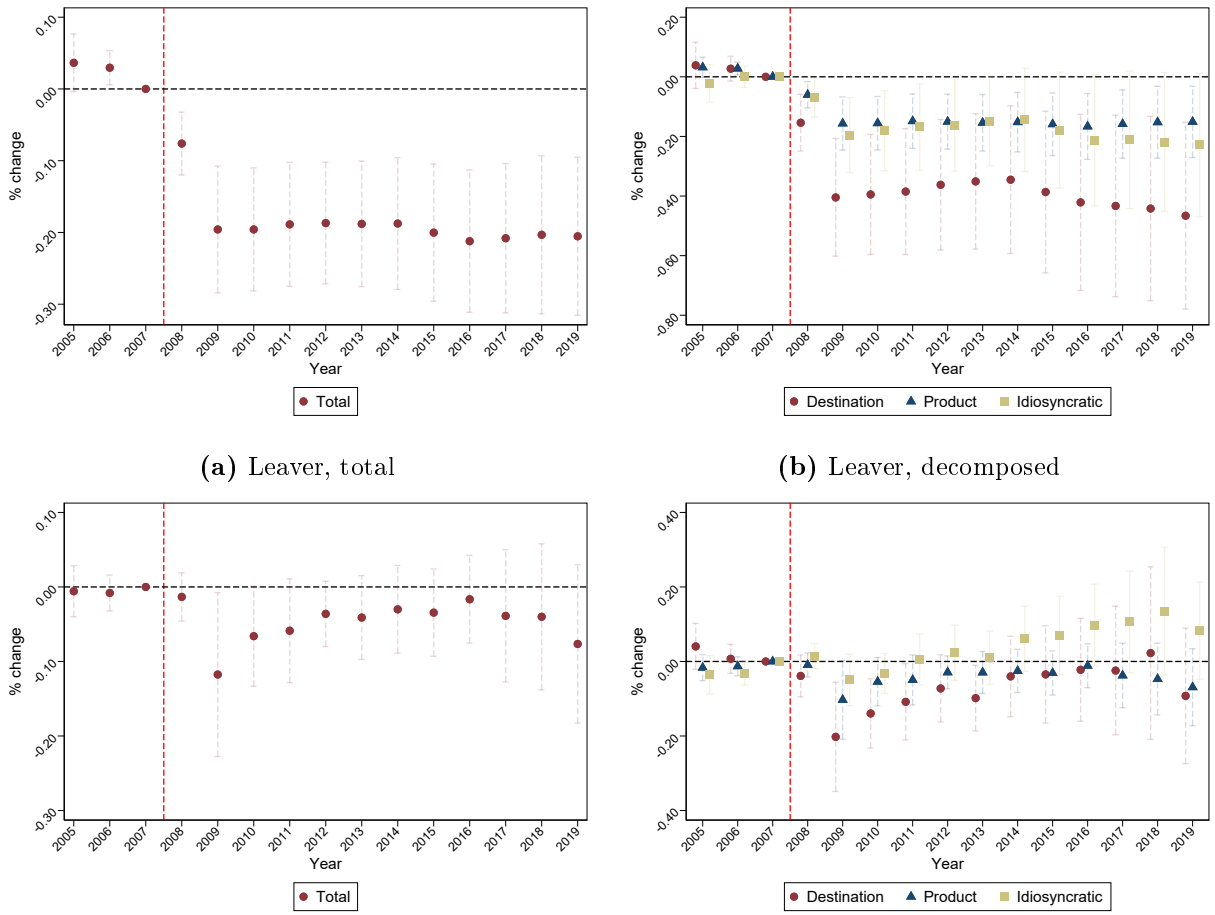
To identify who bears these losses, I next distinguish workers who stayed with their 2007 employer until 2019 (*stayers*) from those who left earlier (*leavers*). Figure 6 and Table 7 present the results. Stayers show little or no decline in earnings for total exposure, but small short-run losses from destination and product shocks, consistent with temporary wage or hour adjustments. This matches evidence that firms insure continuing employees against temporary shocks, with limited pass-through to incumbent wages (Juhn et al., 2018). Leavers, in contrast, face large and persistent losses of about 0.21-0.23 percent for total exposure and 0.40-0.44 percent for destination shocks, along with lower employment. These results confirm that aggregate losses mainly reflect displacement penalties rather than wage compression, consistent with evidence from offshoring and job displacement (Davis and von Wachter, 2011; Hummels et al., 2014).

Overall, local market conditions rather than firm-specific exposure explain most of the adjustment to external demand shocks. Common shocks across destinations or products reduce earnings mainly by lowering the value of outside options and the quality of post-displacement matches. Workers who remain with their pre-recession employers experience only temporary adjustments, while those who separate face persistent scarring from weaker re-employment opportunities. This mechanism is consistent with job displacement and search-friction models (Kambourov, 2009; Davis and von Wachter, 2011) and with regional evidence that trade-related shocks cause long-term earnings losses (Autor et al., 2013, 2014; Amior and Manning, 2018).

7 Discussion

7.1 Source of Demand Shocks Matters

The decomposition shows that destination shocks dominate adjustment on both the firm and worker sides. When demand falls across an entire market, the contraction spreads to all



(a) Leaver, total

(b) Leaver, decomposed

(c) Stayer, total

(d) Stayer, decomposed

Figure 6. Dynamic response of worker outcomes by shock component (total, destination, product, firm-specific) with 2007 baseline and 95% CIs. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates from equations (4) and (5) by pre-period means. Stayers are workers continuously employed by their 2007 firm through 2019. Leavers are workers employed in 2007 who left before 2019. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province. Appendix Figure A.11 plots the level coefficient estimates.

Table 7. Average elasticities of worker outcomes by stayer and leaver status

	2009–2013		2014–2019		2008–2019	
	Stayers	Leavers	Stayers	Leavers	Stayers	Leavers
Panel A. Total shock						
Earnings	-0.059	-0.213***	-0.035	-0.225***	-0.043	-0.209***
	(0.036)	(0.048)	(0.043)	(0.055)	(0.038)	(0.049)
Employment	-	-0.029***	-	-0.020	-	-0.023
	(-)	(0.012)	(-)	(0.015)	(-)	(0.014)
Panel B. Destination-level shock						
Earnings	-0.140**	-0.401***	-0.086	-0.438***	-0.087	-0.401***
	(0.055)	(0.108)	(0.140)	(0.148)	(0.066)	(0.122)
Employment	-	-0.045	-	-0.026	-	-0.033
	(-)	(0.029)	(-)	(0.045)	(-)	(0.034)
Panel C. Product-level shock						
Earnings	-0.043	-0.173***	-0.027	-0.177***	-0.032	-0.167***
	(0.035)	(0.048)	(0.042)	(0.057)	(0.037)	(0.050)
Employment	-	-0.021*	-	-0.013	-	-0.016
	(-)	(0.011)	(-)	(0.015)	(-)	(0.011)
Panel D. Idiosyncratic shock						
Earnings	0.014	-0.164**	0.114*	-0.192*	0.066	-0.169**
	(0.038)	(0.071)	(0.068)	(0.109)	(0.049)	(0.086)
Employment	-	-0.016	-	-0.005	-	-0.010
	(-)	(0.021)	(-)	(0.035)	(-)	(0.028)

Notes: Elasticities per 1 percent decline in corresponding demand. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Stayers are workers continuously employed by their 2007 firm through 2019. Leavers are workers employed in 2007 who left before 2019. Specification matches the worker baseline: exposure based on 2007 employer; firm fixed effects; headquarter-province×year fixed effects; worker province×year fixed effects; demographic and experience controls. Standard errors clustered by industry×province. Appendix Table A.10 provides the estimates in levels.

firms that sell there, regardless of what they produce. Firms cannot fully offset these shocks, though many expand into new destinations to rebuild trade links. Product-level shocks lead firms to contract and focus on core lines, while idiosyncratic shocks remain mostly internal. For workers, destination shocks are the most damaging because they hit many local employers at once, reducing outside options and causing persistent earnings losses. Product and firm-specific shocks have smaller and shorter-lived effects.

These results reveal that the spatial concentration of foreign demand is the key channel through which external shocks propagate. Geographic exposure explains why downturns that appear sectoral in aggregate data often originate from specific markets. Canada's auto

industry provides a clear example. Before the Great Recession, passenger vehicles with large engines exported mainly to the United States accounted for about eight percent of total exports. When U.S. import demand fell by more than twenty percent, most of the apparent global decline in vehicle demand reflected this single destination's contraction. A decomposition that stops at the product level would treat it as a global product shock, overstating sectoral exposure while missing the geographic concentration that drove it.

A quantitative decomposition confirms this point. The shocks with the largest effects are not the ones that explain most of the variation in external demand. Product-wide shocks account for more than three quarters of the total variance, while destination-wide shocks explain less than one fifth. Yet the regressions show that destination shocks have much larger and more persistent effects on both firms and workers. This contrast highlights a structural vulnerability: geographically concentrated shocks appear small in aggregate variation but generate severe local adjustment.[7].

Recognising this structure clarifies both the mechanism and its consequences. Destination-wide shocks restrict firms' ability to reallocate and constrain workers' mobility within affected regions. Product and firm-specific shocks play smaller roles. The results demonstrate that the composition of external demand, particularly its geographic concentration, determines how trade shocks propagate and who bears the cost of adjustment.

7.2 How Firms and Workers Adjust and Who Bears the Costs

The results reveal a consistent asymmetry in recovery across all types of external demand shocks. Firms reduce activity sharply during the crisis but later rebuild exports, sales, and value added. Workers, by contrast, experience lasting earnings losses that persist even after re-employment. This divergence arises from the distinct margins through which firms and workers adjust. Firms recover by reallocating activity across markets and products, while workers adjust mainly through separation, facing slower re-employment and lower post-shock

[7]See Appendix Table A.5 which reports the covariance weights of each component, and Appendix Figures A.3 and A.6, which plot the weighted responses of firms and workers, respectively

wages.

The decomposition clarifies that this pattern holds across different shocks, though the scale of adjustment varies. Destination shocks generate broad contractions that trigger geographic diversification, while product shocks lead firms to concentrate on core lines. Both responses allow firms to recover output but weaken employment ties, since recovery occurs through new markets, products, or customers. Long-run gains in value added per worker likely reflect compositional changes rather than pure productivity growth, consistent with reallocation toward more resilient firms and activities.

For workers, the costs of adjustment are longer lasting. Whether the contraction originates in a product or a destination, workers displaced during the downturn face reduced re-employment opportunities and slower wage recovery. The contrast between stayers and leavers shows that these losses stem from separations rather than pay cuts: those who remain with affected firms recover part of their earnings, while displaced workers experience large and persistent income losses. This pattern aligns with evidence that trade shocks transmit only partly to wages and that long-run worker losses arise mainly through separations rather than wage flexibility (Amiti and Davis, 2011; Hummels et al., 2014; Garin and Silvério, 2023; Carballo and Mansfield, 2025; Dauth et al., 2021).

