



Unveiling the Effects of Worker Mobility on Regional Diversification

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Abstract: Worker mobility is widely recognised as a key mechanism for knowledge diffusion and regional productivity growth, yet its role in shaping the dynamics of regional economic specialisation remains insufficiently understood. While existing studies have emphasised firm-level outcomes or highly aggregated mobility measures, less attention has been paid to how different forms of labour mobility contribute both to the emergence and to the erosion of regional specialisations. This paper addresses this gap by examining how distinct mobility patterns across regions, sectors, and occupations shape entry into and exit from regional economic specialisations. Focusing on Brazil—a context characterised by persistent regional inequalities, segmented labour markets, and uneven industrial development—we analyse how labour mobility operates under conditions of limited institutional capacity and high structural heterogeneity. The empirical analysis combines administrative worker-level microdata from the Annual Social Information Report (RAIS), covering approximately 46 million workers per year and used to construct detailed indicators of labour inflows and outflows, with regional employment data to identify entry into and exit from regional specialisations over the period 2007–2021. The results show that entry into new specialisations is strongly associated with worker inflows involving sectoral and occupational reallocation, particularly when such mobility occurs within regions or combines multiple dimensions of change, highlighting the role of labour mobility as a mechanism of knowledge recombination and regional branching. Similar inflow patterns significantly reduce the probability that regions lose existing specialisations, while sectoral outflows increase the likelihood of exit, indicating that the erosion of activity-specific knowledge bases undermines regional resilience. Mobility involving only geographic relocation or occupational change without sectoral reallocation plays a more limited role. Overall, the findings indicate that it is not mobility per se, but the composition and direction of labour flows, that shape regional specialisation trajectories, contributing to a more context-sensitive understanding of regional structural change and offering insights for labour market and regional development policies in highly unequal economies.

Keywords: worker mobility; regional capacity; regional diversification

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Worker mobility plays a central role in the diffusion of knowledge and the enhancement of productivity across regions and sectors, acting as a key mechanism of interactive learning and technological change (Faggian, Rajbhandari, and Dotzel 2017). By carrying skills, routines, and experience acquired in previous employment, mobile workers contribute to the recombination of knowledge within local production systems, thereby fostering regional diversification, resilience, and long-term development (Simonen, Svento, and McCann 2016; Costa et al. 2023). In this sense, labour mobility constitutes a key channel through which knowledge circulates and regional economic structures evolve over time.

Despite its recognised importance, however, the role of worker mobility in shaping regional economic specialisation remains insufficiently understood. Existing studies have predominantly focused on firm-level outcomes—such as innovation, wages, and productivity—or have analysed mobility in highly aggregated terms, without distinguishing between its spatial, sectoral, and occupational dimensions (Breschi and Lenzi 2010; Maré, Fabling, and Stillman 2014; Miguélez and Moreno Serrano 2013). As a result, current evidence offers only a partial understanding of how labour mobility contributes to regional structural change.

More specifically, the literature has devoted limited attention to how different forms of worker mobility affect regional patterns of economic specialisation. While mobility is often implicitly associated with the emergence of new activities and processes of diversification, far less is known about its role in the weakening, displacement, or loss of existing specialisations. This imbalance constrains our understanding of regional structural change as a dynamic and potentially reversible process, in which entry into and exit from specialisations are jointly shaped by labour reallocation. As a result, we still lack systematic evidence on how different forms of worker mobility contribute not only to the emergence of new regional specialisations but also to the loss of existing ones.

This paper argues that the effects of worker mobility on regional specialisation cannot be understood by considering mobility as a unidimensional phenomenon. Instead, what matters is the multidimensional composition of labour flows, as different combinations of spatial, sectoral, and occupational mobility embody distinct types of knowledge and capabilities, with heterogeneous implications for regional structural change.

These gaps are particularly salient within the framework of Evolutionary Economic Geography (EEG). EEG conceptualises regional structural change as a path-dependent process, in which diversification typically occurs into activities related to existing regional capabilities, while entry into more distant sectors requires substantial recombination and learning efforts (Frenken, Van Oort & Verburg, 2007; Boschma & Frenken, 2009). Worker mobility can potentially relax these constraints by introducing new combinations of sector- and occupation-specific knowledge that can be locally adapted and integrated into regional production structures. At the same time, however, high levels of worker outflows from key activities may erode local capabilities, increasing the risk of specialisation loss. Importantly, EEG often implicitly assumes that labour mobility primarily reflects the circulation of valuable knowledge and skills—an assumption that may not hold uniformly across different institutional and labour market contexts.

This concern is closely related to the empirical focus of much of the existing EEG literature. A substantial share of the evidence has been developed in contexts characterised by high institutional capacity, relatively formal and coordinated labour markets, strong linkages between firms, universities and the state, low levels of extreme regional inequality, and selective, skill-intensive mobility. Even within these advanced economies, the relationship between worker mobility and regional specialisation has not been systematically explored in its multiple dimensions. By contrast, in peripheral contexts, worker mobility may compensate for weak local relatedness, linking debates on catching up, path dependence, and development traps (Martin & Sunley, 2015; Tessarin et al., 2025). In such settings, diversification may also occur through more abrupt and less related transitions, driven by public policies, the entry of multinational firms, or external competitiveness shocks.

