Place-based Policy, Migration Barriers, and Spatial Inequality*

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Abstract

This study quantifies the effects of place-based tax incentives and easing migration barriers on spatial inequality in Vietnam. I construct a dynamic spatial general equilibrium model incorporating firm dynamics, occupational choices, migration, congestion, and agglomeration. Leveraging policy variations and model-consistent equations, I identify firm entry elasticity and changes in migration costs. The place-based policy increases economic activity and welfare in targeted areas despite compromising public services. The household registration reform has a small impact on spatial welfare inequality. Combining migration cost reductions to central provinces with tax incentives to disadvantaged ones mitigates welfare losses and reduces spatial inequality more effectively than each policy alone.

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1 Introduction

Most low-income countries prioritize economic growth, but it can increase inequality, as rapid development tends to concentrate economic activities in productive regions, leaving less developed areas behind (Kuznets, 1955). To address spatial inequality, policymakers worldwide consider place-based incentives to attract firms to disadvantaged areas and migration policies to encourage people to leave these regions for better opportunities. However, the individual and combined effects of large-scale changes in these policies on spatial inequality remain inadequately addressed.

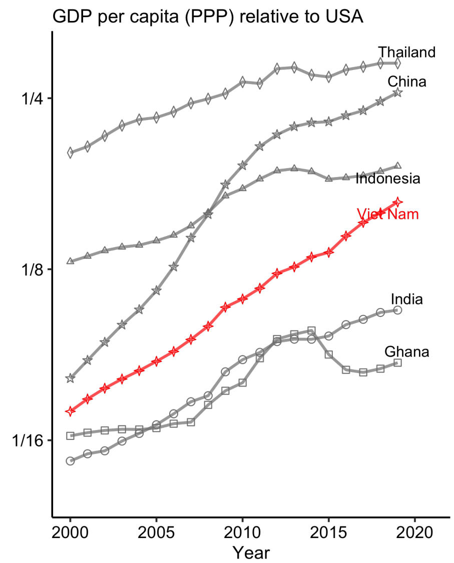
This study examines Vietnam, where both policies were implemented nationally. Despite tremendous economic growth, Vietnam saw a decline in regional inequality as seen in Figure 1. I consider two policies aimed at changing the distribution of economic activities across regions. In 2003, the Vietnamese government classified 600 districts in Vietnam into three groups based on increasing poverty levels. They started offering tax incentives for firms entering poorer places, with these incentives gradually falling as firms age. In 2005, the government eased household restrictions (*Ho Khau*) that had limited regional migration, with a milder relaxation for migration to centrally-administered provinces compared to the rest of Vietnam.

To quantify the effects of these policies, I construct a dynamic spatial general equilibrium model, integrating policy interactions with firm dynamics, occupational choices, migration, congestion, and agglomeration. The model incorporates the trade-off between attracting firms through place-based tax incentives and the cost to the government budget. It also considers the potential influx of workers and firms when reducing migration barriers, which may exacerbate inequality or congest public services. Consequently, the effects of place-based policies and easing migration barriers on regional inequality are ambiguous, necessitating a quantitative analysis in this specific context.

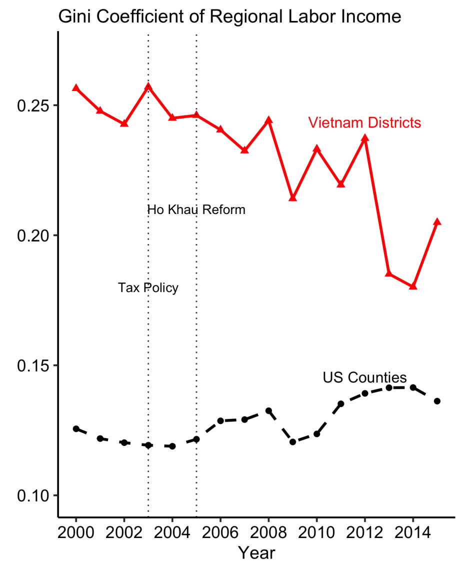
The policy effects depend on identifying two crucial parameters: the firm entry elasticity and the migration costs associated with the Ho Khau policy reform. I derive reduced-form equations from the model and use policy variations to estimate these objects separately. To estimate the firm entry elasticity, I leverage the model's prediction that lower tax rates for young firms, compared to older firms, increase the entry rate relative to the survival rate of older firms in a local economy. To test this prediction and identify the firm entry elasticity, I employ a model-consistent triple difference-in-difference design, taking advantage of tax variations over time, across districts, and firm ages.

To identify changes in migration costs associated with the Ho Khau reform over time and across regions, I leverage the model's version of the Head-Ries (HR) index (Head and

Figure 1: Vietnam's Growth and Spatial Inequality Trends



(a) GDP Per Capita (PPP)



(b) Spatial Inequality Trends

Sources: Panel (a) World Bank World Development Indicators, and Panel (b) Vietnamese Annual Establishment Surveys and the US Bureau of Economic Analysis (2000-2015). *Notes*: Regional labor income is defined as the average wage within a region.

Ries, 2001). I examine the changes in HR indices for migration flows between regions that experienced different degrees of migration barrier easing. My method resembles a triple difference-in-difference approach, capitalizing on the changing migration patterns based on destination, origin, and time.

Despite having elasticities, solving a dynamic multi-region model still requires estimating a large set of fixed and time-varying exogenous factors and policy values. To overcome this computational challenge, I extend the technique of "dynamic hat algebra" from Caliendo et al. (2019). This solution method does not presume that the economy is in a steady state, which is particularly relevant to Vietnam, where many other significant changes like trade policy occurred during the study period (McCaig and Pavcnik, 2018).

The 2003 tax policy increases economic activity and welfare in targeted areas without substantially compromising public services. The 2005 Ho Khau reform increases employment and firms in disadvantaged regions but has a small impact on spatial welfare inequality. A counterfactual policy easing migration costs exclusively into central provinces reduces inequality at the cost of welfare losses in the two largest provinces, Ha Noi and Ho Chi Minh City, because of increased congestion and reduced wages. Combining this migration strategy with the 2003 Tax Policy mitigates welfare losses and lessens spatial inequality more effectively than each policy alone.

By introducing occupational choice into a dynamic spatial general equilibrium framework, this paper extends the seminal work of Lucas (1978) and recent studies such as Allub and Erosa (2019). The framework builds upon dynamic spatial general equilibrium models from Caliendo and Parro (2020) and Kleinman et al. (2023), and aligns with the growing interest in occupational choice in the development literature (Mobarak et al., 2023 and Balboni et al., 2022).

This work hopes to bring together studies on place-based policy and easing migration barriers, all of which follow seminal works by Harris and Todaro (1970) and Lewis (1954). This study complements recent papers on place-based policy, a field that has seen substantial growth since Neumark and Simpson (2015)'s review, such as Gaubert et al. (2021), Fajgelbaum and Gaubert (2020), Heblich et al. (2022), and Austin et al. (2018)[1].

The closest paper in this literature is Atalay et al. (2023), examining a place-based industrial policy in Turkey. Relative to their framework, my model integrates entrepreneurs' dynamic decisions, occupational choice, congestion, and agglomeration externalities, thereby shedding light on the complex interactions between workers, firms, and policies. I also combine policy variation with model-consistent equations to identify structural parameters that govern the effects of place-based policies.

This study contributes to the migration literature by analyzing the general equilibrium effects of large-scale policy changes in migration costs. While recent empirical studies like Imbert et al. (2022), Wang et al. (2021), and Clemens et al. (2018) have begun exploring the interplay between workers and firms, this paper incorporates dynamic firm decisions and congestion externalities within a general equilibrium framework. Therefore, it also expands on studies examining the impact of reducing migration costs, such as Morten and Oliveira (2023), Lagakos et al. (2023), and Caliendo et al. (2021).

In examining the effects of migration costs related to Vietnam's Ho Khau policy, this paper contributes to the understanding of systems similar to China's Hukou, complementing the insights of Tombe and Zhu (2019) and Kinnan et al. (2018). Beyond Vietnam and China, Imbert and Papp (2020) also find limited access to public services for migrants in India.

I provide the context of Vietnam and details of the policies in Section 2 and the data in Section 3. Section 4 introduces the model. Section 5 takes the model to the data. Policy evaluation and counterfactual results are in Section 6.

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[1]Other significant contributions include Busso et al. (2013). Kline and Moretti (2014), Greenstone et al. (2010) in the United States, and studies from developing countries including Lu et al. (2019) and Chaurey (2017)

2 Vietnam's Place-based Policy and Ho Khau Reform

Vietnam offers a rare opportunity to explore the impact of location-based policies and migration restrictions. This section discusses a set of three policies: tax incentives for new firms in disadvantaged districts, central government redistribution mechanisms, and reforms to the household registration (Ho Khau) system, which restricts internal migration.