The results show that recovery and scarring are two sides of the same process. The reallocation that restores firm output also breaks employment links, transferring the burden of adjustment from firms to workers. This uneven recovery defines the incidence of trade shocks and motivates the policy discussion that follows.

7.3 Policy Implications and External Validity

Firms regain activity by reallocating across products and destinations, while workers absorb the cost of that reallocation through separation and slower re-employment. The same adjustments that restore output weaken employment links. Policies that reduce this transfer of costs, by keeping viable matches intact or by rebuilding outside options, address the central

margin revealed by the evidence.

For workers, the findings point to two clear needs. First, long-run losses arise mainly from separations rather than pay cuts, so preserving productive matches during downturns can limit permanent scarring. Short-time work schemes, which subsidise reduced hours instead of layoffs, serve this role in temporary contractions. Second, when separations are unavoidable, earnings recover only when workers can transition to new firms or regions. Programmes that expand retraining, relocation, or wage insurance directly target this adjustment margin by widening the set of feasible transitions where local outside options collapse (Hyman, 2018; Conwell et al., 2024; Hyman et al., 2024). These policies matter because they counteract the same regional concentration that amplifies destination shocks in the data.

For firms, the evidence shows that recovery depends on diversification. Firms that spread exposure across markets regain exports and sales more quickly, while those that remain concentrated experience deeper and longer contractions (Vannoorenberghe, 2012; Vannoorenberghe et al., 2016; Carballo and Mansfield, 2025). Yet diversification requires resources and time. Financial constraints restrict entry into new markets, making access to credit and export support critical for resilience (Manova, 2012). Programmes that ease these barriers encourage the same reallocation mechanism that underlies firm recovery in the data. Supporting diversification before the shock reduces the need for costly adjustment after it.

The broader implications extend to other advanced and small open economies. Similar persistence appears in Germany and the United States, where geographically concentrated trade shocks slowed recovery (Autor et al., 2013; Dauth et al., 2021; Amior and Manning, 2018). Small open economies are especially exposed because their exports are concentrated in a few large destinations, and reallocation requires time and capital. The results therefore imply that resilience depends less on avoiding exposure and more on the capacity to reallocate when demand collapses. Policies that sustain diversification, mobility, and credit access strengthen that capacity and determine how evenly the costs of trade adjustment are shared between firms and workers.

7.4 Limitations

This study relies on predetermined export structures and on changes in foreign demand that are plausibly exogenous to Canadian firms. These assumptions are strong and not beyond question. The United States was both Canada's largest export destination and the centre of the 2008-2009 collapse. Because Canadian supply chains are deeply linked to the U.S. economy, part of what I treat as a foreign-demand shock may reflect domestic spillovers or shared credit constraints rather than independent shifts in foreign demand. This concern parallels recent discussions on correlated shocks in shift-share designs (Goldsmith-Pinkham et al., 2020; Borusyak et al., 2021). Province-by-year fixed effects and pre-trend checks reduce, but cannot fully remove, these correlations. The design therefore cannot fully separate external demand shocks from correlated domestic conditions linked to the United States.

The linked employer-employee data also impose limits on the adjustment margins observed. Worker outcomes are based on annual T4 earnings, which may not capture short-term mobility or secondary employment. Firm exposure is based on pre-crisis export patterns, which ensures identification but does not reflect later diversification or new market entry. These constraints are typical of linked employer-employee studies, where precision in identifying exposure comes at the cost of full coverage of adjustment margins.

The estimates also reflect adjustment to a global, synchronised downturn. Results may differ for shocks that are narrower in sectoral or geographic scope. The framework therefore captures responses to a specific type of crisis rather than a general class of trade shocks.

8 Conclusion

This paper examines how firms and workers adjust to large external demand shocks using matched employer-employee data. I separate total export shocks into destination, product, and firm-specific components to identify which dimensions of foreign demand drive adjust-

ment. Distinguishing these sources matters because they differ in how they spread across firms and regions, shaping both aggregate recovery and individual outcomes.

The results show that destination-wide shocks cause the largest and most persistent effects. When demand falls across an entire market, firms cut sales sharply but later recover by diversifying across new destinations and products. Workers employed by these firms experience lasting earnings losses even after re-employment, driven mainly by the shared exposure of local employers to the same foreign markets. Product shocks generate smaller and shorter-lived effects, while firm-specific shocks have little impact on aggregate outcomes but create earnings risks for affected workers. These findings highlight that trade shocks transmit through the geography of demand as much as through firm-specific exposure.

These adjustment patterns lead to an uneven recovery. Firms rebuild activity through reallocation, while workers bear the long-run costs through reduced earnings. Because destination shocks strike many employers simultaneously, they depress local outside options and slow wage recovery. The results point to policies that expand worker mobility, preserve viable matches, and support firm diversification as key margins for reducing long-term adjustment costs.

The framework developed here can be applied to other large trade or commodity shocks, such as the 2014-2015 oil price collapse, or to other advanced economies with different export structures. Linking these reduced-form estimates to structural models of firm and worker adjustment would help identify the mechanisms behind asymmetric recoveries and assess how trade exposure shapes resilience across firms and workers in open economies.

References

Amior, M. and Manning, A. (2018). The persistence of local joblessness. *American Economic Review*, 108(7):1942–1970.

Amiti, M. and Davis, D. R. (2011). Trade, firms, and wages: Theory and evidence. *The Review of Economic Studies*, 79(1):1–36.

Autor, D., Dorn, D., and Hanson, G. H. (2021). On the persistence of the china shock. Working Paper 29401, National Bureau of Economic Research.

Autor, D. H., Dorn, D., and Hanson, G. H. (2013). The china syndrome: Local labor market effects of import competition in the united states. *American Economic Review*, 103(6):2121–68.

Autor, D. H., Dorn, D., Hanson, G. H., and Song, J. (2014). Trade adjustment: Worker-level evidence. *The Quarterly Journal of Economics*, 129(4):1799–1860.

Baldwin, R., editor (2009). *The Great Trade Collapse: Causes, Consequences and Prospects*. Centre for Economic Policy Research Press, London & Paris.

Bank of Canada (2010). The coming thaw: Canada's economy and global trade during the crisis. *Bank of Canada Bulletin*, February. Accessed on [2025-11-04].

Bank of Canada (2015). Monetary policy report, april 2015: Canada's economy and the long-term effect of low oil prices. Accessed on [2025-11-04].

Bank of Canada (2024). Legacy noon and closing exchange rates. Accessed on [2025-11-04].

Bastos, P., Silva, J., and Verhoogen, E. (2018). Export destinations and input prices. *American Economic Review*, 108(2):353–92.

Behrens, K., Corcos, G., and Mion, G. (2013). Trade crisis? what trade crisis? *The Review of Economics and Statistics*, 95(2):702–709.

Berman, N., Martin, P., and Mayer, T. (2012). How do different exporters react to exchange rate changes? *The Quarterly Journal of Economics*, 127(1):437–492.

Bernard, A. B., Jensen, J. B., Redding, S. J., and Schott, P. K. (2007a). Firms in international trade. *Journal of Economic Perspectives*, 21(3):105–130.

Bernard, A. B., Redding, S. J., and Schott, P. K. (2007b). Comparative advantage and heterogeneous firms. *The Review of Economic Studies*, 74(1):31–66.

Bloom, N., Draca, M., and Van Reenen, J. (2015). Trade induced technical change? the impact of chinese imports on innovation, it and productivity. *The Review of Economic Studies*, 83(1):87–117.

Borusyak, K., Hull, P., and Jaravel, X. (2021). Quasi-experimental shift-share research designs. *The Review of Economic Studies*, 89(1):181–213.

Brambilla, I., Lederman, D., and Porto, G. (2012). Exports, export destinations, and skills. *American Economic Review*, 102(7):3406–38.

Bustos, P. (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of mercosur on argentinian firms. *American Economic Review*, 101(1):304–40.

Carballo, J. and Mansfield, R. K. (2025). Firm trade exposure, labor market competition, and the worker incidence of trade shocks. Working Paper 33481, National Bureau of Economic Research.

Caselli, F., Koren, M., Lisicky, M., and Tenreyro, S. (2019). Diversification through trade. *The Quarterly Journal of Economics*, 135(1):449–502.

Cilekoglu, A. A. (2024). Export destination and firm upgrading: evidence from spain. *Journal of Applied Economics*, 27(1):2427408.

Conwell, L., Finlay, J., and Williams, T. C. (2024). Schooled by trade? retraining and import competition. Working Paper 24/50, Institute for Fiscal Studies. Accessed on [2025-11-04].

Dauth, W., Findeisen, S., and Suedekum, J. (2014). The rise of the east and the far east: German labor markets and trade integration. *Journal of the European Economic Association*, 12(6):1643–1675.

Dauth, W., Findeisen, S., and Suedekum, J. (2021). Adjusting to globalization in germany. *Journal of Labor Economics*, 39(1):263–302.

Davis, S. J. and von Wachter, T. (2011). Recessions and the costs of job loss. *Brookings Papers on Economic Activity*, Spring:1–72.

di Giovanni, J., Levchenko, A. A., and Mejean, I. (2014). Firms, destinations, and aggregate fluctuations. *Econometrica*, 82(4):1303–1340.

Dix-Carneiro, R. and Kovak, B. K. (2017). Trade liberalization and regional dynamics. *American Economic Review*, 107(10):2908–46.

Eckel, C. and Neary, J. P. (2010). Multi-product firms and flexible manufacturing in the global economy. *The Review of Economic Studies*, 77(1):188–217.

Foster, L., Grim, C., and Haltiwanger, J. (2016). Reallocation in the great recession: Cleansing or not? *Journal of Labor Economics*, 34(S1):S293–S331.

Gabaix, X. (2011). The granular origins of aggregate fluctuations. *Econometrica*, 79(3):733–772.

Garin, A. and Silvério, F. (2023). How responsive are wages to firm-specific changes in labour demand? evidence from idiosyncratic export demand shocks. *The Review of Economic Studies*, 91(3):1671–1710.

Giovanni, J. d. and Levchenko, A. A. (2009). Trade openness and volatility. *The Review of Economics and Statistics*, 91(3):558–585.

Goldsmith-Pinkham, P., Sorkin, I., and Swift, H. (2020). Bartik instruments: What, when, why, and how. *American Economic Review*, 110(8):2586–2624.

Gopinath, G. and Neiman, B. (2014). Trade adjustment and productivity in large crises. *American Economic Review*, 104(3):793–831.

Hakobyan, S. and McLaren, J. (2016). Looking for local labor market effects of nafta. *The Review of Economics and Statistics*, 98(4):728–741.