These issues are particularly relevant in the Brazilian case. Brazil is characterised by persistent regional inequalities, uneven industrial development, and segmented labour markets that shape opportunities for structural transformation (Azzoni & Haddad, 2018; Galetti, Tessarin & Morceiro,

2021). In recent decades, the country has experienced a marked loss of manufacturing capacity, representing one of the most severe cases of deindustrialisation worldwide (Morceiro & Tessarin, 2025). However, this process has been spatially uneven. While traditional industrial regions have experienced significant declines, there has also been a relocation of manufacturing activities towards interior regions of the country, albeit with lower intensity (Morceiro & Tessarin, 2026). In this context, productive activities and workers have moved beyond metropolitan areas, generating new regional specialisations while eroding others. As a result, worker mobility may reflect not only knowledge diffusion and opportunity-driven reallocation, but also structural shifts in productive capacity, low-skill circulation, and limited local absorptive capacity.

Against this background, understanding how worker mobility contributes to both entry into and exit from regional economic specialisations is crucial for assessing the mechanisms through which regions adapt, diversify, or experience decline. Brazil therefore constitutes a critical test case for evaluating the conditions under which the core mechanisms proposed by EEG operate, and when they may produce qualitatively different outcomes. In this sense, this paper examines whether—and how—the central mechanisms of Evolutionary Economic Geography operate under conditions of high inequality, informality, weak institutions, and segmented labour markets.

To address these issues, we use matched employer–employee microdata from the Annual Social Information Report (RAIS), covering approximately 46 million workers per year between 2007 and 2021. We track individual worker movements across regions, sectors, and occupational groups, constructing detailed indicators of both inflows and outflows along multiple mobility dimensions. These data allow us to estimate fixed-effects models that examine how distinct mobility patterns influence the probability that regions enter into or exit from economic specialisations. By doing so, we show that it is not mobility per se, but rather the composition and direction of labour flows, that shape trajectories of regional specialisation.

Overall, the paper contributes to the EEG literature by providing a micro-founded and context-sensitive account of how worker mobility shapes both the emergence and the erosion of regional economic specialisations. By distinguishing between multiple dimensions of labour mobility, jointly analysing entry and exit dynamics, and using Brazil as a critical test case, the study advances current understandings of regional structural change and offers insights for the design of labour market and regional development policies in economies characterised by strong spatial inequalities.

2 Theoretical Background

2.1 Worker mobility, knowledge diffusion, and the limits of diversification

Within Evolutionary Economic Geography (EEG), regional economic development is understood as a cumulative and path-dependent process driven by the recombination of existing knowledge and capabilities (Boschma & Frenken, 2006; Frenken et al., 2007). A central assumption of this framework is that knowledge is unevenly distributed across space and sectors, largely tacit in nature, and embedded in individuals, organisations, and routines (Trippel & Maier, 2010). As a result, mechanisms that enable the circulation and recombination of knowledge are fundamental for explaining regional structural change.

Worker mobility has been identified as one of the most important micro-level channels through which knowledge diffuses across firms, sectors, and regions (Breschi & Lissoni, 2001; Boschma et al., 2009; Trippel & Maier, 2010; Breschi & Lenzi, 2010; Simonen et al., 2016). By moving between jobs, workers carry sector-specific experience, occupational skills, and organisational routines that can be recombined within new production contexts, thereby facilitating processes of learning, innovation, and productivity growth (Faggian et al., 2017; Simonen et al., 2016; Costa et al., 2023; Giorgi et al., 2023). Empirical evidence from advanced economies shows that labour mobility contributes to firm-level innovation (Song et al., 2003; Breschi & Lenzi, 2010; Miguélez & Moreno, 2013; Costa et al., 2023), regional productivity growth (Maré et al., 2014), and the emergence of new industrial activities (Simonen et al., 2016; Neffke et al., 2018; Faggian, et al. 2017).

In the EEG literature, worker mobility is therefore not seen merely as a labour market outcome, but as a fundamental mechanism underpinning regional branching, diversification, and long-term

development. Regions that are better able to attract and retain workers with relevant experience are expected to expand their productive structures by recombining existing capabilities into new, related activities (Boschma, 2017).

A core concept in EEG is relatedness, which captures the cognitive and technological proximity between economic activities (Frenken et al., 2007). The relatedness framework predicts that regions are more likely to diversify into activities that are technologically or cognitively close to their existing industrial base, as these activities require similar skills, knowledge, and organisational routines. This mechanism has been widely supported by empirical studies showing that regional diversification follows path-dependent trajectories shaped by historical specialisation patterns (Neffke et al., 2011; Boschma et al., 2013; Mascarini et al., 2023; Tessarin et al., 2025).