2.1 2003 Enterprise Income Tax Law

The 2003 revisions to the Enterprise Income Tax Law by the National Assembly, as illustrated in Figure 2a, is a place-based tax policy that can influence where firms are located in Vietnam. The previous version of the law, effective from 1997 to 2003, imposed a 32% profit tax on all establishments, regardless of their location, age, or cohort. Any changes to this profit rate are highly significant, given that enterprise income taxes accounted for almost 40% of Vietnamese government tax revenue in 2000, surpassing all other taxes, such as value-added tax (22%) and personal income taxes (2%) (Shukla et al., 2011).

This study focuses on three major revisions to the enterprise income tax law in 2003. First, the government lowered the tax rate for all establishments to 28%. Household businesses, defined as family-run entities employing fewer than ten people and operating at a single location without an official seal, are exempt from formal registration for tax IDs and therefore from this enterprise profit tax[2]. If a business does not fit this description, it must register as an enterprise[3].

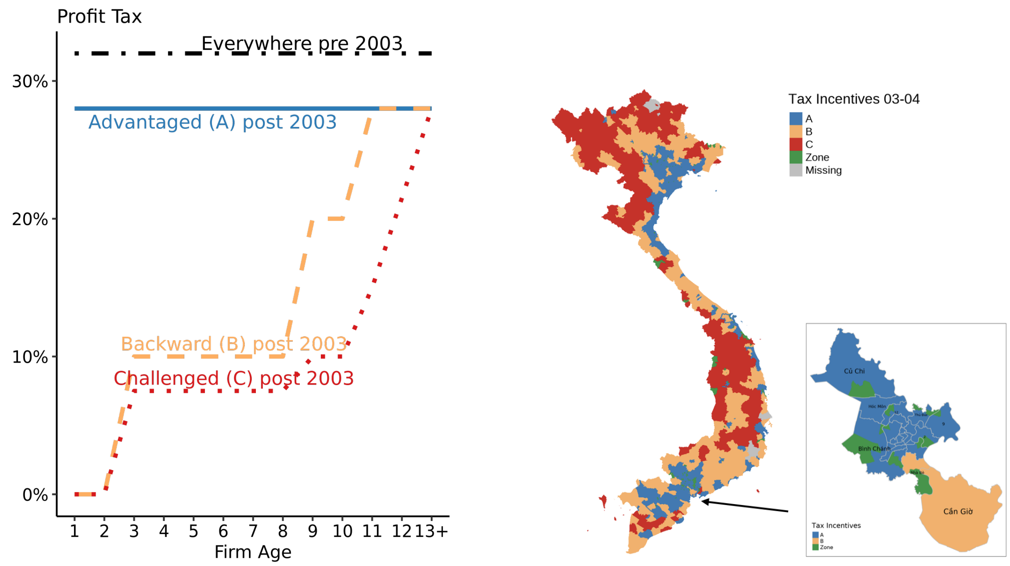
Following Decree 164/2003/ND-CP, the government categorized Vietnam's 610 districts into three groups: those facing special socio-economic difficulties (Challenged - C), those with socio-economic difficulties (Burdened - B), and those without economic difficulties (Advantaged - A). While the precise criteria remain undisclosed, Figure A1 reveals stark differences in pre-reform poverty incidence, doubling from an average of 28% in A districts to 65% in C districts.

Furthermore, Table 1, based on census and establishment data detailed in section 3, shows that B and C districts have lower population densities, more ethnic minorities, lower urbanization rates, and lower wages than A districts. However, wage data likely fail to capture the full extent of inequality due to the prevalence of informal activities in early 2000s Vietnam. Overall, pre-reform indicators confirm significant disparities in economic activities and well-being across these districts.

[2] See Article 36 in Decree 88/2006/ND-CP

[3] Although formalization incurs costs like registration fees, hiring accountants, and adhering to reporting standards, it offers benefits such as access to broader markets, capital, and governmental support.

Figure 2: Enterprise Profit Tax Varies over Time, across Districts, and Firm Ages



(a) Tax Schedule Before and After 2003 (b) Map of Tax Policy Labels

Sources: Decrees 164/2003/ND-CP and 88/2004/TT-BTC; *Notes*: Post-2004, manufacturing entrants in Special Economic Zones (SEZs) follow tax schedules similar to C districts, while service entrants are subject to B rates (Panel (a)). Panel (b) displays Vietnam's commune-level map as of 2010, with a zoomed-in section on Ho Chi Minh City.

The tax incentives provided to B and C districts vary over the life cycle of the firms, which is a common yet understudied feature of place-based policies around the world[4]. As demonstrated in Figure 2a, establishments that begin in or relocate to C or B districts receive lower tax rates starting from the first year they make profits in those areas. For instance, if a business enters an A district in 2005, it is indefinitely taxed at a 28% rate. A counterpart in a B district pays no profit tax for the first two years, then 10% from three to eight years old, 20% from eight to ten years old, and 28% thereafter.

Third, in 2004, the government expanded the preferential tax rates to Special Economic Zones (SEZs)[5]. Manufacturing entrants post-2004 receive tax schedules akin to C districts, whereas service entrants get B district rates. I compiled a list of all SEZs up to 2021, encompassing industrial parks and high-tech zones. Later analysis only considers SEZs established before 2004 to avoid the potential endogenous response of setting up SEZs after

[4]For examples, see Hasan et al. (2021) for India, the Regional Assistance Zones (ZAFR) for France, Slattery and Zidar, 2020 for the US

[5]Decree 88/2004/TT-BTC

Table 1: Summary Statistics Grouped by Tax Policy Labels

Characteristic	**Overall**, N = 610	**A**, N = 267	**B**, N = 201	**C**, N = 142
Incidence of Poverty	0.42 (0.21)	0.28 (0.14)	0.44 (0.14)	0.65 (0.16)
Pop. per Acre	6.47 (23.18)	13.65 (33.72)	1.21 (1.09)	0.43 (0.82)
Ethnic Minority (%)	0.23 (0.33)	0.03 (0.09)	0.21 (0.26)	0.65 (0.32)
Urban Share (%)	0.22 (0.29)	0.33 (0.37)	0.15 (0.18)	0.10 (0.09)
Literate Pop.15+ (%)	0.87 (0.13)	0.93 (0.05)	0.89 (0.06)	0.73 (0.18)
Average Wage (Million VND)	7.99 (3.88)	9.07 (4.25)	7.66 (3.49)	6.43 (2.99)
Agriculture Share (%)	0.72 (0.25)	0.58 (0.30)	0.79 (0.15)	0.87 (0.09)
Manufacturing Share (%)	0.07 (0.09)	0.12 (0.11)	0.05 (0.04)	0.02 (0.02)

Sources: Data from Minot et al. (2003) for rows 1-5, Annual Establishment Surveys (2000-2002) for row 6, and Population Census 1999 for the remaining rows.
Notes: Presented as Mean (Standard Deviation). District labels A, B, and C represent Advantaged, Backward, and Challenged districts, as defined in Decree 164/2003/ND-CP. Average wage calculations cover the period from 2000 to 2002.

the 2004 tax incentives. Notably, most SEZs are in A districts: of the 85 communes (the third administrative level after district and province) with an SEZ prior to 2004, only 8 are in C districts and 17 in B districts.

Although this place-based policy aims to uplift underdeveloped districts, concerns arise about firms exploiting these incentives by shutting down and restarting in tax-favored areas. However, the practicality of such maneuvers is restricted due to the high costs of business closure stemming from regulations strategically designed to thwart tax evasion and prevent capital flight out of the country. Moreover, merely changing the business name but keeping the same ownership fails to qualify for the tax advantages[6] Finally, Figure A7 shows that exit rates across cohorts did not spike in 2003.

The policy's effect on multi-entity firms might be complex. As per Table A1, in 2000, 99% of Vietnamese firms had just one establishment. While the number of multi-establishment firms might have risen over time, those operating across several districts in a province are taxed at the provincial level (Le et al., 2020). District tax authorities handle single-establishment businesses or household enterprises. Formal enterprises in various locations pay profit taxes at their headquarters unless they operate in tax-advantaged areas, where separate filings for each location are required[7].

[6]See Section III Article 1 of Decree 128/2003/TT-BTC and Item 6.1.2 of Decree 88/2004/TT-BTC.
[7]See Section III Article 1 of Decree 128/2003/TT-BTC and Article 11 of Decree 126/2020/ND-CP.

2.2 Revenue Redistribution Policy

In addition to cutting taxes in poorer districts B and C to attract firms, the central government is regularly engaged in a fiscal redistribution policy where they take more revenue from richer areas and allocate a higher share of their revenue to poorer regions. Since I do not have access to redistribution of lower level than provinces, I aggregate the A, B, and C labels from the tax policy to the province level which use 1999 population shares in B and C and try to keep the similar shares of A, B, C across provinces as in across districts. Figure A9 displays the map of these provinces with A, B, and C labels next to the map of the official labels at the district levels.

Figure A2 plots the retention shares of provincial revenues and the contribution from the central government across the periods 2003, 2006, and 2015, based on official records of the Ministry of Finance. The central government lets the most disadvantaged provinces keep all of the revenue while giving them back three times the revenue that they raise. At the same time, they take about half of local revenues from advantaged areas and redistribute only about 10% of their income back. Since the focus of this paper is not on decisions of central government on redistribution or how it is best to combine it with other instruments like place-based and migration policies, I will take this revenue redistribution policy as given and allow it to either evolve exactly as I see in the data or experiment with varying levels of redistribution in the counterfactual analysis.