Hummels, D., Jørgensen, R., Munch, J., and Xiang, C. (2014). The wage effects of offshoring: Evidence from danish matched worker-firm data. *American Economic Review*, 104(6):1597–1629.

Hyman, B. (2018). Can displaced labor be retrained? evidence from quasi-random assignment to trade adjustment assistance. Working Paper 3155386, SSRN.

Hyman, B., Kovak, B. K., and Leive, A. (2024). Wage insurance for displaced workers. Working Paper 32464, NBER.

IMF (2010). Canada: 2010 article iv consultation — staff report. Technical Report CR/10/377, IMF. Accessed on [2025-11-04].

Jacobson, L. S., LaLonde, R. J., and Sullivan, D. G. (1993). Earnings losses of displaced workers. *The American Economic Review*, 83(4):685–709.

Juhn, C., McCue, K., Monti, H., and Pierce, B. (2018). Firm performance and the volatility of worker earnings. *Journal of Labor Economics*, 36(S1):S99–S131.

Kambourov, G. (2009). Labour market regulations and the sectoral reallocation of workers: The case of trade reforms. *The Review of Economic Studies*, 76(4):1321–1358.

Kovak, B. K. (2013). Regional effects of trade reform: What is the correct measure of liberalization? *American Economic Review*, 103(5):1960–76.

Kramarz, F., Martin, J., and Mejean, I. (2020). Volatility in the small and in the large: The lack of diversification in international trade. *Journal of International Economics*, 122:103276.

Lileeva, A. and Trefler, D. (2010). Improved access to foreign markets raises plant-level productivity...for some plants. *The Quarterly Journal of Economics*, 125(3):1051–1099.

Manova, K. (2012). Credit constraints, heterogeneous firms, and international trade. *The Review of Economic Studies*, 80(2):711–744.

Mayer, T., Melitz, M. J., and Ottaviano, G. I. P. (2014). Market size, competition, and the product mix of exporters. *American Economic Review*, 104(2):495–536.

Mayer, T., Melitz, M. J., and Ottaviano, G. I. P. (2021). Product mix and firm productivity responses to trade competition. *The Review of Economics and Statistics*, 103(5):874–891.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71(6):1695–1725.

Menezes-Filho, N. A. and Muendler, M.-A. (2011). Labor reallocation in response to trade reform. Working Paper 17372, National Bureau of Economic Research.

OECD (2011). Key trends in 2010: Exports lead growth in canada. OECD Economic Outlook / Statistics Canada Key Indicators. Accessed on [2025-11-04].

Pavcnik, N. (2002). Trade liberalization, exit, and productivity improvements: Evidence from chilean plants. *The Review of Economic Studies*, 69(1):245–276.

Pierce, J. R. and Schott, P. K. (2016). The surprisingly swift decline of us manufacturing employment. *American Economic Review*, 106(7):1632–62.

Schmieder, J. F., von Wachter, T., and Heining, J. (2023). The costs of job displacement over the business cycle and its sources: Evidence from germany. *American Economic Review*, 113(5):1208–54.

Statistics Canada (2011). International merchandise trade, annual review 2010. Technical Report 65-208-XIE. Accessed on [2025-11-04].

Statistics Canada (2016). Canadian economic observer: Feature article — canada's export performance after the 2008–09 recession. *Canadian Economic Observer*, (11-010-X). Accessed on [2025-11-04].

Statistics Canada (2017). Canada's exports over time: Resources and manufactured goods. *Canadian Economic Observer*, (11-630-X). Accessed on [2025-11-04].

Vannoorenberghe, G. (2012). Firm-level volatility and exports. *Journal of International Economics*, 86(1):57–67.

Vannoorenberghe, G., Wang, Z., and Yu, Z. (2016). Volatility and diversification of exports: Firm-level theory and evidence. *European Economic Review*, 89:216–247.

Verhoogen, E. A. (2008). Trade, quality upgrading, and wage inequality in the mexican manufacturing sector. *The Quarterly Journal of Economics*, 123(2):489–530.

World Bank (2024). Trade (% of gdp) – oecd members. Accessed on [2025-11-04].

Zouheir, E.-S., Terhi, M., and Katariina, N. H. (2023). Firm-level consequences of export demand shocks: Swedish and finnish exporters. Working Paper 108, Research Institute of the Finnish Economy.

Appendix

A Appendix Tables and Figures

Appendix Tables

Table A.1. Average estimates of firm outcomes with respect to total demand change

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
Exports	4,000,000	-1,332,245***	-1,420,953***	-1,296,182***	-1,342,194***	-751,562**	-1,023,872***
		(155,053)	(170,567)	(158,082)	(170,481)	(285,038)	(204,066)
Sales	19,000,000	-3,742,059***	-3,927,486***	-3,516,864***	-3,583,082***	-1,600,655	-2,558,760***
		(695,760)	(775,347)	(729,487)	(795,005)	(1,352,668)	(968,965)
Employment	77	-9.470***	-10.917***	-8.879***	-9.630***	-3.084	-5.982**
		(2.289)	(2.555)	(2.388)	(2.606)	(3.742)	(2.833)
Payroll	3,400,000	-392,588***	-464,834***	-384,726***	-426,501***	-100,795	-242,761*
		(117,529)	(130,459)	(120,848)	(131,093)	(195,269)	(145,704)
Value added	4,900,000	-938,370***	-993,560***	-845,048***	-859,498***	-187,409	-516,229**
		(196,967)	(217,987)	(199,702)	(215,914)	(320,037)	(238,143)

Notes: Estimates per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (2), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level.

Table A.2. Average estimates of firm adjustment margins with respect to total demand change

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
No. of products exported	7.8	-0.647***	-0.746***	-0.686***	-0.754***	-0.57**	-0.628***
		(0.172)	(0.185)	(0.172)	(0.182)	(0.247)	(0.193)
No. of destinations	4.6	-0.358***	-0.379***	-0.357***	-0.369***	-0.347*	-0.352**
		(0.121)	(0.13)	(0.125)	(0.132)	(0.182)	(0.14)
Exports per product	470,000	-171,205***	-176,719***	-163,553***	-165,331***	-116,750***	-140,151***
		(20,935)	(22,400)	(20,880)	(22,005)	(33,468)	(25,092)
Exports per destination	920,000	-354,938***	-379,120***	-355,507***	-370,130***	-193,708***	-274,607***
		(38,979)	(42,109)	(39,287)	(41,690)	(61,213)	(45,788)
Value added per worker	61,000	-6,478***	-6,775***	-5,420***	-5,387***	263.78	-2,578*
		(1,310)	(1,403)	(1,257)	(1,327)	(1,842)	(1,346)

Notes: Estimates per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (2), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level.

Table A.3. Average estimates of firm outcomes by shock component

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
Panel A. Destination-level component							
Exports	4,000,000	-2,707,073***	-2,933,066***	-2,745,871***	-2,889,227***	-1,016,897***	-1,881,384***
		(306,370)	(325,231)	(311,971)	(326,940)	(387,725)	(307,415)
Sales	19,000,000	-5,467,862***	-5,770,945***	-5,118,367***	-5,230,317***	-1,743,403	-3,430,885**
		(1,230,785)	(1,318,736)	(1,274,982)	(1,355,351)	(1,985,074)	(1,445,598)
Employment	77	-19.205***	-21.596***	-18.124***	-19.343***	-11.27*	-14.697***
		(4.172)	(4.541)	(4.334)	(4.642)	(6.065)	(4.709)
Payroll	3,400,000	-737,551***	-841,817***	-713,352***	-771,071***	-326,324	-519,838**
		(209,440)	(226,338)	(217,581)	(231,996)	(313,540)	(242,980)
Value added	4,900,000	-1,597,456***	-1,707,247***	-1,407,186***	-1,435,006***	-86,696	-746,941*
		(344,721)	(369,294)	(352,609)	(373,860)	(507,433)	(386,109)
Panel B. Product-level component							
Exports	4,000,000	-1,158,461***	-1,232,112***	-1,106,215***	-1,139,956***	-815,742**	-960,978***
		(188,036)	(207,071)	(196,783)	(212,604)	(355,157)	(258,807)
Sales	19,000,000	-3,676,563***	-3,917,020***	-3,515,255***	-3,627,267***	-2,101,876	-2,808,565**
		(842,609)	(935,365)	(893,701)	(972,082)	(1,565,681)	(1,156,360)
Employment	77	-7.556***	-9.057***	-7.252***	-8.091***	-1.854	-4.553
		(2.704)	(3.02)	(2.866)	(3.134)	(4.498)	(3.426)
Payroll	3,400,000	-332,346**	-410,560***	-336,521**	-384,285**	-84,174	-210,347
		(137,845)	(152,870)	(143,538)	(155,896)	(235,097)	(175,691)
Value added	4,900,000	-858,643***	-907,929***	-796,200***	-813,284***	-247,076	-521,638*
		(227,432)	(253,881)	(236,762)	(258,192)	(395,062)	(291,933)
Panel C. Idiosyncratic component							
Exports	4,000,000	-394,856*	-473,918**	-539,414**	-615,762***	-891,862***	-715,638***
		(214,964)	(225,655)	(222,839)	(234,273)	(328,913)	(251,311)
Sales	19,000,000	-949,651	-1,040,317	-1,017,537	-1,085,514	-3,022,452	-2,019,995
		(1,009,627)	(1,082,526)	(1,074,792)	(1,154,295)	(1,848,975)	(1,309,095)
Employment	77	-0.762	-0.363	-0.592	-0.319	-3.209	-1.901
		(3.329)	(3.583)	(3.570)	(3.837)	(5.716)	(4.239)
Payroll	3,400,000	17,139	24,457	838	1,969	-130,253	-64,707
		(171,896)	(184,920)	(180,368)	(193,382)	(289,061)	(213,483)
Value added	4,900,000	-48,310	-103,200	8,644	-12,899	-181,770	-86,563
		(267,616)	(292,255)	(289,015)	(311,588)	(469,083)	(344,433)

Notes: Estimates per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (3), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level.