Worker mobility plays a crucial role in this process by enabling the transfer of related knowledge across activities. When workers move between related sectors or occupations, they facilitate incremental recombination and learning, lowering the costs and risks associated with diversification (Neffke et al., 2017). Conversely, diversification into unrelated activities is typically more challenging, as it requires more radical recombination efforts and higher absorptive capacity (Boschma & Capone, 2015).

However, this literature has largely focused on contexts characterised by relatively stable labour markets, strong institutional coordination, and high levels of human capital. Under such conditions, worker mobility is assumed to reflect the circulation of valuable and complementary knowledge, reinforcing cumulative processes of regional development. Less attention has been paid to how these mechanisms operate in regions where labour mobility is shaped by instability, informality, or weak institutional support.

2.2 Multiple dimensions of worker mobility and regional structural change

A growing body of literature recognises worker mobility as a key channel for knowledge diffusion and economic development. However, much of this research has examined labour mobility along single dimensions, often in isolation from one another. Early contributions primarily focused on inter-firm mobility, analysing how job-to-job transitions facilitate the transfer of tacit knowledge and organisational routines between firms, with implications for innovation, productivity, and wage dynamics (Breschi & Lissoni, 2001; Song, Almeida & Wu, 2003; Breschi & Lenzi, 2010). Closely related work has examined inter-regional mobility, emphasising the role of labour flows in shaping spatial knowledge spillovers and regional productivity differentials (Maré, Fabling & Stillman, 2014; Faggian, Rajbhandari & Dotzel, 2017; Simonen et al., 2016).

A particularly influential and well-established strand of the literature focuses on international mobility, especially the cross-country movement of highly skilled workers, scientists, and inventors (Breschi & Lenzi, 2010; Costa et al., 2023). This line shows that international labour mobility is strongly associated with innovation performance, technological novelty, and the diffusion of frontier knowledge (Franzoni, Scellato & Stephan, 2014; Miguélez & Moreno, 2013; Kerr & Kerr, 2019). While this literature provides robust evidence that mobility can act as a powerful conduit for knowledge transfer, it typically abstracts from regional production structures and focuses on firm- or individual-level innovation outcomes, rather than on processes of regional structural change.

Within the EEG and regional diversification literature, a growing number of studies have examined sectoral mobility, demonstrating that workers moving across industries carry industry-specific knowledge that shapes regional industrial evolution. Neffke and Henning (2013) show that labour flows between industries reflect underlying skill relatedness and significantly influence regional branching patterns. Subsequent studies confirm that sectoral labour mobility facilitates diversification into related activities by transferring relevant capabilities across industries (Boschma et al., 2014; Neffke et al., 2017).

In parallel, research on occupational mobility has highlighted the importance of functional skills and task-based knowledge in processes of innovation and upgrading (Elekes et al., 2023). Occupational transitions capture changes in functional roles within production systems and are therefore closely linked to learning and skill recombination (Muneepeerakul et al., 2013; Kogler et al., 2013; Elekes et

al., 2023). Recent work shows that occupational mobility is particularly relevant for understanding functional upgrading and technological change, especially when workers move into more complex or knowledge-intensive tasks.

More recently, studies have begun to explicitly link inter-regional mobility of highly skilled workers to the emergence of technological novelty. Giorgi et al (2023) show that inter-regional inflows of highly skilled labour increase the likelihood of regions producing novel technologies, highlighting the importance of the quality and content of mobility rather than its volume. Their findings reinforce the idea that geographic mobility contributes to innovation and structural change primarily when it involves workers carrying specialised, non-redundant knowledge that can be recombined within local production systems (Simonen et al., 2016; Costa et al., 2023). At the same time, they remain focused on innovation outcomes and does not explicitly address how such mobility affects the entry into or exit from regional economic specialisations.

By contrast, purely geographic mobility has often been implicitly treated as a sufficient proxy for knowledge diffusion in regional analyses (Trippl & Maier, 2010; Breschi & Lenzi, 2010), despite growing evidence that spatial relocation alone may not entail meaningful knowledge transfer. Several studies show that the developmental effects of geographic mobility depend critically on the sectoral and occupational experience that workers bring with them, and that mobility without changes in sectoral or functional content may have limited implications for regional diversification (Boschma, Eriksson & Lindgren, 2009; Eriksson & Lindgren, 2009).

Taken together, these strands of literature indicate that worker mobility is a fundamentally multidimensional phenomenon, with different dimensions capturing distinct mechanisms of knowledge transfer. Yet existing studies have rarely examined how these dimensions interact, nor have they systematically assessed their combined effects on both entry into and exit from regional specialisations. By jointly analysing geographic, sectoral, and occupational mobility, and by considering both inflows and outflows, this paper responds directly to these limitations, providing a more integrated account of how labour mobility shapes regional structural change, particularly in contexts characterised by segmented labour markets, uneven absorptive capacity, and persistent regional inequalities.

2.3 Beyond relatedness: mobility, catching-up, and peripheral regions

Recent contributions have begun to question the universality of the relatedness principle, particularly in the context of peripheral and late-developing regions (Boschma, 2015; MacKinnon et al., 2019). In such contexts, strict path dependence may constrain development by locking regions into low-complexity activities (Mascarini et al., 2023), giving rise to development traps (Martin & Sunley, 2015; Tessarin et al., 2025). From this perspective, diversification into unrelated activities may play a more important role in processes of catching up, especially when driven by external sources of knowledge such as multinational firms, public policies, or global production networks (Martin & Sunley, 2015; Dawley et al., 2019).