2.3 2005 Ho Khau Reform

In 2005, the government in Vietnam began easing the Ho Khau requirement, a regulation similar to China's Hukou system[8], which governs household registration and internal migration between provinces. Prior to this change, households moving to a different province faced challenges in obtaining permanent residency. To qualify for permanent residency, migrants had to meet several criteria, including obtaining a relocation certificate from their original province and demonstrating land or property ownership, which ironically required having a Ho Khau permanent status in the destination province (Liu and Meng (2019)).

The distinction between temporary and permanent status was primarily based on access to amenities in the destination province, with temporary migrants often struggling to access public services, healthcare, credit, and education for their children (World Bank Group and Vietnam Academy of Social Sciences, 2016).

In 2005, Decree 108/2005/ND-CP simplified the process by eliminating various prerequi-

[8]The Ho Khau policy is less strict than the Hukhou policy because, unlike the Hukhou, it does not restrict individuals to the birth sector.

sites and introduced a path to permanent residency solely based on proof of residence. For instance, the law no longer linked home ownership to permanent residence and removed the requirement for a moving certificate from the migrant's origin.

As a result, migrants can apply for permanent residency if they can demonstrate legal residence in their destination province, including possessing land or property certificates, a certificate from local authorities confirming the legal status of their residence, or a lease agreement. However, for the five centrally administered cities (Hanoi, Hai Phong, Da Nang, Ho Chi Minh City, and Can Tho)[9], temporary migrants must also show evidence of continuous residence for at least one year[10], although in practice people must reside longer than a year due to the lengthy bureaucratic process and various difficulties in acquiring such proof.

In summary, the Ho Khau policy reform has decreased migration costs for migrants everywhere, but the decrease is less pronounced for the five centrally administered provinces. For brevity, I call these central provinces A^* and the rest of Vietnam as R (for Rest). While changes in tariffs or taxes are given in numeric terms, the exact reduction in migration costs due to this policy is unknown. To perform welfare analysis, I will estimate this change using a model based on the features of this policy shift later on.

3 Data and Motivating Facts

The following data sources and three empirical facts provide insights into the economic trends in Vietnam from 2000 to 2019 and serve as the foundation for the coming model.

3.1 Data Sources

Establishment-level Data. The establishment-level data covers the period 2000 to 2015 and stems from annual enterprise surveys conducted by the General Statistics Office (GSO). This survey is mandatory for all registered firms. Starting in 2004, single-location household businesses employing fewer than ten workers are exempt from registration, allowing them to operate as "informal" entities without the need for survey reporting or paying taxes as discussed in subsection 2.1. Nevertheless, many of these enterprises opt to register voluntarily, as evidenced by the firm size distribution in Figure A6.

I follow McCaig et al. (2022) to create consistent firm identifiers, 4-digit ISIC industry codes, and locations. I also take advantage of employment and wage bill information. Additional details concerning these variables can be found in Appendix **??**.

[9] Ha Tay was merged into Ha Noi in 2008 and thus is considered part of Ha Noi in this study

[10] While Decree 108/2005/ND-CP requires a continuous stay of at least three years, the Residence Law of 2006 81/2006/QH11 reduces the requirement to at least one year.

Household Data. In addition to examining firm behavior from establishment surveys, I also analyze the choices made by households using the Population and Housing Censuses. Specifically, I use the 3% samples from the 1999, 2009, and 2019 censuses to assess the effects of policies on household location choices. I restrict the samples to the working-age population, aged 15 to 65.

In this study, a migrant is defined as someone who reports the current province as different from their province of residence five years ago, consistent with the GSO definition. However, this definition may underestimate actual migration since it does not consider seasonal migration or migrants who have returned to their origin within the past five years. Nonetheless, it is likely to be a good indicator of permanent migration.

Internal Trade Data. I use inter-provincial trade data for the year 2000 from JICA (2000). Using the 1999 IPUMS map, I calculated truck distances between provinces with ArcGIS network analysis tools. This data will help me analyze the link between trade and distance, further detailed in subsection 5.3.

3.2 Descriptive Facts

By merging the firm's location with the district label from the 2003 tax policy, I examine Vietnam's overall changes across industries and regions. Figure A8 displays the evolution of employment share by district tax labels and the three main sectors: Agriculture, Manufacturing, and Services. For each sector-district type, employment shares are normalized based on their respective 2000 levels. The figure first illustrates the substantial structural transformation in Vietnam, as observed in prior studies (McCaig and Pavcnik, 2013). The shares of employment in the manufacturing and service sectors experience rapid growth, while agriculture share falls.

Equally significant as the aggregate structural change are the employment dynamics across district categories within sectors. Prior to 2003, Advantaged (A) districts held about 90% of employment in manufacturing and services and around 50% in agriculture. Yet, from 2005 onward, B and C districts saw faster growth in manufacturing employment share than A districts. This change is particularly significant considering the parallel employment trends across these areas before 2005. This pattern remains evident even when adding the Zone category as a fourth location in Figure A4. These figures highlight the potential impact of policy reforms on the regional economic landscape.

During this period, the entry and exit margins play a crucial role in shaping the economy and are likely the driving force behind the substantial growth in non-agricultural employment observed in Figure A8, particularly in poorer districts. Table A2 presents data on entrants and exits in 2000 and 2015. In 2015, firms that were newly established (not present in 2000) accounted for 98% of all firms, contributing to 85% of employment and 83% of revenue. On the other hand, exiters, referring to firms present in 2000 but no longer in operation by 2015, tended to be smaller in size, comprising only 47% of employment and 49% of revenue in 2000. These figures highlight the significant degree of establishment turnover in the economy and underscore the importance of new establishments in driving employment growth.

At the local level, entry is not limited to completely new firms. Firms can also enter a location by relocating from another place between $t-1$ and t, or "in-migrants". Additionally, firms can re-enter after a period of inactivity or for other reasons that make them unobserved. Among re-entrants, there are "re-entrant incumbents" that return to the same location and "re-entrant migrants" that relocate from elsewhere. Nonetheless, most entrants to a district are completely new, as shown in Figure A5. The average annual entry rate is 27%, consistent with the rate reported by McCaig and Pavcnik (2021). Relocation across districts for incumbents is 6%, while the re-entrant in-migrant rate is less than 1%[11].

The establishment-level data used in this study omits the informal sector, encompassing small household businesses, and lacks information on whether an entrant was informal before. However, this limitation's impact on firm entry measurement should be minimal, given the infrequent formalization of private domestic firms. As highlighted by McCaig et al. (2022) and McCaig and Pavcnik (2021), the majority of private firms start as formal, and only about 2% of informal firms transition to formality within two years. Additionally, although the informal sector makes up a large part of employment, Cling et al., 2011 estimates it contributes just 20% to GDP. In short, the establishment-level data effectively capture the majority of Vietnamese firm dynamics.

Migration increased significantly from 2004 to 2009 compared to 1994-1999, following tax and Ho Khau policy reforms. Figure A3a shows that households with R Ho Khau labels, representing 80% of Vietnam's population in 1999, migrated more frequently than those with A^* labels. The appeal of migration grew for both R and A^* origins, with the out-migration share from R origins nearly doubling during 2004-2009.

Figure A3b reveals that out-migrants from R provinces increasingly preferred A^* destinations, while those from A^* favored R destinations. The stricter requirements for A^* Ho Khau post-reform likely reduced in-migration from R to A^* and had an even greater impact on those from A^*.

Migration costs vary based on origin and destination, and the Ho Khau policy influences

[11] The fraction of firms that re-enter after one exit period is extremely rare, at 0.1% among all firms that exit on average across exit cohorts.

these costs. This is incorporated into the dynamic model in section 4. Section 5 shows how the model can infer the Ho Khau policy's effects on migration costs from observed changes in migration flows.

3.2.1 Event-study Motivating Evidence

In this subsection, I use an event-study design to document how district labels under the Enterprise Income Tax Law correlate with firm location decisions and employment. As the policy offers incentives for firms entering C and B districts, along with Zone communes, I expect that these regions will experience higher rates of new entry and increased employment compared to A districts. As suggested by Figure A8, the answer may differ across sectors.

The unit of analysis is the district-zone level, as illustrated in Figure 2b. The map displays each polygon as a commune, an administrative tier below the district level. Commune colors denote socioeconomic status (C, B, A, or Zone). A commune is classified as a Zone if it hosted at least one economic zone before 2004. For instance, consider Cu Chi, a district in Ho Chi Minh City. While classified as A under the 2003 tax law, one of its communes is labeled as Zone, colored Green at the upper right corner. This distinction divides Cu Chi into two units for subsequent analysis: Cu Chi with Zone and Cu Chi without Zone. The following analyses aggregate establishment data into a balanced panel at the district-zone-sector level, encompassing approximately 700 district zones and 60 two-digit ISIC sectors.