Table A.4. Average estimates of firm outcomes by shock component

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
Panel A. Destination-level component							
No. of products exported	7.8	0.096	0.127	0.198	0.238	-0.249	-0.025
		(0.371)	(0.41)	(0.386)	(0.418)	(0.466)	(0.393)
No. of destinations	4.6	0.826***	1.033***	1.079***	1.255***	1.583***	1.331***
		(0.219)	(0.241)	(0.227)	(0.246)	(0.298)	(0.239)
Exports per product	470,000	-351,949***	-368,318***	-351,837***	-361,636***	-164,765***	-258,301***
		(54,082)	(56,284)	(54,662)	(56,367)	(53,360)	(50,792)
Exports per destination	920,000	-870,417***	-956,162***	-907,447***	-966,299***	-518,453***	-712,950***
		(85,279)	(91,791)	(88,206)	(93,201)	(94,140)	(83,762)
Value added per worker	61,000	-5,699**	-5,395*	-3,355	-2,704	8,281**	2,463
		(2,751)	(3,081)	(2,758)	(2,992)	(3,535)	(2,818)
Panel B. Product-level component							
No. of products exported	7.8	-0.837***	-0.988***	-0.93***	-1.039***	-0.723**	-0.826***
		(0.181)	(0.195)	(0.187)	(0.200)	(0.281)	(0.216)
No. of destinations	4.6	-0.672***	-0.746***	-0.724***	-0.778***	-0.748***	-0.736***
		(0.151)	(0.162)	(0.157)	(0.166)	(0.219)	(0.174)
Exports per product	470,000	-149,350***	-154,136***	-139,160***	-139,994***	-122,602***	-130,881***
		(28,184)	(30,267)	(29,350)	(31,061)	(46,134)	(35,953)
Exports per destination	920,000	-284,490***	-298,793***	-278,839***	-286,290***	-160,840**	-219,839***
		(43,562)	(47,977)	(44,879)	(48,340)	(77,404)	(56,766)
Value added per worker	61,000	-7,449***	-7,817***	-6,651***	-6,712***	-1,743	-4,197**
		(1,443)	(1,558)	(1,417)	(1,516)	(2,328)	(1,687)
Panel C. Idiosyncratic component							
No. of products exported	7.8	-0.227	-0.162	-0.171	-0.12	-0.503	-0.337
		(0.275)	(0.295)	(0.269)	(0.287)	(0.395)	(0.298)
No. of destinations	4.6	-0.031	-0.055	-0.03	-0.044	-0.3	-0.165
		(0.188)	(0.197)	(0.185)	(0.194)	(0.272)	(0.205)
Exports per product	470,000	-70,732*	-76,496*	-87,725***	-94,583***	-137,286***	-112,506**
		(41,293)	(43,238)	(42,586)	(44,402)	(47,984)	(429,49)
Exports per destination	920,000	-97,225*	-102,787*	-126,705***	-135,938***	-226,713***	-176,709**
		(52,325)	(56,676)	(55,261)	(59,247)	(77,323)	(611,42)
Value added per worker	61,000	262	342	997	1,192	3,223	2,110
		(2,230)	(2,458)	(2,306)	(2,487)	(3,097)	(2,462)

Notes: Estimates per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (3), and subtracting the pre-period average from the corresponding year period average. The regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province times 4-digit industry level.

Table A.5. Weights of shock components in total demand change

	Firms sample	**Workers sample**
Destination component	0.14	0.87
Product component	0.76	0.19
Idiosyncratic component	0.09	-0.06

Notes: Entries report covariance–variance ratios $\text{cov}(X^k, X^{\text{tot}})/\text{var}(X^{\text{tot}})$ for each component k of the decomposed total demand change. Values may not sum exactly to one due to rounding.

Table A.6. Average estimates of worker outcomes with respect to firms' total demand shifter

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
Earnings	36,000	-5,679***	-0.6631***	-5,792***	-6,386***	-6,163***	-5,978***
		(1,365)	(1,542)	(1,323)	(1,424)	(1,357)	(1,320)
Employment	0.950	-0.017**	-0.022***	-0.018**	-0.021**	-0.012	-0.015*
		(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)

Notes: Estimates per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (4), and subtracting the pre-period average from the corresponding year period average. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province.

Table A.7. Average estimates of worker outcomes by shock component

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
Panel A. Destination-level component							
Earnings	36,000	-10,780***	-12,671***	-10,758***	-11,888***	-11,536***	-11,147***
		(2,545)	(2,916)	(2,535)	2,761	(3,188)	(2,796)
Employment	0.948	-0.025	-0.030*	-0.021	-0.023	0.002	-0.009
		(0.014)	(0.016)	(0.015)	(0.017)	(0.024)	(0.019)
Panel B. Product-level component							
Earnings	36,000	-4,707***	-5,497***	-4,850***	-5,352***	-5,157***	-5,003***
		(1,275)	(1,454)	(1,246)	(1,353)	(1,335)	(1,267)
Employment	0.948	-0.015**	-0.019***	-0.017***	-0.020**	-0.015*	-0.016**
		(0.006)	(0.007)	(0.007)	(0.008)	(0.009)	(0.008)
Panel C. Firm-specific component							
Earnings	36,000	-4,255***	-5,155***	-4,176***	-4,699***	-4,821**	-4,498**
		(1,500)	(1,721)	(1,510)	(1,649)	(2,200)	(1,810)
Employment	0.948	-0.012	-0.015	-0.010	-0.011	-0.004	-0.007
		(0.011)	(0.012)	(0.013)	(0.014)	(0.025)	(0.019)

Notes: Estimates per 1 percent decline in demand; standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All coefficients are obtained from estimating equation (5), and subtracting the pre-period average from the corresponding year period average. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province.

Table A.8. Average elasticities of worker outcomes by market and firm-specific components

	2009–2013		2014–2019		2008–2019	
	Market	Firm dev.	Market	Firm dev.	Market	Firm dev.
Panel A. Total shock						
Earnings	-0.239***	-0.035	-0.241***	-0.028	-0.228***	-0.030
	(0.048)	(0.030)	(0.045)	(0.026)	(0.044)	(0.026)
Employment	-0.033***	-0.004	-0.024*	0.003	-0.027***	-0.000
	(0.011)	(0.008)	(0.013)	(0.010)	(0.010)	(0.000)
Panel B. Destination-level shock						
Earnings	-0.464***	-0.120**	-0.434***	-0.123*	-0.426***	-0.116**
	(0.096)	(0.058)	(0.118)	(0.066)	(0.100)	(0.058)
Employment	-0.041*	-0.002	0.007	-0.011	-0.015	-0.007
	(0.021)	(0.014)	(0.033)	(0.023)	(0.023)	(0.021)
Panel C. Product-level shock						
Earnings	-0.176***	-0.037	-0.182***	-0.026	-0.170***	-0.029
	(0.042)	(0.027)	(0.040)	(0.021)	(0.038)	(0.021)
Employment	-0.026***	-0.005	-0.027**	0.004	-0.025**	-0.000
	(0.009)	(0.007)	(0.012)	(0.011)	(0.009)	(0.000)

Notes: Elasticities per 1 percent decline in corresponding demand. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The market component measures average exposure across firms within a local market (census division × 4-digit NAICS), while the firm deviation captures each firm's deviation from this market average. Specification matches the worker baseline: exposure based on 2007 employer; firm fixed effects; headquarter-province×year fixed effects; worker province×year fixed effects; demographic and experience controls. Standard errors clustered by industry×province. Appendix Table A.9 provides the estimates in levels.

Table A.9. Average estimates of worker outcomes by market and firm-specific components

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
Panel A. Total shock							
Market average							
Earnings	36,000	-7,595	-8,987	-7,844	-8,729	-8,790	-8,317
		(1,703)	(1,925)	(1,629)	(1,751)	(1,659)	(1,611)
Employment	0.948	-0.026	-0.032	-0.028	-0.032	-0.023	-0.026
		(0.009)	(0.010)	(0.010)	(0.011)	(0.012)	(0.010)
Firm deviation							
Earnings	36,000	-1,187	-1,383	-1,159	-1,271	-1,003	-1,081
		(1,060)	(1,111)	(1,042)	(1,076)	(939)	(957)
Employment	0.948	-0.003	-0.004	-0.003	-0.004	0.003	-0.000
		(0.007)	(0.008)	(0.008)	(0.008)	(0.010)	(0.008)
Panel B. Destination-level shock							
Market average							
Earnings	36,000	-15,202	-18,012	-15,235	-16,929	-15,818	-15,527
		(3,197)	(3,672)	(3,188)	(3,485)	(4,320)	(3,658)
Employment	0.948	-0.044	-0.052	-0.036	-0.039	0.006	-0.015
		(0.016)	(0.018)	(0.018)	(0.020)	(0.030)	(0.023)
Firm deviation							
Earnings	36,000	-4,027	-4,663	-4,003	-4,380	-4,477	-4,240
		(1,925)	(2,128)	(1,988)	(2,131)	(2,389)	(2,107)
Employment	0.948	-0.001	-0.001	-0.002	-0.002	-0.011	-0.006
		(0.014)	(0.016)	(0.016)	(0.018)	(0.023)	(0.019)
Panel C. Product-level shock							
Market average							
Earnings	36,000	-5,572	-6,548	-5,775	-6,401	-6,648	-6,211
		(1,469)	(1,653)	(1,413)	(1,518)	(1,453)	(1,395)
Employment	0.948	-0.018	-0.023	-0.022	-0.025	-0.025	-0.024
		(0.008)	(0.009)	(0.008)	(0.009)	(0.011)	(0.009)
Firm deviation							
Earnings	36,000	-1,191	-1,430	-1,197	-1,341	-931	-1,064
		(987)	(1,009)	(951)	(966)	(769)	(802)
Employment	0.948	-0.004	-0.005	-0.004	-0.005	0.004	-0.000
		(0.005)	(0.006)	(0.006)	(0.007)	(0.011)	(0.008)

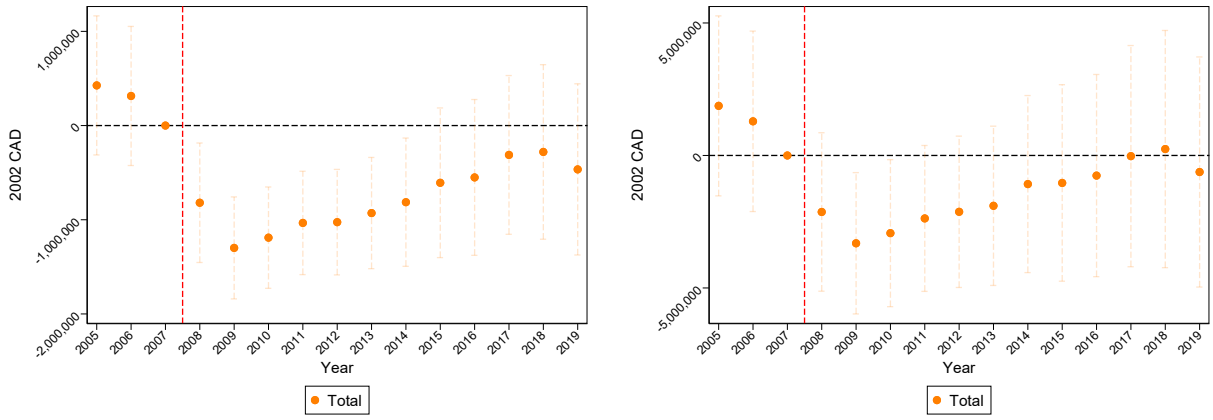
Notes: Estimates per 1 percent decline in the corresponding demand. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The market component measures average exposure across firms within a local market (census division × 4-digit NAICS), while the firm deviation captures each firm's deviation from this market average. Specification matches the worker baseline: exposure based on 2007 employer; firm fixed effects; headquarter-province×year fixed effects; worker province×year fixed effects; demographic and experience controls. Standard errors clustered by industry×province.