Worker mobility may act as a compensatory mechanism in these settings by importing knowledge and skills that are not locally available (Trippl & Maier, 2010; Costa et al., 2023; Elekes et al., 2023). Mobility across sectors and occupations can enable regions to overcome local capability constraints, facilitating jumps into more distant activities (Neffke & Henning, 2013). However, whether such mobility leads to sustainable diversification depends critically on local absorptive capacity, institutional support, and the stability of employment relationships.

This strand of the literature suggests that the developmental effects of worker mobility are context-dependent and may vary significantly across regions with different institutional and economic structures. Yet, systematic empirical evidence on these dynamics remains limited, particularly outside advanced economies (Trippl & Maier, 2010; Faggian et al., 2017).

Taken together, the literature suggests that worker mobility is a central but highly context-dependent mechanism in EEG (Boschma, 2017; Boschma et al., 2017). Its effects depend not only on the volume of mobility, but also on its direction, composition, and interaction with local capabilities and institutions (Simonen et al., 2016; Giorgi et al., 2023; Costa et al., 2023). In emerging economies characterised by strong regional inequalities, segmented labour markets, and uneven absorptive

capacity, mobility may reflect both opportunity-driven knowledge transfer and necessity-driven circulation of low-skilled labour.

This ambiguity makes such contexts particularly valuable for testing the boundary conditions of EEG. By examining how different dimensions of worker mobility shape both the emergence and erosion of regional specialisations, it becomes possible to assess when the core mechanisms proposed by EEG operate as expected, and when they produce qualitatively different outcomes. In this sense, analysing worker mobility in Brazil provides a critical opportunity to refine evolutionary theories of regional diversification and to better understand the role of labour markets in shaping long-term development trajectories

3 Methodology

3.1 Data and variables

We employ employment data from the Brazilian Annual Social Information Report (RAIS – Relação Anual de Informações Sociais), covering the period from 2007 to 2021. RAIS is an administrative dataset that covers the universe of formal employment relationships in Brazil and provides annual information on workers' region of employment, economic activity, occupation, and employment status. Our analysis focuses on 38 economic activities, encompassing manufacturing industries and knowledge-intensive business services (KIBS).

Following previous studies on regional structural change and specialisation dynamics (e.g. Balland & Boschma, 2021a; Rigby, 2015), we estimate entry and exit models to assess the probability that a region gains or loses economic specialisation over time. The dependent variables capture either entry into or exit from economic specialisation across Brazilian regions.

To measure regional economic specialisation, we compute a Revealed Comparative Advantage (RCA) index based on employment data aggregated at the region–sector–year level³. A region is considered specialised in a given sector if its share of employment in that sector exceeds the national average, an approach widely adopted in employment-based studies of regional specialisation. Formally, a region r is considered specialised in sector/activity i ($M_{r,i} = 1$) if:

$$M_{r,i} = 1 \text{ if } RTA_{r,i} = \frac{Emp_{r,i} / \sum_i Emp_{r,i}}{\sum_r Emp_{r,i} / \sum_r \sum_i Emp_{r,i}} > 1$$

With $Emp_{r,i}$ denotes employment in sector i in region r . A region is classified as entering a new economic specialisation when it was not specialised in sector i in year $t-1$ but becomes specialised in year t . Conversely, a region is classified as exiting a specialisation when it loses this condition between $t-1$ and t .

Our main explanatory variable is worker mobility. While economic specialization is measured using aggregated employment data from RAIS, worker mobility is constructed from RAIS microdata, which allow individual workers to be followed annually through a unique identifier. By comparing workers' employment characteristics in years $t-1$ and t , we identify transitions across combinations of region, sector, and occupation. Worker mobility is defined as any transition involving a change in at least one of these three dimensions between two consecutive years.

All transitions are identified by comparing workers' employment characteristics between $t-1$ and t . Inflows capture entries into destination region–sector combinations, while outflows capture employment losses from origin region–sector combinations. Although the flows are calculated using information from $t-1$ and t , we use their lagged values as explanatory variables in the model, so that the independent variables refer to the period preceding the dependent variable, which is measured in year t . This ensures a proper temporal ordering and avoids simultaneity between worker mobility and the outcome of interest.

Regarding inflow, we distinguish seven different types. First, *IN_Reg* captures geographic mobility within the same sector and occupation, that is, inflows involving a change in region only, with

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sector and occupation unchanged. Second, *IN_Sec* represents sectoral reallocations within a region without changing occupation, that is, inflows involving a change in sector only, with region and occupation constant. Third, *IN_Occ* corresponds to occupational reallocations within a region without changing sector, that is, inflows involving a change in occupation only, with region and sector constant.