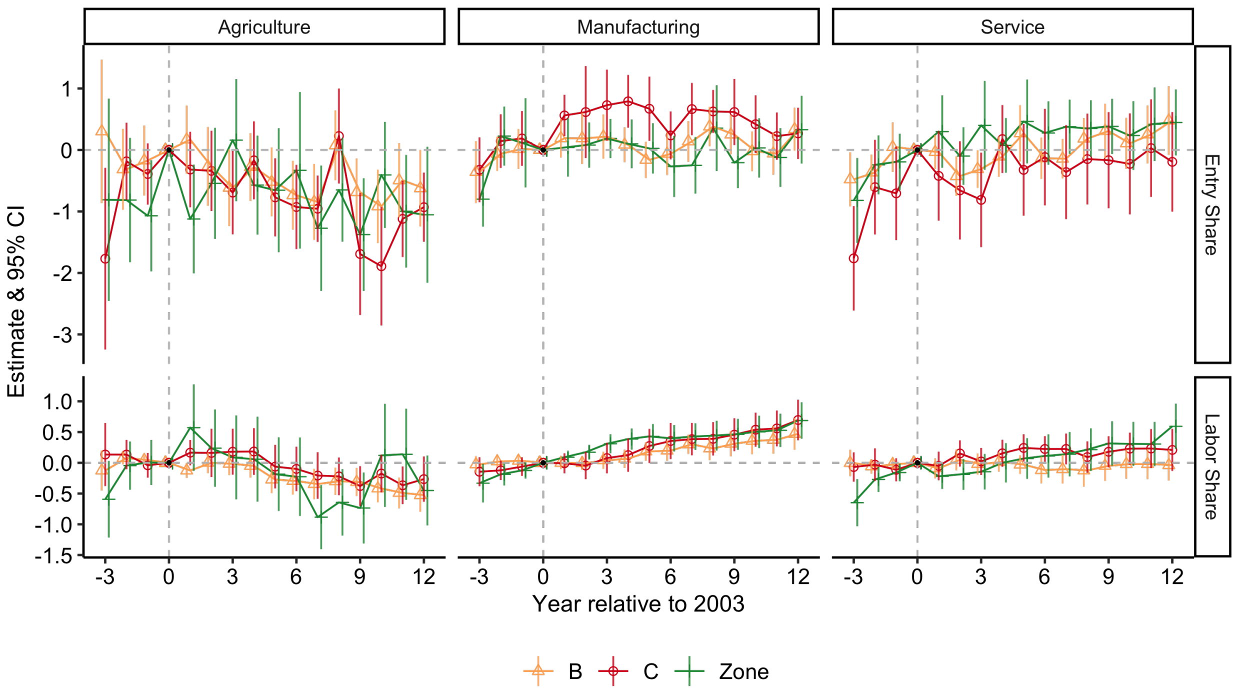
The time and spatial variation of the policies suggest the following event-study:

$$Y_{ist} = \sum_{j \in \{-3,\ldots,0,\ldots,12\}} \boldsymbol{\beta}_j^P \cdot \mathbf{Treat}_i \cdot \mathbf{1}_{t-j} + \underbrace{\alpha_i}_{\text{Region FE}} + \underbrace{\theta_s \cdot \delta_t}_{\text{Sector-Year FE}} + \varepsilon_{ist}, \tag{1}$$

where Y_{ist} is an outcome variable, which measures the share of entrants located in district-zone i among all entrants in sector s at year t, or the total labor employed by all firms in district-zone-sector is in year t. The variable $\mathbf{Treat}_i$ takes four different values (A, B, C, and $Zone$) with A being the control group, while indicator $\mathbf{1}_{t-j}$ equals one for year t. Commune i is classified as a Zone if it has an economic zone prior to 2004. Thus, the vector of coefficients of interest, $\boldsymbol{\beta}_j^P$, include $\beta_t^B, \beta_t^C, \beta_t^{\text{Zone}}$ which I hypothesize to be positive for both outcomes after 2003.

The estimated coefficients for years prior to 2003 are used to provide suggestive evidence of the parallel trend assumptions for the identification of these coefficients. In order to address potential unobserved correlations within locations, standard errors are clustered at the district-zone level. To account for numerous zeros in the outcome variables, I estimate Equation 1 using Pseudo Poisson Maximum Likelihood (PPML).

Figure 3: Event-Study Analysis of Firm Entry and Employment



Source: Annual Establishment Surveys (2000-2015). *Notes*: The figure organizes outcomes including entry share and employment in rows, with columns differentiating between all sectors and manufacturing only. Each graph shows PPML estimates from Equation 1, incorporating fixed effects for district-zone and sector-year.

The introduction of tax incentives in B and C districts did not yield increases in entry or employment when running regression Equation 1 on all establishments. This result can potentially be explained by heterogeneous effects across sectors. Manufacturing, comprising many tradable sectors, is more likely to respond to tax incentives in geographically disadvantaged districts due to its dependence on broader market demand rather than local consumption. However, given the relatively small share of manufacturing firms (approximately 24%), their response may not significantly impact the overall trends.

Consequently, when separately estimating Equation 1 within the three main sectors, I find an increase in both entry rates and employment within manufacturing as indicated in Figure 3. Tax incentives lead to an approximate 65% rise in the entrant share in C districts compared to A districts. Furthermore, these effects exhibit a degree of persistence over 10 years. These findings align with results in India, where place-based tax incentives led to an increase in manufacturing entry in backward districts (Chaurey, 2017; Hasan et al., 2021). Additionally, the rise in firm entry potentially translates to increased employment within manufacturing firms in B and C districts, as illustrated in the second row in Figure 3.

The Zone results suggest that tax incentives may not be the main driver of firm entry into SEZs. However, lower tax rates can allow firms to persist longer in these areas as I will explore after presenting how age-specific taxes affect the likelihood of continuing operating versus exit in the model.

In summary, this event-study analysis reveals that tax policy has the potential to stimulate structural transformation in less affluent districts. Table A3 presents the results of pooled regressions based on Equation 1, where I aggregate the data into pre- and post-periods and analyze them separately for major sectors. Following the implementation of tax incentives, both entry and employment in the manufacturing sector in B and C districts increase compared to A districts. Conversely, the agriculture sector witnesses a decline. There is a modest increase in the service sector, although not statistically significant, possibly due to a higher likelihood of informal operations with smaller-scale businesses in the service sector.

Interpreting these event-study results as effects of tax incentives, Ho Khau reform, or both, requires careful consideration for two reasons. First, I exclude the Ho Khau reform from this analysis due to the lack of a clean control group. In particular, several A districts, acting as the control group in regression (1) for the tax policy, become the A^* treatment group in the Ho Khau reform. Furthermore, it is difficult to isolate the effects of each and both policies because of the close timing of both policies. Furthermore, even with a clean control group, the DiD analysis is partial equilibrium in nature, as the impact of these policies on the control group is ignored. Large-scale policies can yield intricate general equilibrium effects through prices. Overcoming these challenges to quantify the welfare effects of the policies of interest requires a model.

4 A Dynamic Spatial General Equilibrium Model

This section introduces a dynamic spatial general equilibrium model designed to evaluate national-scale policies, improve upon event-study analyses by connecting data with policies more effectively, and examine counterfactual policies. The model incorporates standard ingredients, with the economy evolving in discrete time, indexed by $t \geq 0$, and consisting of heterogeneous locations, indexed by $i, n \in \{1, \ldots, N\}$, sectors $j, k \in \{1, \ldots, J\}$, and infinitely-lived households classified as workers and entrepreneurs.

The first element that distinguishes this model from standard ones in the place-based policy literature is the consumption of rivalrous public services. Local governments supply these services through profit taxes, so place-based tax incentives can hurt government revenues if the increase in firm entry is weaker than the tax rate reduction. Similarly, easing migration barriers to cities can concentrate firms and workers, but congestion in public services can reduce welfare inequality across regions. The importance of this first element becomes clear when considering the workers' problem next.

4.1 Workers

Each location has a continuum of workers of measure $L_{i,t}$, who supply labor inelastically and are fully mobile across sectors. At the start of period t, they earn wage $w_{i,t}$ and spend all of it on consuming varieties. Furthermore, each worker gains utility from consuming per capita public services $(G_{i,t}/\mathcal{L}_{i,t})$ in addition to goods, following Fajgelbaum et al. (2018).

The model's second novel element allows workers and entrepreneurs to switch occupations. After consuming goods and public services, each worker draws a productivity vector $\boldsymbol{\varepsilon}_t = \{\varepsilon_t^j\}_{j=0,1,\ldots,J}$ across occupations, where $j = 0$ denotes paid employment. They then decide between remaining an employee or becoming an entrepreneur in sector j. The indirect utility of workers in i at time t is given by

$$u_{i,t} = \gamma \log\left(G_{i,t}/\mathcal{L}_{i,t}\right) + (1-\gamma)\log\left(w_{i,t}/P_{i,t}\right) + \max\left\{\Xi_{i,t} + \chi\varepsilon_t^0, \max_{j=1,\ldots,J}\left\{\beta V_{i,t+1}^{j,\mathrm{I}} + \chi\varepsilon_t^j\right\}\right\} \quad (2)$$

where β is the discount factor, $G_{i,t}$ is the level of public services provided by the local government, and $\mathcal{L}_{i,t}$ is the total mass of local population, including workers $L_{i,t}$ and entrepreneurs $E_{i,t}$, i.e. $\mathcal{L}_{i,t} = L_{i,t} + E_{i,t}$. $V_{i,t+1}^{j,\mathrm{I}}$ denotes the expected value of entrepreneurship in location i and sector j at $t+1$, and $\Xi_{i,t}$ represents the option value of migration from i. The shocks $\boldsymbol{\varepsilon}_t$ follow a Type-I Extreme Value distribution and are i.i.d over time. The parameter $\chi > 0$ governs the transition of workers to entrepreneurs, with a higher χ indicating larger idiosyncratic heterogeneity and a smaller response to policy changes.