Table A.10. Average estimates of worker outcomes by stayer and leaver status

	2005–2007 average	2008–2011	2009–2011	2008–2013	2009–2013	2014–2019	2008–2019
Panel A. Total shock							
Stayers							
Earnings	47,000	-2,764	-3,550*	-2,371	-2,764	-1,622	-1,996
		(1,698)	(2,001)	(1,549)	(1,700)	(2,010)	(1,754)
Leavers							
Earnings	34,000	-6,407***	-7,417***	-6,676***	-7,336***	-7,739***	-7,207***
		(1,504)	(1,690)	(1,542)	(1,665)	(1,886)	(1,684)
Employment	0.950	-0.023**	-0.028**	-0.024**	-0.028**	-0.020	-0.022*
		(0.010)	(0.012)	(0.011)	(0.012)	(0.015)	(0.013)
Panel B. Destination-level shock							
Stayers							
Earnings	47,000	-6,438**	-7,736***	-5,866**	-6,530**	-2,227	-4,046
		(2,502)	(2,857)	(2,401)	(2,581)	(4,021)	(3,066)
Leavers							
Earnings	34,000	-12,275***	-14,346***	-12,527***	-13,821***	-15,066***	-13,796***
		(3,174)	(3,629)	(3400)	(3,726)	(5,089)	(4,183)
Employment	0.950	-0.041**	-0.049**	-0.038	-0.042	-0.025	-0.032
		(0.019)	(0.023)	(0.024)	(0.027)	(0.043)	(0.033)
Panel C. Product-level shock							
Stayers							
Earnings	47,000	-2,061	-2,757	-1,677	-2,018	-1,262	-1,470
		(1,629)	(1,915)	(1,498)	(1,643)	(1,965)	(1,706)
Leavers							
Earnings	34,000	-5,170***	-5,974***	-5,423***	-5,957***	-6,077***	-5,750***
		(1,449)	(1,648)	(1,513)	(1,651)	(1,960)	(1,705)
Employment	0.950	-0.016**	-0.020**	-0.018**	-0.020**	-0.012	-0.015
		(0.008)	(0.009)	(0.009)	(0.010)	(0.014)	(0.011)
Panel D. Idiosyncratic shock							
Stayers							
Earnings	47,000	323	-142	824	645	5,337*	3,080
		(1,474)	(1,664)	(1,613)	(1,748)	(3,153)	(2303)
Leavers							
Earnings	34,000	-5,045**	-6,002**	-5,063**	-5,641**	-6,607*	-5,835**
		(2,051)	(2,341)	(2,224)	(2,437)	(3,736)	(2,944)
Employment	0.950	-0.016	-0.019	-0.014	-0.015	-0.005	-0.009
		(0.015)	(0.017)	(0.018)	(0.020)	(0.035)	(0.026)

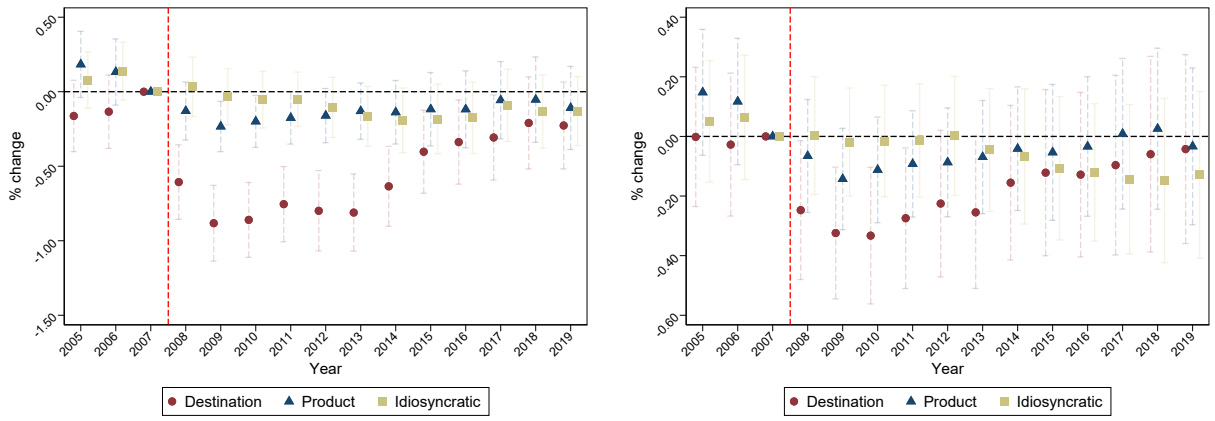
Notes: Estimates per 1 percent decline in the corresponding demand. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Stayers are workers continuously employed by their 2007 firm through 2019. Leavers are workers employed in 2007 who left before 2019. Specification matches the worker baseline: exposure based on 2007 employer; firm fixed effects; headquarter-province×year fixed effects; worker province×year fixed effects; demographic and experience controls. Standard errors clustered by industry×province.

Appendix Figures



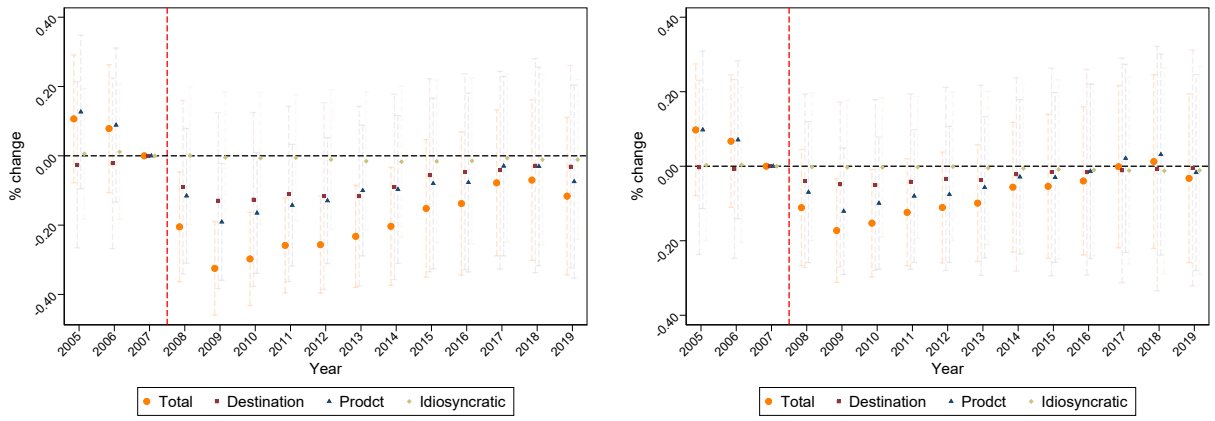
(a) Exports **(b)** Sales

Figure A.1. Dynamic response to the external demand shifter with 2007 baseline and 95% CIs. Coefficients are obtained from estimating equation (2). Regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province×4-digit industry level.



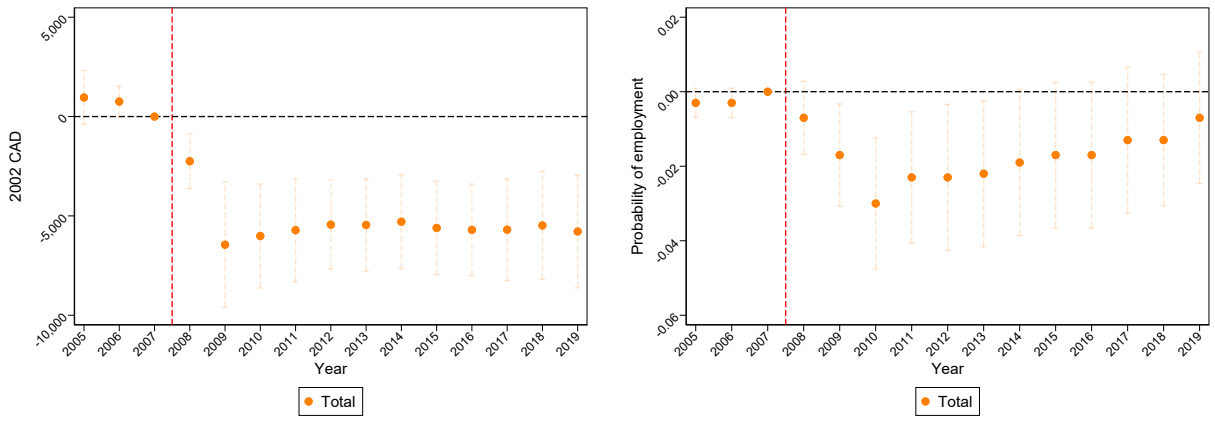
(a) Exports **(b)** Sales

Figure A.2. Dynamic responses by shock component (destination, product, firm-specific) with 2007 baseline and 95% CIs. Coefficients are obtained by estimating equation (3). Regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province×4-digit industry level.



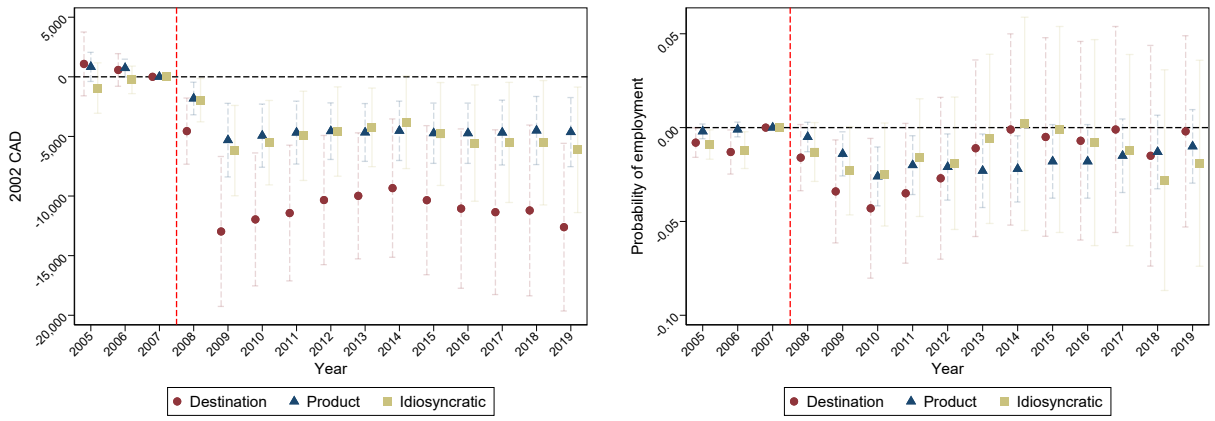
(a) Exports **(b)** Sales

Figure A.3. Dynamic response to the external demand shifter and weighted decomposed shock components (destination, product, firm-specific) with 2007 baseline and 95% CIs. Weights are covariance ratios, $\text{cov}(X^k, X^{\text{tot}})/\text{var}(X^{\text{tot}})$, presented in Appendix Table A.5. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates from equations (2) and (3) by pre-period means. Regressions have year×province fixed effects and control for pre-recession shares of firms' exports going to the US. The standard errors are clustered at province×4-digit industry level.