In addition, inflows involving simultaneous changes in multiple dimensions are defined as follows. *IN_Reg_Sec* captures changes in both region and sector, with occupation constant. *IN_Reg_Occ* captures changes in region and occupation, with sector constant. *IN_Sec_Occ* captures changes in sector and occupation within the same region, representing internal reallocations across both activities and functions within the region. *IN_Reg_Sec_Occ* captures changes in region, sector, and occupation.

Regarding outflow, we distinguish two indicators. *OUT_Reg* captures all transitions in which workers leave a given region, regardless of sector or occupation. *OUT_Sec* captures transitions across sectors within the same region, with occupation remaining unchanged or not.

For illustration, consider a worker employed in region r , sector i , and occupation o in year $t-1$: if the worker moves to region r' , sector i , and occupation o in year t ($r' \neq r$), this transition generates a regional inflow into destination region r' and sector i (*IN_Reg*) and a regional outflow from origin region r and sector i (*OUT_Reg*). If a worker remains in region r but moves from sector i and occupation o to sector i' and occupation o , the transition generates a sectoral inflow (*IN_Sec*) and a sectoral outflow (*OUT_Sec*) within region r . If a worker moves from sector i and occupation o to sector i' and occupation o' within the same region r , the transition generates a sectoral and occupational inflow (*IN_Sec_Occ*) and a corresponding outflow (*OUT_Sec*).

Together, these inflow- and outflow-based measures ensure that the estimated effects of worker mobility reflect gross worker flows across region–sector combinations, rather than net employment reallocation.

In addition, we include three control variables in the analysis. GDP per capita captures the level of economic development in each region. Population captures the total population of the region. Human Capital captures Share of workers with higher education in total workforce in the region–sector.

3.2 Econometric strategy

To estimate the probability of regional specialization entry and exit, we employ panel logit models with fixed effects for region-sector pairs and for year. The dependent variable equals 1 if region r enters in new or existing specialisation in sector i in a given year t , and 0 otherwise

The estimated model is specified as follows:

$$\Pr(\text{Entry}_{r,i,t} \text{ or } \text{Exit}_{r,i,t} = 1) = \text{logit}^{-1}(\beta X_{r,i,t-1} + \lambda_t + \gamma_{r,i} + \varepsilon_{r,i,t})$$

Where *Entry* or *Exit* indicates either the entry or exit of specialisation of region r in sector i at year t ; $X_{r,i,t-1}$ includes lagged values of the main explanatory variables (*IN_Reg*, *IN_Sec*, *IN_Occ*, *IN_Reg_Sec*, *IN_Reg_Occ*, *IN_Sec_Occ*, *IN_Reg_Sec_Occ*, *OUT_Reg*, *OUT_Sec*) and controls (*GDP*, *Pop*, *Human Capital*); $\gamma_{r,i}$ captures unobserved time-invariant heterogeneity across region-technology pairs, λ_t are time-fixed effects. Robust standard errors are employed to account for potential heteroscedasticity in the error term.

This empirical design enables a systematic assessment of how distinct types of worker mobility, measured through annual inflows and outflows, influence regional specialization and diversification dynamics. By combining yearly indicators of regional and sectoral inflows and outflows, the model captures both the creation and erosion of regional capabilities. Using a panel framework with annual observations between 2007 and 2020, we identify the relative contribution of each type of mobility to changes in regional-sectoral employment patterns. This approach provides a dynamic view of how labour reallocation across regions, sectors, and occupations shapes regional diversification trajectories, revealing whether worker inflows and outflows act as drivers of expansion, mechanisms of stability, or buffers against sectoral decline.

4 Results and discussion

Table 1 presents the results of the entry model, which estimates the probability that a region

enters a new economic specialisation. Overall, the findings indicate that worker mobility plays a central role in shaping the emergence of new productive specialisations across Brazilian regions, particularly when mobility involves cognitively complex transitions across sectors and occupations.

Table 1 - Entry Models

	1	2	Full Model
<i>IN_Reg_{r,i,t-1}</i>	0.180*** (0.042)		0.051 (0.048)
<i>IN_Sec_{r,i,t-1}</i>	0.364*** (0.043)		0.181*** (0.041)
<i>IN_Occ_{r,i,t-1}</i>	0.440*** (0.044)		0.320*** (0.045)
<i>IN_Reg_Sec_{r,i,t-1}</i>		0.251*** (0.040)	0.226*** (0.040)
<i>IN_Reg_Occ_{r,i,t-1}</i>		0.148** (0.056)	0.104+ (0.059)
<i>IN_Sec_Occ_{r,i,t-1}</i>		0.590*** (0.074)	0.474*** (0.077)
<i>IN_Reg_SecOcc_{r,i,t-1}</i>		0.334*** (0.043)	0.291*** (0.044)
<i>OUT_Reg_{r,i,t-1}</i>	0.076 (0.049)	0.079+ (0.044)	0.045 (0.044)
<i>OUT_Sec_{r,i,t-1}</i>	-0.063+ (0.038)	-0.068+ (0.041)	-0.086* (0.042)
<i>GDP per capita_{r,i,t-1}</i>	-0.003 (0.009)	-0.005 (0.009)	-0.008 (0.009)
<i>Population_{r,i,t-1}</i>	-0.127 (0.697)	-0.017 (0.704)	-0.090 (0.709)
<i>Human Capital_{r,i,t-1}</i>	0.613+ (0.323)	0.608+ (0.322)	0.595+ (0.325)
Num.Obs.	28021	28021	28021
R2	0.134	0.144	0.150
R2 Adj.	-0.133	-0.123	-0.118
R2 Within	0.023	0.034	0.040
R2 Within Adj.	0.022	0.033	0.039
RMSE	0.34	0.34	0.33
Std.Errors	by: ID & year	by: ID & year	by: ID & year
FE: ID	X	X	X
FE: ano	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Notes: Dependent variable is a binary indicator of entry.