As in standard spatial models, workers exhibit a nested constant elasticity of substitution (CES) preference structure over a continuum of varieties produced by entrepreneurs across the country. The local price index $P_{i,t}$ is derived as

$$P_{i,t} = \prod_{j=1}^{J}\left(\frac{P_{i,t}^j}{\alpha^j}\right)^{\alpha^j}, \quad 0 < \alpha^j < 1 \text{ and } \sum_j \alpha^j = 1, \quad (3)$$

where α^j is the consumption share of goods from sector j. $P_{i,t}^j$ represents the location-sector price index. Plus, the location-sector price index can be expressed as

$$P_{i,t}^{j}=\left(\sum_{n=1}^{N}E_{n,t}^{j}(p_{ni,t}^{j})^{1-\sigma}\right)^{1/(1-\sigma)}, \tag{4}$$

where σ is the elasticity of substitution, $E_{n,t}^{j}$ is the measure of entrepreneurs or varieties in location n and sector j, and $p_{ni,t}^{j}$ represents the price set by entrepreneurs in n and selling to destination i at time t. Entrepreneurs operate under monopolistic competition and face sector-specific iceberg trade costs d_{in}^{j}.

The lifetime utility of a worker in location i, derived in Appendix B, is given by

$$U_{i,t}=\gamma\log\left(G_{i,t}/\mathcal{L}_{i,t}\right)+(1-\gamma)\log\left(w_{i,t}/P_{i,t}\right)+\chi\log\left[\exp(\Xi_{i,t})^{1/\chi}+\sum_{j=1}^{J}\exp(V_{i,t+1}^{j,\mathrm{I}})^{1/\chi}\right]. \tag{5}$$

The share of workers opting for entrepreneurship in sector j is given by

$$\psi_{i,t}^{j}=\frac{\exp(V_{i,t+1}^{j,\mathrm{I}})^{1/\chi}}{\exp(\Xi_{i,t})^{1/\chi}+\sum_{j=1}^{J}\exp(V_{i,t+1}^{j,\mathrm{I}})^{1/\chi}},\ \text{for } j>0, \tag{6}$$

and the share of remaining workers is

$$\psi_{i,t}^{0}=\frac{\exp(\Xi_{i,t})^{1/\chi}}{\exp(\Xi_{i,t})^{1/\chi}+\sum_{j=1}^{J}\exp(V_{i,t+1}^{j,\mathrm{I}})^{1/\chi}}. \tag{7}$$

Should a worker opt to stay employed, they draw another vector of idiosyncratic shocks across locations immediately, represented by $\boldsymbol{\epsilon}_t=\{\epsilon_{n,t}\}_{n=1}^{N}$. They then decide the next location based on migration costs $m_{in,t}$, the expected value of being in destination n, denoted by $U_{n,t+1}\equiv\mathbb{E}_{\epsilon}\left[u_{n,t+1}\right]$, and the idiosyncratic shocks $\boldsymbol{\epsilon}_t$ which i.i.d over time with a Type-I Extreme Value distribution with dispersion $\nu>0$.

The option value of choosing where to migrate from location i is given by

$$\Xi_{i,t}\equiv\mathbb{E}\left[\max_{\{n=1,\dots,N\}}\beta U_{n,t+1}-m_{in,t}+\nu\epsilon_{n,t}\right]=\nu\log\left[\sum_{n=1}^{N}\exp\left(\beta U_{n,t+1}-m_{in,t}\right)^{1/\nu}\right], \tag{8}$$

and the share of workers who migrate from origin i to destination n between time t and $t+1$

$$\mu_{in,t}=\frac{\exp\left(\beta U_{n,t+1}-m_{in,t}\right)^{1/\nu}}{\sum_{n=1}^{N}\exp\left(\beta U_{n,t+1}-m_{in,t}\right)^{1/\nu}}. \tag{9}$$

Following **Caliendo2021empty citation**, the migration cost $m_{in,t}$ from origin i to destination n consists of a fixed component m_{in} (like distance) and a Ho Khau policy-related cost $mpol_{in,t}$ for those migrating from i to n

$$m_{in,t} = m_{in} + mpol_{in,t}, \text{ with } m_{ii,t} = 0 \text{ and } m_{in,t} > 0 \text{ for } n \neq i. \tag{10}$$

The pre-existing Ho Khau policy, which increases $mpol_{in,t}$, is designed to manage population and reduce congestion in public services $G_{i,t}$. Consequently, the welfare impacts of decreasing Ho Khau costs are nuanced, balancing between productivity gains from eased migration frictions and the potential for increased congestion in public services and a decrease in entrepreneurship.

4.2 Entrepreneurs

Entrepreneurs, in contrast to workers, are bound to a specific sector due to unique technologies in each sector, with their productivity independently determined each period. They progress through stages $s \in \{\mathrm{I}, \mathrm{II}, \mathrm{III}\}$, encountering varying local profit tax rates $\tau^s_{i,t}$ at each stage, with lower Roman numerals indicating younger firms. These stages represent a discretized version of continuous firm age, reflecting the post-2003 tax schedule outlined in Figure 2a. Similar to workers, entrepreneurs consume goods by spending their after-tax profits on goods without saving, following Caliendo and Parro (2020).

4.2.1 Static Decisions

An entrepreneur in location i and sector j decides how much to produce and at what price to charge each period t. The firm's output, $y^j_{i,t}$, depends on location-sector productivity, $A^j_{i,t}$, labor, $L^j_{i,t}$, and land, $H^j_{i,t}$. The total amount of land in each location i is fixed, i.e. $\sum_{j=1}^{J} H^j_{i,t} = \bar{H}_i, \forall t$. Given the share of labor in value-added ξ^j, the production function in each sector is given by

$$y^j_{i,t} = A^j_{i,t} \left(L^j_{i,t}\right)^{\xi^j} \left(H^j_{i,t}\right)^{1-\xi^j}.$$

The firm's cost minimization problem determines the unit cost bundle as

$$x^j_{i,t} = B^j \left(w_{i,t}\right)^{\xi^j} \left(r_{i,t}\right)^{1-\xi^j} \tag{11}$$

where $w_{i,t}$ denote the local wage, $r_{i,t}$ the land price, and B^j is a constant, $B = {\xi^j}^{-\xi^j}(1-\xi^j)^{-(1-\xi^j)}$. The input markets are perfectly competitive, so cost minimization implies the following land market clearing condition

$$r_{i,t}H^{j}_{i,t} = \frac{1-\xi^{j}}{\xi^{j}}w_{i,t}L^{j}_{i,t}. \tag{12}$$

In addition to input costs, firms in sector j and location i incur iceberg trade costs d^{j}_{in} in destination n. Thus, entrepreneurs set their optimal prices by including a constant markup to the combined input cost and the trade cost:

$$p^{j}_{in,t} = \frac{\sigma}{\sigma-1}\frac{d^{j}_{in}x^{j}_{i,t}}{A^{j}_{i,t}}. \tag{13}$$

Entrepreneurs sell their varieties across all locations, generating pre-tax profits $\pi^{j}_{i,t}$,

$$\pi^{j}_{i,t} = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{A^{j}_{i,t}}{x_{i,t}}\right)^{\sigma-1}\sum_{n=1}^{N}(d^{j}_{in})^{1-\sigma}X^{j}_{n,t}(P^{j}_{n,t})^{\sigma-1} \tag{14}$$

where $X^{j}_{n,t}$ represents the expenditure on sector j in location n. If varieties are substitutes (i.e., $\sigma > 1$), profits rise with lower effective input costs $(x^{j}_{i,t}/A^{j}_{i,t})$, lower trade costs, and higher demand.

4.2.2 Dynamic Decisions

Entrepreneurs decide to continue operations or exit to become a worker. This setup implies that it takes at least two periods for current entrepreneurs in location i to become entrepreneurs in a different location n because they need to first exit and migrate before setting up a new firm in n. While an entrepreneur in practice might pursue various outside options like managing a different firm, I limit their outside option to being a worker based on observations that (a) exiting firms seldom return, (b) firms rarely change locations, and (c) transitioning to a worker role aligns with an idea in Lucas (1978) where economic development may see small entrepreneurs join larger firms as workers.