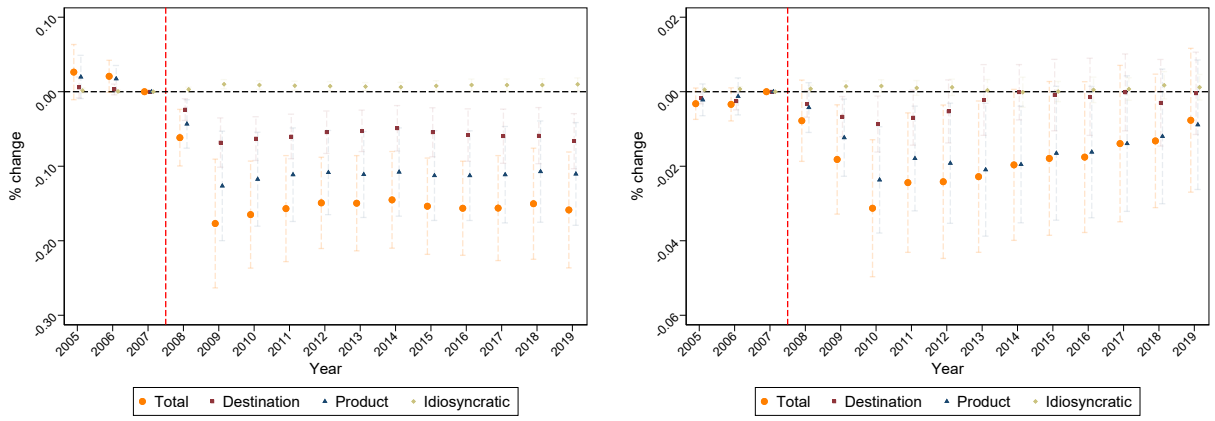
(a) Earnings **(b)** Employment

Figure A.4. Dynamic response of worker outcomes to the external demand shifter with 2007 baseline and 95% CIs. Coefficients are obtained by estimating equation (4). Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province.



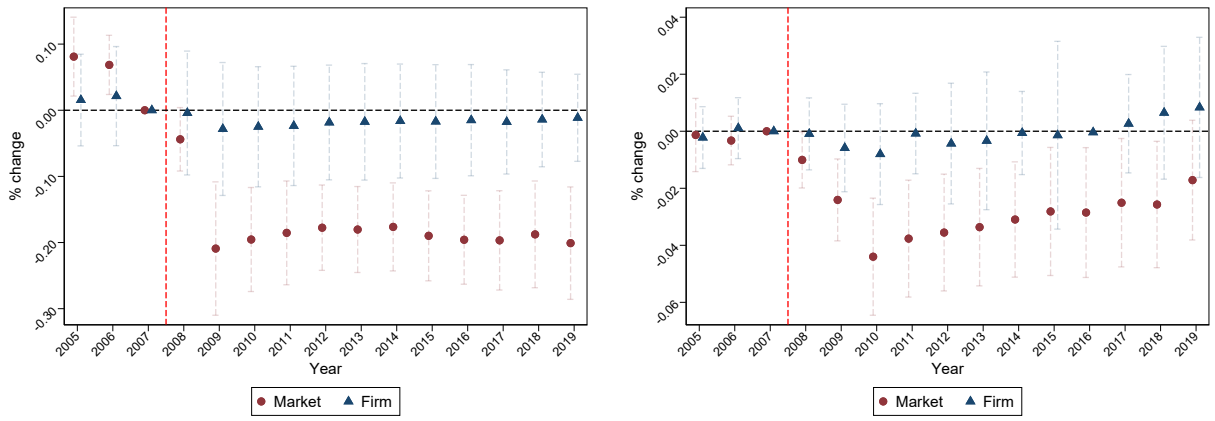
(a) Earnings **(b)** Employment

Figure A.5. Dynamic response of worker outcomes by shock component (destination, product, firm-specific) with 2007 baseline and 95% CIs. Coefficients are obtained by estimating equation (5). Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province.



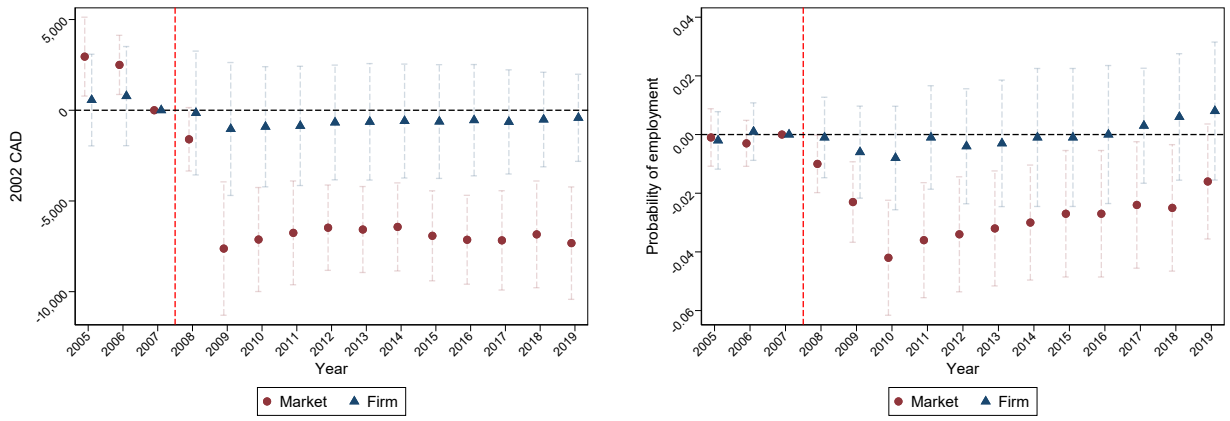
(a) Earnings **(b)** Employment

Figure A.6. Dynamic response of worker outcomes to the external demand shifter and weighted decomposed shock components (destination, product, firm-specific) with 2007 baseline and 95% CIs. Weights are covariance ratios, $\text{cov}(X^k, X^{\text{tot}})/\text{var}(X^{\text{tot}})$, presented in Appendix Table A.5. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates from equations (4) and (5) by pre-period means. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province.



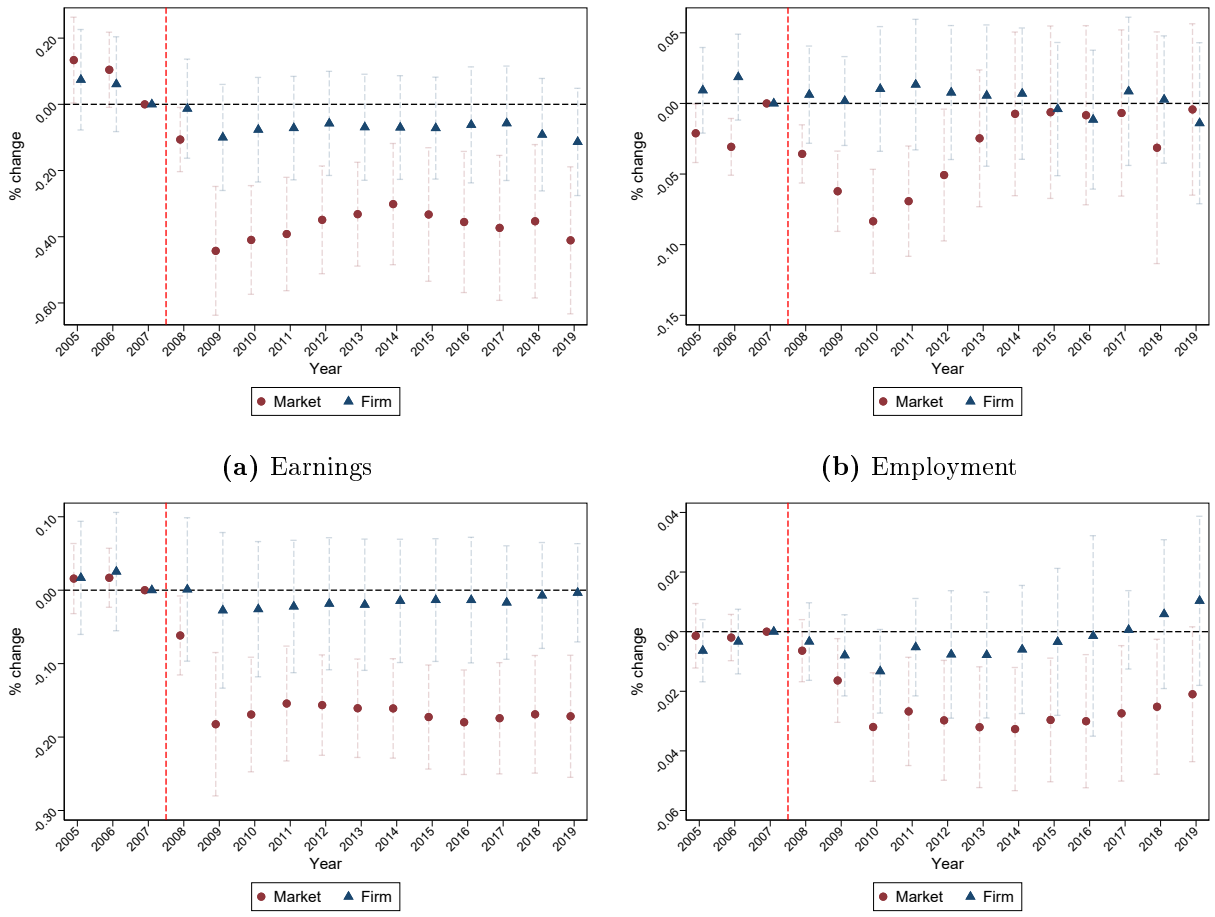
(a) Earnings **(b)** Employment

Figure A.7. Dynamic responses of worker outcomes to "market-average" and "firm-deviations" of external demand shifter with 2007 baseline and 95% CIs. The market average is the average shock of firms operating within the local labour market m, weighted by their pre-recession employment shares. The firm-deviation is the firm's shock's deviation from the market average. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand, obtained by dividing estimates by pre-period means. Negatives of estimated coefficients are plotted for interpretation. Specification matches the worker baseline: exposure based on 2007 employer; firm fixed effects; headquarter-province×year fixed effects; worker province×year fixed effects; demographic and experience controls. Standard errors clustered by industry×province. Appendix Figure A.8 plots the level coefficient estimates.