Models are estimated using fixed-effects logit (feglm).

All independent variables are lagged by one period and transformed using the inverse hyperbolic sine.

Standard errors are clustered at the ID and year levels.

Inflows involving changes along a single dimension are positively associated with entry into specialisation, although their effects vary in magnitude and robustness. Pure geographic inflows within the same sector and occupation (IN_Reg) are positively related to entry when considered in isolation, but their effect becomes smaller and statistically insignificant once more complex mobility patterns are included. This suggests that geographic mobility alone is not sufficient to trigger new specialisations. Rather, it is the content of the knowledge carried by mobile workers, rather than their mere relocation, that matters for regional diversification.

By contrast, sectoral and occupational inflows within regions display strong and statistically significant effects. Sectoral inflows (IN_Sec) and occupational inflows (IN_Occ) are both positively associated with entry, with occupational mobility exhibiting the largest coefficients among single-dimension transitions. This pattern points to the importance of internal worker mobility across activities and functions in reshaping the regional skill base. In particular, occupational reallocation within the same region and sector often reflects career advancement or functional upgrading within firms, rather than lateral job changes. For instance, a worker may remain in the same firm, region, and activity but move from an analytical to a managerial role. Such occupational upgrading can enhance organisational and managerial capabilities, strengthen coordination within production processes, and facilitate the diffusion of knowledge, thereby increasing the likelihood that regions develop new economic specialisations.

Inflows involving simultaneous changes across multiple dimensions exhibit the largest and most robust effects on entry into new specialisations. In particular, inflows combining sectoral and occupational changes within the same region (IN_Sec_Occ) show the strongest association with entry, highlighting the importance of endogenous processes of worker reallocation across both activities and tasks. This finding underscores the role of internal labour market dynamics in enabling regions to recombine existing capabilities into new productive configurations.

Similarly, inflows that combine geographic mobility with sectoral and occupational change (IN_Reg_Sec_Occ) display large and statistically significant effects. These transitions reflect the arrival of workers who bring diversified experience acquired in different regional and sectoral contexts, thereby introducing novel combinations of knowledge into the local production system. Inflows involving geographic and sectoral change only (IN_Reg_Sec) also exert a positive and significant effect, albeit of smaller magnitude.

Additionally, inflows combining geographic mobility with occupational change only (IN_Reg_Occ) exhibit weaker and less stable effects. While such transitions may also capture occupational upgrading or promotion, their limited impact suggests that occupational mobility without accompanying sectoral reallocation is less effective in generating new specialisations. This reinforces the idea that sector-specific knowledge and production routines play a critical role in regional branching processes, and that functional upgrading alone is not sufficient to trigger structural change at the regional level.

Turning to outflows, sectoral outflows within regions (OUT_Sec) are negatively and significantly associated with entry into specialisation. This indicates that the loss of workers from specific activities, even when they remain within the same region, reduces the local capacity to develop new specialisations, likely due to the erosion of sector-specific knowledge and productive networks. By contrast, aggregate regional outflows (OUT_Reg) do not display statistically significant effects, suggesting that the impact of worker exits depends more on the type of knowledge being lost than on the sheer volume of departures.

Taken together, the results indicate that entry into new economic specialisations is primarily driven by gross worker inflows that reallocate skills across sectors and occupations, rather than by simple geographic mobility or aggregate regional conditions. These findings support an evolutionary interpretation of regional structural change, in which new specialisations emerge from cumulative and interactive processes of learning and recombination, with worker mobility acting as a key vector for the diffusion and recombination of heterogeneous knowledge bases within and across regions.

Table 2 presents the results of the exit model, which estimates the probability that a region exits an existing economic specialisation. Overall, the results mirror those of the entry model and highlight the stabilising role of worker mobility patterns that foster knowledge recombination and capability renewal within regions.

Inflows involving changes along a single dimension are negatively associated with exit, indicating that worker inflows generally reduce the likelihood that regions lose existing specialisations. Pure geographic inflows within the same sector and occupation (IN_Reg) are associated with a lower probability of exit when considered in isolation, although their effect weakens once more complex mobility patterns are taken into account. This suggests that geographic mobility alone provides only limited protection against the erosion of regional specialisations.