In each period, a mass of s-stage entrepreneurs, denoted by $E^{j,s}_{i,t}$, in each location-sector ij decides whether to continue their business or switch to employment, considering productivity shocks similar to those of workers. Let $v^{j,s}_{i,t}$ represent the value of a stage s-entrepreneur where $s \in \{\text{I, II, III}\}$ in location-sector ij at time t, with its expected value $V^{j,s}_{i,t+1} \equiv \mathbb{E}_t[v^{j,s}_{i,t+1}]$. The value for an s entrepreneur in location-sector ij at time t is given by

$$v^{j,s}_{i,t} = \log\left(c^{j,s}_{i,t}\right) + \max\left\{\beta V^{j,s+\mathrm{I}_s}_{i,t+1} + \chi\epsilon_{stay,t}, \beta U_{i,t+1} + \chi\epsilon_{exit,t}\right\}, \tag{15}$$

where I_s accounts for the transition to the next stage for younger firms, but not for the final stage ($s = \mathrm{III}$), i.e. $\mathrm{I}_s = \mathrm{I}$ for $s < \mathrm{III}$ and 0 if $s = \mathrm{III}$. Entrepreneurs differ from workers in their consumption patterns slightly, spending their after-tax profits instead of wages:

$$c_{i,t}^{j,s} = \left(\frac{G_{i,t}}{\mathcal{L}_{i,t}}\right)^{\gamma} \left((1-\tau_{i,t}^{s})\frac{\pi_{i,t}^{j}}{P_{i,t}}\right)^{1-\gamma}.$$

The expected value for an s-entrepreneur at time t in location-sector ij is

$$V_{i,t}^{j,s} = \log c_{i,t}^{j,s} + \chi \log \left[\exp\left(V_{i,t+1}^{j,s+\mathrm{I}_s}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}\right], \tag{16}$$

and the likelihood of s entrepreneurs remaining in location-sector ij from time t to $t+1$ is

$$\varsigma_{i,t}^{j,s} = \frac{\exp\left(V_{i,t+1}^{j,s+\mathrm{I}_s}\right)^{\beta/\chi}}{\exp\left(V_{i,t+1}^{j,s+\mathrm{I}_s}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}}. \tag{17}$$

Entrepreneurs' local consumption leads to agglomeration effects, stemming from home bias due to trade costs. This effect allows firms to follow other firms entering a location, as increasing local variety reduces prices. This cycle can bolster the location's appeal, promoting business growth and elevating local economic dynamism. However, since land supply is fixed, rent acts as a congestion force against this agglomeration effect.

The evolution of entrepreneurs $E_{i,t+1} = \sum_{j=1}^{J} E_{i,t+1}^{j}$ consists of different components:

$$E_{i,t+1}^{j,\mathrm{III}} = \varsigma_{i,t}^{j,\mathrm{III}} E_{i,t}^{j,\mathrm{III}} + \varsigma_{i,t}^{j,\mathrm{II}} E_{i,t}^{j,\mathrm{II}}, \tag{18}$$

$$E_{i,t+1}^{j,\mathrm{II}} = \varsigma_{i,t}^{j,\mathrm{I}} E_{i,t}^{j,\mathrm{I}}, \tag{19}$$

$$E_{i,t+1}^{j,\mathrm{I}} = \psi_{i,t}^{j} L_{i,t}, \tag{20}$$

$$E_{i,t+1}^{j} = \sum_{j=1}^{J} \sum_{s=\mathrm{I}}^{\mathrm{III}} E_{i,t+1}^{j,s}. \tag{21}$$

Here, $\psi_{i,t}^{j}$ is based on (6). Similarly, worker dynamics are

$$L_{i,t+1} = \sum_{n=1}^{N} \mu_{ni,t} \psi_{n,t}^{0} L_{n,t} + \sum_{j=1}^{J} \sum_{s=\mathrm{I}}^{\mathrm{III}} \left(1 - \varsigma_{i,t}^{j,s}\right) E_{i,t}^{j,s}, \tag{22}$$

reflecting both continuing employees and those transitioning out of entrepreneurship. The first term accounts for the inflow and persistence of employees, while the second term tracks entrepreneurs exiting their ventures.

4.3 Local Government

In each location i, a local government funds public services $G_{i,t}$ through three revenue streams: central government transfers, land rent, and profit taxes. Their expenditures are outlined as

$$P_{i,t}G_{i,t} = \Omega_{i,t}\Lambda_t + \omega_{i,t} \underbrace{\left(r_{i,t}H_i + \sum_{j=1}^{J}\sum_{s=\mathrm{I}}^{\mathrm{III}} E_{i,t}^{j,s}\tau_{i,t}^{s}\pi_{i,t}^{j} \right)}_{\Gamma_{i,t}} \tag{23}$$

where $\omega_{i,t}$ is the retained share of local government's revenue $\Gamma_{i,t}$ from land income and profit taxes, $\Omega_{i,t}$ is the share of the central government's budget allocating to location i, and Λ_t is the central government's total revenue, which aggregates from local incomes,

$$\Lambda_t = \sum_{i=1}^{N}(1-\omega_{i,t})\Gamma_{i,t}.$$

As highlighted in Subsection 2.2, the parameters $\omega_{i,t}$ and $\Omega_{i,t}$ represent the observed fiscal redistribution policies. The model simplifies by assuming that local governments collect all land rent, excluding private landlords, unlike Kleinman et al. (2023). This assumption is empirically motivated by the substantial land rent revenue of local governments in Vietnam, particularly in special economic zones, and theoretically by Henry George's theorem (Stiglitz, 1977).

Lastly, the model assumes that local governments spend all income on public services, bypassing complexities like bureaucratic delays or revenue losses due to other political motives. Incorporating dynamic public finance interactions between local and central governments is beyond the scope of this paper.

4.4 Equilibrium

In each sector j, the bilateral trade share of goods bought by location n and produced by i is given by

$$\lambda_{in,t}^{j} = E_{i,t}^{j}\frac{p_{in,t}^{j}y_{in,t}^{j}}{X_{n,t}^{j}} = E_{i,t}^{j}\left(\frac{p_{in,t}^{j}}{P_{n,t}^{j}}\right)^{1-\sigma} = \frac{E_{i,t}^{j}(d_{in}^{j}x_{i,t}^{j})^{1-\sigma}(A_{i,t}^{j})^{\sigma-1}}{\sum_{n'=1}^{N}E_{n',t}^{j}(d_{n'n}^{j}x_{i,t}^{j})^{1-\sigma}(A_{n',t}^{j})^{\sigma-1}}, \tag{24}$$

where the last equation follows from (13).

The total income of location i, denoted by $\Pi_{i,t}$, is the sum of three components: local government's budget, workers' income, and net profits of entrepreneurs, which can be expressed as

$$\Pi_{i,t} = P_{i,t}G_{i,t} + \sum_{j=1}^{J}\left(w_{i,t}L_{i,t}^{j} + \pi_{i,t}^{j}\sum_{s=\mathrm{I}}^{\mathrm{III}} E_{i,t}^{j,s}(1-\tau_{i,t}^{s})\right) \tag{25}$$

Since each agent spends the same share, α^j, on goods from sector j, the total expenditure on goods in sector j in location i is given by

$$X_{i,t} = \alpha^j \Pi_{i,t}. \tag{26}$$

The labor market clearing condition is given by

$$w_{i,t}L_{i,t}^{j} = \frac{\sigma-1}{\sigma}\sum_{n=1}^{N}\lambda_{in,t}^{j}X_{n,t}^{j}. \tag{27}$$

I can now define the equilibrium of the model given the economy's exogenous fundamentals, policies, and state variables. Let the set of exogenous fundamentals be $\mathcal{F}_t \equiv \{d_{in}^{j}, A_{i,t}^{j}, m_{in}\}_{i,n,j}$ which includes trade costs, local TFPs, and non-policy migration cost, and the set of policies be $\mathcal{P}_t \equiv \{\tau_{i,t}^{s}, mpol_{in,t}\}_{i,n,s}$ which comprises profit tax and Ho Khau policy. The state variables consist of the distribution of workers and entrepreneurs $\mathcal{S}_t \equiv \{L_{i,t}, E_{i,t}^{j,\mathrm{I}}, E_{i,t}^{j,\mathrm{II}}, E_{i,t}^{j,\mathrm{III}}\}_{i,j,s}$.

Definition 1. Each period t, given the set of state variables, policies, and exogenous fundamentals $\{\mathcal{S}_t, \mathcal{P}_t, \mathcal{F}_t\}$, the *static equilibrium* is a set of factor prices $\{w_{i,t}, r_{i,t}\}_i$ that solves the equilibrium conditions (3), (4), (13), (14), (24), (25), (27).

I use variables with only time subscripts to denote matrices in the next definition. For instance, L_t is a $N \times 1$ matrix that represents the distribution of labor across N locations in period t.

Definition 2. Given an initial set of allocations of $\mathcal{S}_0$, a set of sequences of fundamentals and policies $\{\mathcal{F}_t, \mathcal{P}_t\}_{t=0}^{\infty}$, a *sequential competitive equilibrium* consists of sequences of allocations, values, and prices $\{L_t, \mu_t, , E_t, \varsigma_t, \psi_t, V_t, U_t, w_t, r_t, P_t\}_{t=0}^{\infty}$ that solve each household's dynamic problem (5), (15), (16), equilibrium conditions (9), (22), (17), (20), (6), (23), and the static equilibrium at each period t.