(a) Earnings **(b)** Employment

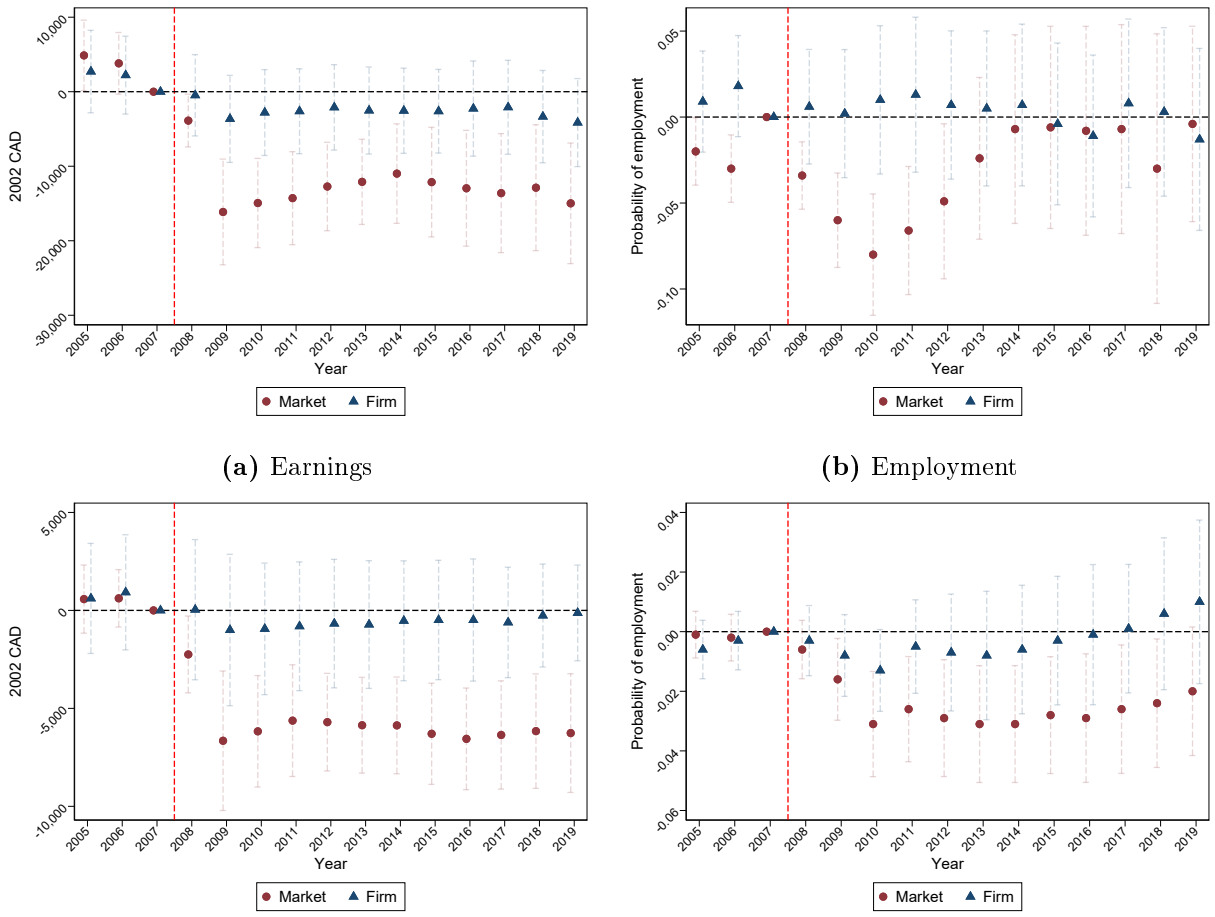
Figure A.8. Dynamic responses of worker outcomes to "market-average" and "firm-deviations" of external demand shifter with 2007 baseline and 95% CIs. The market average is the average shock of firms operating within the local labour market m, weighted by their pre-recession employment shares. The firm-deviation is the firm's shock's deviation from the market average. Negatives of estimated coefficients are plotted for interpretation. Specification matches the worker baseline: exposure based on 2007 employer; firm fixed effects; headquarter-province×year fixed effects; worker province×year fixed effects; demographic and experience controls. Standard errors clustered by industry×province.



(a) Earnings **(b)** Employment

(c) Earnings **(d)** Employment

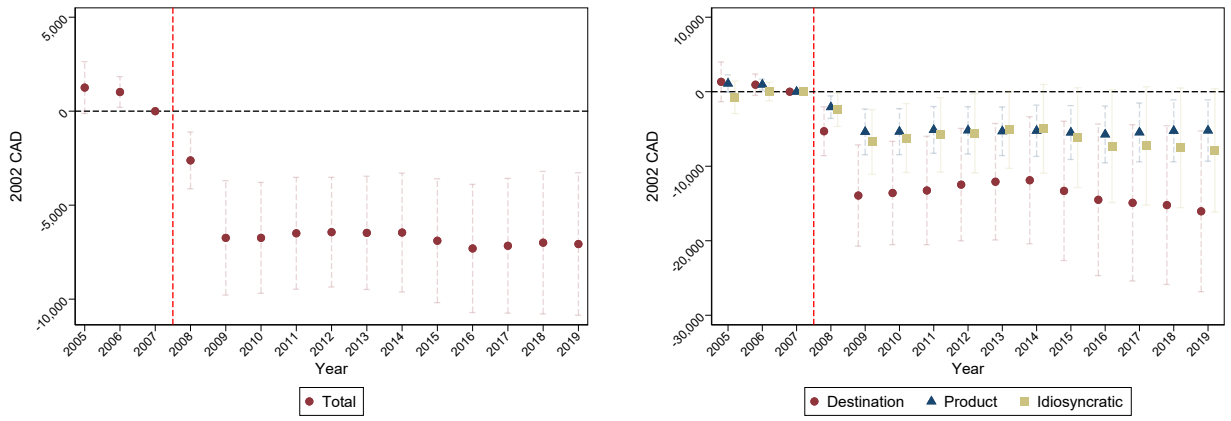
Figure A.9. Dynamic responses of worker outcomes to "market-average" and "firm-deviations" of product-wide and destination-wide shocks with 2007 baseline and 95% CIs. The market average is the average shock of firms operating within the local labour market m, weighted by their pre-recession employment shares. The firm-deviation is the firm's shock's deviation from the market average. Coefficients are (semi-)elasticities with respect to 1% change in corresponding demand. Elasticities are obtained by dividing coefficient estimates by pre-period means. Negatives of estimated coefficients are plotted for interpretation. The outcome variable is employment earnings for the left panel, and an employment dummy for the right panel. The coefficients are obtained from estimating equation (5) but with substituting the demand shock with the two "decomposed" shocks. The regressions have year-by-firm's province and 2007 employer firm fixed-effects, alongside year-by-worker's province, year-by-worker's labour market experience, age, sex, and marital status fixed-effects. The standard errors are clustered at province times 4-digit industry level. Appendix Figure A.10 plots the level coefficient estimates.



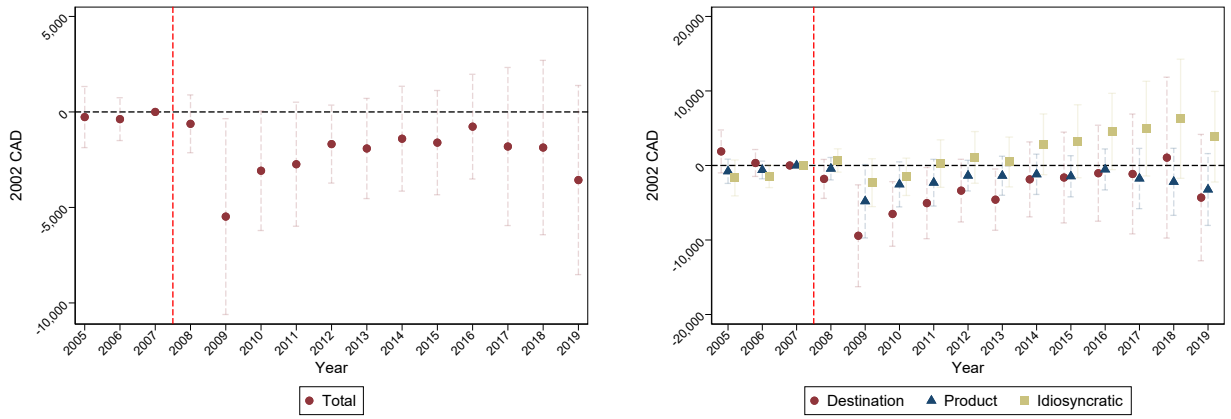
(a) Earnings **(b)** Employment

(c) Earnings **(d)** Employment

Figure A.10. Dynamic responses of worker outcomes to "market-average" and "firm-deviations" of product-wide and destination-wide shocks with 2007 baseline and 95% CIs. The market average is the average shock of firms operating within the local labour market m, weighted by their pre-recession employment shares. The firm-deviation is the firm's shock's deviation from the market average. Negatives of estimated coefficients are plotted for interpretation. The outcome variable is employment earnings for the left panel, and an employment dummy for the right panel. The coefficients are obtained from estimating equation (5) but with substituting the demand shock with the two "decomposed" shocks. The regressions have year-by-firm's province and 2007 employer firm fixed-effects, alongside year-by-worker's province, year-by-worker's labour market experience, age, sex, and marital status fixed-effects. The standard errors are clustered at province times 4-digit industry level.



(a) Leaver, total **(b)** Leaver, decomposed



(c) Stayer, total **(d)** Stayer, decomposed

Figure A.11. Dynamic response of worker outcomes by shock component (total, destination, product, firm-specific) with 2007 baseline and 95% CIs. Coefficients are obtained by estimating equations (4) and (5). Stayers are workers continuously employed by their 2007 firm through 2019. Leavers are workers employed in 2007 who left before 2019. Exposure based on 2007 employer; regressions have firm FE; firm's province×year FE; worker's province×year FE; age, sex, marital-status FEs; experience×year FE. Standard errors clustered by industry×province.

B Data Appendix

B.1 Firm-Level Variables

This subsection describes the construction and content of all firm-level variables used in the analysis. All values expressed in dollars are converted to constant 2002 Canadian dollars using the national consumer price index. Variables are drawn from the Canadian Employer-Employee Dynamics Database (CEEDD), primarily from the National Accounts Longitudinal Microdata File (NALMF) and the Trade by Exporter Characteristics (TEC) file. Missing values are set to zero for flow variables such as sales, exports, payroll, and value added, where a missing entry typically reflects zero activity. All continuous variables are winsorized at the 5th and 95th percentiles, calculated separately for each year.