Table 2: Exit Models

	1	2	Full Model
<i>IN_Reg_{r,i,t-1}</i>	-0.161*** (0.033)		-0.079* (0.032)
<i>IN_Sec_{r,i,t-1}</i>	-0.309*** (0.027)		-0.152*** (0.024)
<i>IN_Occ_{r,i,t-1}</i>	-0.319*** (0.053)		-0.243*** (0.050)
<i>IN_Reg_Sec_{r,i,t-1}</i>		-0.146** (0.048)	-0.128** (0.048)
<i>IN_Reg_Occ_{r,i,t-1}</i>		-0.092+ (0.055)	-0.036 (0.058)
<i>IN_Sec_Occ_{r,i,t-1}</i>		-0.495*** (0.063)	-0.406*** (0.064)
<i>IN_Reg_SecOcc_{r,i,t-1}</i>		-0.285*** (0.041)	-0.247*** (0.038)
<i>OUT_Reg_{r,i,t-1}</i>	0.052 (0.045)	0.029 (0.048)	0.074 (0.046)
<i>OUT_Sec_{r,i,t-1}</i>	0.103** (0.035)	0.087* (0.040)	0.112** (0.038)
<i>GDP per capita_{r,i,t-1}</i>	0.010 (0.012)	0.016 (0.012)	0.017 (0.012)
<i>Population_{r,i,t-1}</i>	-4.406*** (1.265)	-4.767*** (1.221)	-4.640*** (1.224)
<i>Human Capital_{r,i,t-1}</i>	-1.446** (0.464)	-1.705*** (0.469)	-1.629*** (0.465)
Num.Obs.	15356	15356	15356
R2	0.150	0.159	0.164
R2 Adj.	-0.149	-0.141	-0.136
R2 Within	0.023	0.033	0.039
R2 Within Adj.	0.022	0.032	0.037
RMSE	0.38	0.37	0.37
Std.Errors	by: ID & ano	by: ID & ano	by: ID & ano
FE: ID	X	X	X
FE: ano	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Notes: Dependent variable is a binary indicator of exit.

Models are estimated using fixed-effects logit (feglm).

All independent variables are lagged by one period and transformed using the inverse hyperbolic sine.

Standard errors are clustered at the ID and year levels.

By contrast, sectoral and occupational inflows within regions display strong and robust negative effects on exit. Both sectoral inflows (*IN_Sec*) and occupational inflows (*IN_Occ*) significantly reduce the probability of losing an existing specialisation, with occupational mobility again exhibiting a particularly large effect among single-dimension transitions. These results indicate that internal worker mobility across activities and functions plays a key role in sustaining regional specialisations over time. In particular, occupational reallocation within the same region and sector may reflect functional upgrading or promotion within firms, whereby workers move into more specialised, supervisory, or managerial roles. Such transitions can strengthen organisational capabilities, improve coordination within production processes, and support the continuous adaptation of existing activities, thereby lowering the risk of specialisation decline.

Inflows involving simultaneous changes across multiple dimensions exert the strongest stabilising effects. In particular, inflows combining sectoral and occupational changes within the same region (*IN_Sec_Occ*) are associated with the largest reductions in exit probabilities. This finding underscores the importance of endogenous labour reallocation across both activities and functions in renewing sector-specific knowledge bases and maintaining productive capabilities. Similarly, inflows that combine geographic mobility with sectoral and occupational change (*IN_Reg_Sec_Occ*) significantly reduce the likelihood of exit, suggesting that regions benefit from the arrival of workers

bringing diversified experience acquired in different regional and sectoral contexts. These inflows appear to inject new knowledge and practices that help existing specialisations adapt and remain competitive.

Inflows combining geographic mobility with occupational change only (IN_Reg_Occ), by contrast, exhibit weaker and less stable effects. While such transitions may also capture occupational upgrading or promotion, their limited impact suggests that occupational mobility without accompanying sectoral reallocation is less effective in preventing the loss of specialisations. This reinforces the idea that the preservation of regional specialisations depends critically on sector-specific knowledge and production routines, rather than on functional upgrading alone.

Turning to outflows, sectoral outflows within regions (OUT_Sec) are positively and significantly associated with exit. This indicates that the loss of workers from specific activities increases the probability that regions abandon existing specialisations, likely reflecting the erosion of sector-specific skills, experience, and productive networks. By contrast, aggregate regional outflows (OUT_Reg) do not display statistically significant effects, suggesting that exits from specialisation are driven more by the type of knowledge being lost than by the overall volume of worker departures.

Among the control variables, population and human capital are negatively associated with exit, indicating that larger regions and those with a more educated workforce are better able to sustain existing specialisations. GDP per capita does not display a statistically significant effect. Taken together, the results suggest that regional resilience in existing specialisations is strongly shaped by patterns of worker mobility that renew, recombine, and upgrade sector- and occupation-specific capabilities, rather than by baseline regional characteristics alone.

Taken together, the results from the entry and exit models reveal a coherent picture of how worker mobility shapes the dynamics of regional economic diversification. Entry into new specialisations and exit from existing ones are driven by closely related mechanisms, operating in opposite directions. In both cases, worker inflows play a central role, as they enable the recombination, renewal, and upgrading of sector- and occupation-specific capabilities within regions.