4.5 Solving the Model with Policy Changes

To analyze the impact of policy changes from $\mathcal{P}_t$ to a counterfactual $\mathcal{P}'_t$, I need data on exogenous fundamentals and policy levels before and after the changes based on equilibrium definitions. To simplify this task, I extend the "dynamic hat algebra" approach from

Caliendo et al. (2019). This method not only eliminates the need to estimate a large set of unknowns but also ensures a precise matching between the model and observed data, accommodating economies in transitional phases—particularly useful for rapidly growing economies like Vietnam.

The first step involves constructing the actual economy with observed data, reflecting equilibrium outcomes that incorporate both the evolution of fundamentals and policy changes. As the data only spans up to 2019, I assume that fundamentals and policies remain constant from the last data period and solve the model to reach a steady state. This sequential equilibrium, combined with available data, constitutes the actual economy, reflecting the presence of policy reforms.

To get the sequential equilibrium from the last data period, I extend Proposition 2 in Caliendo et al. (2019) to this model, which accounts for heterogeneous entrepreneurs and occupational choice. I use their dot notation to indicate relative time changes for each variable y, denoted by $\dot{y}_{t+1} \equiv y_{t+1}/y_t$. Appendix C.1 provides the proof of the next proposition.

Proposition 1. *Given allocation $(\mathcal{S}_t, \mu_{t-1}, \varsigma_{t-1}, \psi_{t-1}, \lambda_t)$ and constant sequences of policies and fundamentals following t, the sequential equilibrium in relative time change can be solved without knowing the levels of fundamentals and policies.*

Once I have the actual economy after applying Proposition 1, I then solve for a counterfactual economy using the hat notation for each variable x, $\widehat{x}_{t+1} = \frac{\dot{x}'_{t+1}}{\dot{x}_{t+1}}$ where x' is the value of variable x in the counterfactual economy. The following proposition, with its proof in Appendix **??**, outlines the main advantage of this approach in solving counterfactual economies:

Proposition 2 (Dynamic Hat Algebra)**.** *Given an economy, $\{\mathcal{S}_t, \mu_{t-1}, \varsigma_{t-1}, \psi_{t-1}, \lambda_t\}_{t=0}^{\infty}$ and a sequence of policy changes relative to the actual economy $\{\widehat{\mathcal{P}}_t\}_{t=1}^{\infty}$, the counterfactual sequential equilibrium $\{\mathcal{S}'_t, \mu'_{t-1}, \varsigma'_{t-1}, \psi'_{t-1}, \lambda'_t\}_{t=1}^{\infty}$ can be determined without requiring information on the level of the fundamentals.*

Proposition 2 enables the creation of a counterfactual economy that mirrors the actual economy except for the absence of policy changes. I assume that households do not anticipate the counterfactual policy at time $t = 0$ but instead learn about the entirely new policy sequence starting from period $t = 1$. Consequently, this approach allows me to address the counterfactual question: How would the economy change if the only alteration were a policy while all other factors (such as changes in fundamentals and other policies) continued to evolve as observed in the data?

Finally, I can calculate the welfare changes for workers in location i, denoted as $\widehat{W}_i$, using compensating variation. The welfare change of workers in hat notation, which is derived in Appendix C.2, is given by

$$\widehat{W}_i = \sum_{t=1}^{\infty} \beta^t \log \frac{(\widehat{G}_{i,t}/\widehat{\mathcal{L}}_{i,t})^{\gamma}(\widehat{w}_{i,t}/\widehat{P}_{i,t})^{1-\gamma}}{(\widehat{\mu}_{ii,t})^{\nu}(\widehat{\psi}^{0}_{i,t})^{\chi}}. \tag{28}$$

To apply Proposition 2 for calculating the welfare effects in Equation 28, essential data includes allocations, flows, parameter estimates, and quantification of policy changes. Crucial to this quantitative exercise are the variations in migration costs due to the Ho Khau policy, $\Delta mpol_{in,t}$, and the firm entry elasticity governed by the parameter χ. While profit tax figures are readily available, quantifying the Ho Khau policy's impact on migration costs in utils is more challenging.

5 Estimation

To take the model to the data, I first parameterize and calibrate some parameters. I begin by externally setting several parameters. First, I set the discount factor β to 0.95 and assign the elasticity of substitution σ value of 6, a common estimate in the trade literature. By combining these parameter values with the market clearing condition (27) and wage bill data, I deduce the consumption shares across sectors $\{\alpha^j\}_j$. The labor share in value-added, ξ^j, is set at 0.6, reflecting typical labor share in production function estimations. The migration elasticity parameter ν is chosen as 1.6, following Caliendo et al. (2021). Lastly, the share of public service consumption, γ, is calibrated to 0.16, based on Fajgelbaum et al. (2018).

This section focuses on estimating three crucial pieces of information. First, I exploit changes in tax policy across time, space, and firm age as a quasi-random experiment to identify the inverse of the spatial firm entry elasticity χ in subsection 5.1. Next, in subsection 5.2, I estimate the changes in migration costs associated with the Ho Khau policy, leveraging heterogeneous responses among migrants' origins, along with variations in time and destination. Finally, I tackle the scarcity of data on internal trade shares (λ_t), a key element for conducting counterfactual analyses as outlined in Proposition 2, in subsection 5.3.

5.1 Identifying the Spatial Firm Entry Elasticity

The tax policy reform, besides its spatial and temporal aspects that guided the DiD analysis in subsubsection 3.2.1, also incorporates variations based on firm age. From the model developed in Section 4, I now derive reduced-form equations to exploit the full range of firm variations, aiming to identify the (inverse) firm entry elasticity χ. This method not only identifies the key parameter χ but also tests the model's unique predictions qualitatively.

I focus on the effects of place-based profit tax changes on entry, and the decision-making process regarding staying or exiting for firms in different stages. By comparing the logarithmic differences between entry in sector j (6) and paid employment (7), I get

$$\log \psi^j_{i,t} - \log \psi^0_{i,t} = \frac{\beta}{\chi} V^{j,\mathrm{I}}_{i,t+1} - \frac{1}{\chi} \Xi_{i,t},$$

indicating the impact of tax incentives through the value function $V^{j,\mathrm{I}}_{i,t+1}$ on the share of workers transitioning to entrepreneurship in sector j. Specifically, substituting Equation 16 into $V^{j,\mathrm{I}}_{i,t+1}$ yields

$$\log \frac{\psi^j_{i,t}}{\psi^0_{i,t}} = \frac{\beta}{\chi} \log c^{j,\mathrm{I}}_{i,t} + \beta \log \left(\exp \left(V^{j,\mathrm{II}}_{i,t+2} \right)^{\frac{\beta}{\chi}} + \exp \left(U_{i,t+1} \right)^{\frac{\beta}{\chi}} \right) - \frac{1}{\chi} \Xi_{i,t}. \tag{29}$$

The second term on the right-hand side, reflecting the continuation value for an entrepreneur in location-sector ij, can be represented by the share of early-stage I firms that stay, based on Equation 17,

$$\underbrace{1 - \varsigma^{j,\mathrm{I}}_{i,t+1}}_{\text{Exit rate}} = \frac{\exp \left(U_{i,t+1} \right)^{\frac{\beta}{\chi}}}{\exp(V^{j,\mathrm{II}}_{i,t+2})^{\frac{\beta}{\chi}} + \exp \left(U_{i,t+1} \right)^{\frac{\beta}{\chi}}}.$$

Rearranging terms and taking logs of both sides, I get

$$\log \left(\exp \left(V^{j,\mathrm{II}}_{i,t+2} \right)^{\frac{\beta}{\chi}} + \exp \left(U_{i,t+1} \right)^{\frac{\beta}{\chi}} \right) = \frac{\beta}{\chi} U_{i,t+1} - \log(1 - \varsigma^{j,\mathrm{I}}_{i,t+1}),$$

which indicates that the share of I firms that exit location-sector ij, $1 - \varsigma^{j,\mathrm{I}}_{i,t+1}$, encapsulates some of the future value of operating an II firm there. Substituting this expression into equation (29) results in

$$\log \left(\frac{\psi^j_{i,t}}{\psi^0_{i,t}} (1 - \varsigma^{j,\mathrm{I}}_{i,t+1})^{\beta} \right) = \frac{\beta}{\chi} \log c^{j,\mathrm{I}}_{i,t} + \frac{\beta^2}{\chi} U_{i,t+1} - \frac{1}{\chi} \Xi_{i,t}, \tag{30}$$

which relates data on local entry share and future exit share of I entrepreneurs to the entrepreneur's consumption and the future value of being a worker in i.

A reduction in the tax rate for I firms in location i increases the current period's entry rate $\log \psi^j_{i,t}$ relative to paid employment by making entrepreneurship more attractive. However, it also leads to an increased exit rate for firms in the subsequent period due to the heightened competition for inputs from the surge in the number of firms.