- **Employment**: The average number of full-time equivalent employees over the calendar year. This variable is derived from payroll records in CEEDD and reflects total paid hours adjusted to a full-time schedule.

- **Sales**: Total firm revenue, constructed by summing farm and non-farm sales reported in NALMF. If the reported sales value is below the firm's total exports in a given year, sales are adjusted upward to match the export value, ensuring internal consistency.

- **Payroll**: Total gross payroll, including all taxable employment income reported on T4 slips. This measure is obtained directly from CEEDD without further adjustment.

- **Value Added**: Constructed from NALMF components using the income-based approach. It is defined as the sum of (i) gross payroll, (ii) net income before taxes and extraordinary items, and (iii) capital cost allowance.

- **Exports (Level)**: Total value of goods exports, obtained from the TEC file. Export flows are originally reported at the HS8-product-by-destination level. They are aggregated to the HS6 level and mapped to the HS2002 classification system for consistency with international trade data. All export values are deflated to 2002 Canadian dollars.

- **Number of Destinations**: The number of unique destination countries to which the firm exported goods in a given year, regardless of types of products exported.
- **Number of Products**: The number of unique HS6 products exported by the firm in a given year, regardless of destination.
- **Export per Destination**: Total firm exports in a given year divided by the number of destination countries. Reflects average exports per market served.
- **Export per Product**: Total firm exports in a given year divided by the number of unique HS6 products exported. Reflects average exports per product line.
- **Industry and Location**: Firms are assigned to four-digit NAICS industries and census divisions based on their postal code. Both assignments vary over time and reflect the firm's reported headquarters location in each year.

B.2 Worker-Level Variables

This subsection documents the construction of worker-level variables. Worker data are drawn from the T1 Personal Master File (T1PMF), the T1 Family File (T1FF), and T4 tax slips, all accessed through the Canadian Employer-Employee Dynamics Database (CEEDD). The link between employment and demographic records is made using the individual's Social Insurance Number (SIN). I construct a simple random 20% sample of individuals employed at sample firms in 2007, without stratification by firm, industry, or geography. Workers must have been employed with positive T4 earnings in 2007 to be included. Each individual is then followed annually through 2019. This cohort design allows tracking of individuals regardless of whether they stay with their 2007 employer, move to another firm, or leave employment altogether.

Because the worker sample is drawn from employees of continuous exporting firms, it is not representative of the broader Canadian workforce. The analysis focuses on this selected group in order to link firm-level trade shocks to long-run worker outcomes.

- **Annual Earnings**: Total employment income reported on T4 slips, summed across all employers in a given year. This includes wages, bonuses, and other taxable earnings. All earnings are converted to 2002 Canadian dollars using the national consumer price index. Continuous earnings are winsorized at the 5th and 95th percentiles separately by sex and year.

- **Employment Status**: Workers are coded as employed if they have positive T4 earnings in a given year. If no earnings are reported, the individual is coded as not employed and assigned zero earnings. Individuals who remain alive but appear in no employment records are retained in the panel with zero outcomes.

- **Employer Assignment**: Each worker is assigned to a single firm in each year, defined as the employer that paid the highest total earnings. This assignment is used to attach firm-level characteristics to workers. If two firms paid equal amounts, the tie is broken at random. In all years, total annual earnings reflect the sum of income from all employers.

- **Demographics**: Age, sex, and marital status are drawn from the T1PMF and T1FF. All variables are time-varying and updated annually.

- **Mortality**: Year of death is recorded in the T1PMF. Individuals are dropped from the panel in the year of death.

- **Industry and Geography**: Worker industry is defined by the NAICS code of the assigned firm. Geographic location is taken from the worker's residential postal code, as recorded in the T1FF. Both assignments are updated annually.

B.3 Demand Shifter Inputs and Summary Statistics

This section documents the data used to construct the firm-level demand shifter and describes how import demand evolved across products and destinations during the Great Recession.

The analysis uses the BACI trade database, which reports annual bilateral import flows at the HS6 product level. For each product–destination pair, I calculate import values from all countries other than Canada. These flows are averaged over two-year windows before and after the crisis, and symmetric growth rates are computed to measure changes in foreign demand.

The symmetric growth rate remains defined when trade flows are zero in one of the periods. This avoids the need for imputation and ensures that even volatile or thin markets are included. All import values are reported in nominal US dollars, consistent with the BACI database. No deflation is applied. To prevent Canadian activity from mechanically influencing the results, Canadian-origin exports are excluded from the import totals used to calculate demand changes.

The growth rate for each pair is defined as the symmetric change in imports between 2006–2007 and 2009–2010. These rates are later combined with firm-level export shares to generate the exposure measure. Although the firm-specific shifter is constructed using these growth rates, they are not firm-level variables. Rather, they reflect the change in demand in a particular market and serve as inputs to the weighting step that links firms to global conditions.

Table A.11 reports summary statistics for three sets of demand changes: the product–destination growth rate ($\Delta M_{pd}^{T_1}$), the product-wide average ($\Delta M_{p\cdot}^{T_1}$), and the destination-wide average ($\Delta M_{\cdot d}^{T_1}$). These match the margins used in the decomposition of the total firm-level shifter. The unweighted distribution of $\Delta M_{pd}^{T_1}$ is wide, with a mean of 0.08 and a standard deviation of 0.70. Product-level demand changes are less dispersed, with a mean of -0.09 and standard deviation of 0.49. Destination-level demand changes appear more stable, with a positive mean of 0.17 and a standard deviation of 0.39.

These averages, however, give a misleading picture of the demand environment faced by Canadian firms. Weighting each component by Canada's pre-crisis export shares changes the interpretation. The weighted mean of $\Delta M_{pd}^{T_1}$ falls to -0.16, and the mean destination-wide

change drops from 0.17 to −0.15. Product-level changes follow the same pattern. This shift reflects the fact that Canada exported heavily to a small set of advanced economies, many of which experienced steep contractions. The unweighted averages capture global trends across many small or less relevant markets. The weighted measures better reflect how Canadian exporters were actually affected.

Figure A.12 shows the full distributions of these three measures. The product–destination growth rates are broadly spread and nearly symmetric. The product margin has a longer left tail, suggesting that some categories declined more sharply than others. The destination margin is tighter and slightly right-skewed in the unweighted data, but becomes left-skewed once weighted by export shares, consistent with concentrated exposure to markets that contracted more than average.

To provide a sense of which markets were most affected, I identify the five largest collapses in weighted terms. Weights reflect the share of each product–destination pair in total Canadian exports during 2005–2007, based on customs records aggregated to HS6. This ensures that large shocks in economically small or rarely traded markets do not dominate the ranking. Including all destinations, the largest declines occurred in U.S. imports of motor vehicles (HS870324), coniferous wood (HS440710), crude petroleum (HS270900), natural gas (HS271121), and semi-bleached chemical wood pulp (HS470321). Excluding the U.S., the top drops were in Mexican motor vehicles, Indian wheat, Norwegian copper mattes, Hong Kong nickel, and Japanese integrated circuits. These markets played a central role in Canada's export portfolio before the crisis and were key drivers of the overall shift in demand.

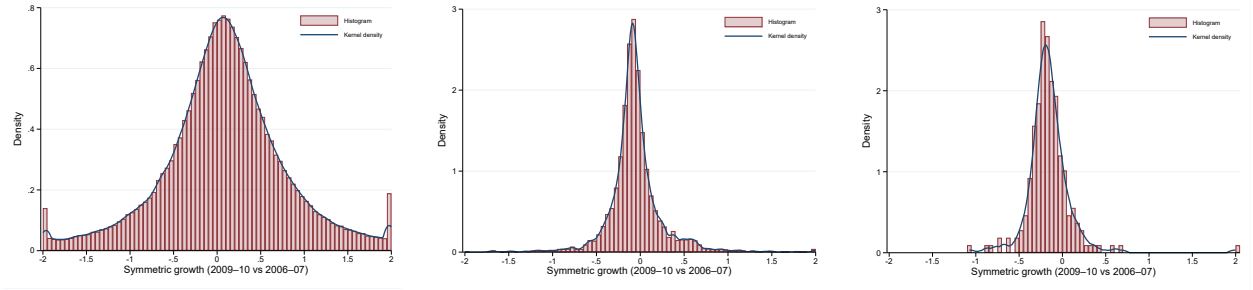
The use of two-year windows helps smooth temporary volatility and provides a clearer signal of the sustained changes that shaped the downturn and recovery. The demand shifter constructed from these values feeds directly into the firm-level exposure measure used in the main analysis.

Table A.11. Summary Statistics for Import-Demand Changes, 2006–07 to 2009–10

	$\Delta M_{pd}^{T_1}$	$\Delta M_{p\cdot}^{T_1}$	$\Delta M_{\cdot d}^{T_1}$
Unweighted			
Mean	0.079	-0.093	0.174
Standard deviation	0.704	0.486	0.386
Median	0.081	-0.055	0.136
10th percentile	-0.770	-0.652	-0.216
90th percentile	0.935	0.423	0.666
Weighted by Canadian Export Shares (2005–2007)			
Mean	-0.155	-0.154	-0.154
Standard deviation	0.500	0.419	0.143
Median	-0.123	-0.123	-0.212
10th percentile	-0.613	-0.585	-0.212
90th percentile	0.371	0.299	0.026

Notes: Each column reports statistics for symmetric growth rates in bilateral import flows, computed using BACI trade data. $\Delta M_{pd}^{T_1}$ refers to the change in imports of product p by destination d, excluding Canadian exports. $\Delta M_{p\cdot}^{T_1}$ and $\Delta M_{\cdot d}^{T_1}$ are weighted averages across destinations and products, respectively. Weighted rows use Canadian export shares during 2005–2007 as weights.

Figure A.12. Distribution of Import-Demand Changes, 2006–07 to 2009–10



(a) $\Delta M_{pd}^{T_1}$ **(b)** $\Delta M_{p\cdot}^{T_1}$ **(c)** $\Delta M_{\cdot d}^{T_1}$

Notes: Each panel displays the kernel density of symmetric growth rates in world import demand, based on BACI trade data. The y-axis represents probability density. The smooth blue line in each panel traces the estimated distribution. Panel (a) shows product–destination changes $\Delta M_{pd}^{T_1}$, panel (b) aggregates over destinations to show product-wide changes $\Delta M_{p\cdot}^{T_1}$, and panel (c) aggregates over products to show destination-wide changes $\Delta M_{\cdot d}^{T_1}$. Aggregations are weighted using Canadian export shares from the pre-crisis period. Canadian-origin exports are excluded.