On the one hand, the entry results show that regions are more likely to develop new specialisations when they experience inflows of workers whose mobility involves sectoral and occupational change, particularly when such reallocations occur within the region or combine multiple dimensions of mobility. These patterns highlight the role of worker mobility as a channel through which heterogeneous knowledge and skills are recombined, fostering processes of regional branching.

On the other hand, the exit results indicate that the same types of inflows significantly reduce the probability that regions exit existing specialisations. Internal reallocations across sectors and occupations, as well as inflows bringing experience from other regional and sectoral contexts, contribute to the continuous adaptation of established activities, lowering the risk of specialisation loss without conflating exit with persistence.

By contrast, mobility patterns that involve only geographic relocation or occupational change without sectoral reallocation play a more limited role in both entry and exit dynamics. This suggests that functional upgrading or promotion alone, while beneficial at the firm or individual level, is insufficient to drive structural change at the regional level unless it is accompanied by the transfer or recombination of sector-specific knowledge and production routines.

Finally, the asymmetric effects of outflows further reinforce this interpretation. Sectoral outflows increase the likelihood of exit from specialisation, pointing to the importance of retaining activity-specific knowledge within regions. Aggregate regional outflows, by contrast, are less consequential, underscoring that what matters for regional structural change is not the sheer volume of worker movements, but the nature of the knowledge embedded in those movements.

Overall, these findings support an evolutionary perspective in which regional structural change emerges from cumulative and interactive processes of learning driven by worker mobility that reallocates skills across activities and functions. Entry into new specialisations and the avoidance of exit from existing ones are thus shaped by the capacity of regions to attract, retain, and internally reconfigure workers carrying complementary and diversified knowledge bases.

5 Conclusion

This paper set out to examine how worker mobility shapes the dynamics of regional economic specialisation in Brazil, focusing explicitly on both entry into and exit from specialisation. While a large body of literature emphasises the role of relatedness, innovation, and regional capabilities in

structural change, less attention has been paid to the micro-level labour mobility mechanisms through which knowledge is reallocated across regions, sectors, and occupations. In particular, existing studies rarely distinguish between different types of worker mobility or assess how these distinct mobility patterns affect the emergence and loss of regional specialisations over time.

By leveraging longitudinal matched employer–employee data from RAIS for the period 2007–2021, this study addresses this gap by decomposing worker mobility into detailed inflow and outflow measures across regions, sectors, and occupations. This approach allows us to move beyond net employment changes and capture gross worker flows, providing a more precise account of how knowledge embedded in labour mobility contributes to regional structural change.

The empirical results highlight three main findings. First, entry into new economic specialisations is strongly associated with worker inflows that involve sectoral and occupational reallocation, particularly when such mobility occurs within regions or combines multiple dimensions of change. These patterns underscore the importance of worker mobility as a mechanism of knowledge recombination, through which heterogeneous skills and experiences are integrated into local production systems, fostering regional branching.

Second, the exit analysis reveals that the same types of worker inflows significantly reduce the probability that regions lose existing specialisations. Internal reallocations across sectors and occupations, as well as inflows bringing experience from other regional and sectoral contexts, contribute to the adaptation and upgrading of established activities, lowering the risk of specialisation loss. In contrast, sectoral outflows increase the likelihood of exit, indicating that the erosion of activity-specific knowledge bases undermines regional specialisation.

Third, mobility patterns involving only geographic relocation or occupational change without sectoral reallocation play a more limited role in both entry and exit dynamics. This finding suggests that mobility contributes to structural change not simply through movement across space or career advancement per se, but through the transfer and recombination of sector-specific knowledge and production routines. Occupational upgrading, such as promotions within firms, appears to be most effective when embedded in broader processes of sectoral learning and capability development.

Taken together, these results support an evolutionary perspective in which regional structural change emerges from cumulative and interactive learning processes driven by worker mobility. Entry into new specialisations and the avoidance of exit from existing ones are shaped by the capacity of regions to attract, retain, and internally reconfigure workers carrying complementary and diversified knowledge bases.

These findings have important policy implications. First, regional development strategies should move beyond policies aimed solely at attracting firms or workers from outside the region and instead place greater emphasis on facilitating internal labour market dynamics. Policies that encourage skill upgrading, internal career progression, and cross-functional mobility within firms can enhance the recombination of knowledge and strengthen regional capabilities.

Second, active labour market and industrial policies should support worker transitions across related sectors, particularly within regions, as these reallocations appear to be especially conducive to both the emergence and maintenance of economic specialisations. This may include targeted training programs, reskilling initiatives, and partnerships between firms, educational institutions, and local governments to align workforce development with regional industrial trajectories.

Finally, policies aimed at reducing excessive sectoral outflows—such as measures to retain skilled workers in strategic activities or to facilitate knowledge retention during restructuring processes—may help mitigate the risk of specialisation loss. By recognising worker mobility as a central vector of knowledge diffusion and recombination, policymakers can design more effective and nuanced strategies to promote resilient and adaptive regional development.

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