I exploit tax variations among different firm age groups to remove the non-tax component in the consumption of early-stage I entrepreneurs, $c_{i,t}^{j,\mathrm{I}}$. From Equation 17, I calculate the survival rate of early-stage I firms by taking the ratio of the share of early-stage I firms that stay versus those that exit, resulting in

$$\frac{\varsigma_{i,t}^{j,\mathrm{I}}}{1-\varsigma_{i,t}^{j,\mathrm{I}}} = \exp\left(V_{i,t+1}^{j,\mathrm{II}} - U_{i,t+1}\right)^{\frac{\beta}{\chi}}.$$

Taking logs of both sides and substituting the value of a stage II entrepreneur (16) yields

$$\log\frac{\varsigma_{i,t}^{j,\mathrm{I}}}{1-\varsigma_{i,t}^{j,\mathrm{I}}} = \frac{\beta}{\chi}\log c_{i,t}^{j,\mathrm{II}} - \frac{\beta}{\chi}U_{i,t+1} + \beta\log\left[\exp\left(V_{i,t+1}^{j,\mathrm{III}}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}\right].$$

Following similar steps as earlier to substitute the continuation value, I get

$$\log\frac{\varsigma_{i,t}^{j,\mathrm{I}}}{1-\varsigma_{i,t}^{j,\mathrm{I}}}\left(\frac{1-\varsigma_{i,t+1}^{j,\mathrm{II}}}{\varsigma_{i,t+1}^{j,\mathrm{II}}}\right)^{\beta} = \frac{\beta}{\chi}\log\left(c_{i,t+1}^{j,\mathrm{II}}\right) - (1-\beta)\frac{\beta}{\chi}U_{i,t+1}.$$

A decrease in profit tax for II firms has a twofold effect: it makes early-stage I firms more likely to stay than exit, as indicated by the survival rate ($\frac{\varsigma_{i,t}^{j,\mathrm{I}}}{1-\varsigma_{i,t}^{j,\mathrm{I}}}$), while also increasing the likelihood of exit in the next period for II firms due to heightened market competition, captured in $\left(\frac{1-\varsigma_{i,t+1}^{j,\mathrm{II}}}{\varsigma_{i,t+1}^{j,\mathrm{II}}}\right)^{\beta}$.

By subtracting each side of this equation from the corresponding side of (30), I obtain

$$\log\frac{\frac{\psi_{i,t}^{j}}{\psi_{i,t}^{0}}(1-\varsigma_{i,t+1}^{j,\mathrm{I}})^{\beta}}{\frac{\varsigma_{i,t}^{j,\mathrm{I}}}{1-\varsigma_{i,t}^{j,\mathrm{I}}}\left(\frac{1-\varsigma_{i,t+1}^{j,\mathrm{II}}}{\varsigma_{i,t+1}^{j,\mathrm{II}}}\right)^{\beta}} = \frac{\beta}{\chi}(1-\gamma)\log\frac{(1-\tau_{i,t+1}^{\mathrm{I}})}{(1-\tau_{i,t+1}^{\mathrm{II}})} + \boldsymbol{\Sigma}_{i,t}^{j} \tag{31}$$

where the location-sector-time fixed effects $\boldsymbol{\Sigma}_{i,t}^{j}$ captures all the local value functions.

The model thus yields a novel prediction. Reducing tax rates for young firms increases the ratio of new entrants to workers, compared to the survival rate of established firms. In Appendix B.2, I extend the model to accommodate continuous firm ages, where $s \in \{\mathrm{I}, \mathrm{II}, \dots\}$. This extension avoids the need to categorize entrepreneurs into only three age groups I, II, or III in the data. As a result, the estimating equation version of (31) features

Table 2: Estimates of Firm Entry Elasticity

	Local Age-Specific Turnover Rate	
	(1)	(2)
Log(Net Profit Rate Ratio)	1.96***	1.59***
	(0.49)	(0.56)
Observations	46,809	46,809
District-AgeGroup FE (1,364)	✓	✓
District-Sector2d-Year FE (12,836)	✓	✓
AgeGroup-Year FE (70)		✓

Source: Annual Establishment Surveys (2000-2015).
Notes: The analysis observes units by district-zone, 2-digit ISIC sector, age group, and year. Regression (32) is estimated by PPML. Significance levels are denoted as *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$. Standard errors, clustered at the district-zone and age group levels, are shown in parentheses.

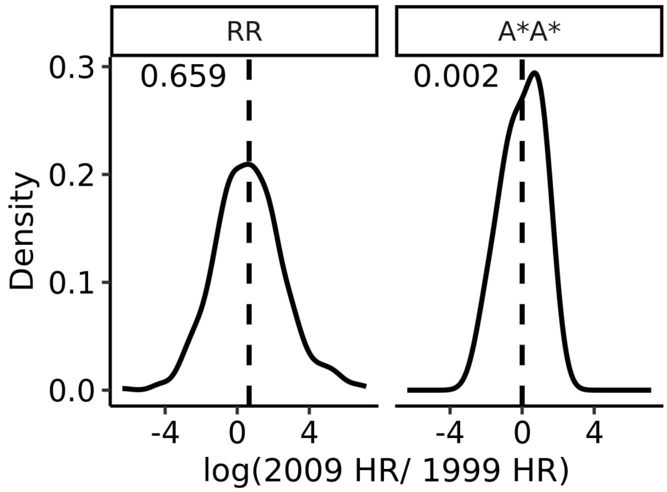
a triple difference-in-difference (DiDiD) design and is expressed as

$$\log \frac{\frac{\psi^{j}_{i,t}}{\psi^{0}_{i,t}}(1-\varsigma^{j,\mathrm{I}}_{i,t+1})^{\beta}}{\frac{\varsigma^{j,s-\mathrm{I}}_{i,t}}{1-\varsigma^{j,s-\mathrm{I}}_{i,t}}(1-\varsigma^{j,s}_{i,t+1})^{\beta}} = \gamma_F \log \frac{1-\tau^{\mathrm{I}}_{i,t+1}}{1-\tau^{s}_{i,t+1}} + \mathbf{\Sigma}^{j}_{i,t} + \mathbf{\Theta}^{\widetilde{S}}_{t} + \varphi^{\widetilde{S}}_{i} + \varepsilon^{j,s}_{i,t}. \tag{32}$$

In this equation, the dependent variable, which I call the Local Age-Specific Turnover Rate (LAST), consists of four components. The first, $\frac{\psi^{j}_{i,t}}{\psi^{0}_{i,t}}$, is the number of entrants in sector j and location i between periods t and $t+1$ relative to the number of workers in i. The second component accounts for the proportion of 1-year-old establishments leaving location-sector ij from $t+1$ to $t+2$. Third, $\frac{\varsigma^{j,s-\mathrm{I}}_{i,t}}{1-\varsigma^{j,s-\mathrm{I}}_{i,t}}$ measures the ratio of $s-\mathrm{I}$-year-old establishments that stay in ij from t to $t+1$ compared to those that exit. Finally, $(1-\varsigma^{j,s}_{i,t+1})$ indicates the exit rate of s-year-old establishments from ij between $t+1$ and $t+2$.

The assumption for identifying γ_F is that tax variations over time, across regions, and across firm age groups are uncorrelated with the error term. For this assumption to be invalid, an unobserved factor like a technological shift or alterations in tax enforcement

Figure 4: Variations in Ho Khau Costs



Source: Population and Housing Census 1999 and 2009.
Notes: Distributions reflect log ratios of Head Ries indexes for each origin-destination type, calculated for 1999 and 2009. Dashed lines and accompanying numbers represent the average values of these distributions.

would have to disproportionately benefit younger rather than older establishments, while also aligning with the timing of the tax change, district labels, and firm cohorts.

Table 2 presents estimates for γ_F. The preferred specification incorporating all three-way fixed effects gives 1.59, statistically significant at the 1 percent level. Given the calibrated parameters for β and γ, I obtain $\chi = 0.5$.

5.2 Identifying Changes in Ho Khau-related Migration Cost

As the Ho Khau policy underwent changes over time and across locations, this subsection aims to estimate these temporal and spatial variations. I define the time difference in Ho Khau policy for any pair of locations i and n as

$$\Delta_{in} = mpol_{in,post} - mpol_{in,pre},$$

where I recall $mpol_{in,t}$ is a component of the migration cost in (10). After the Ho Khau reform in 2005, Ho Khau cost should drop everywhere, i.e. $\Delta_{in} < 0$ for all combinations of i and n such that $i \neq n$.

Not only did the Ho Khau cost decrease after 2005, but it also varied across locations. Thus, I focus on two estimands: the average change over time due to Ho Khau $\Delta_T \equiv \mathbb{E}[\Delta_{in}]$ and the magnitude of spatial variation $\Delta_L \equiv \mathbb{E}[\Delta_{,A^*} - \Delta_{,R}]$. The latter should be positive as the drop in Ho Khau cost in R compared to A^*.

To identify these changes, I use migration data and leverage the relationship between migration flows and migration costs presented in Equation 9. By applying this equation and taking the log of the ratio between migration shares from location i to n and the shares of those who stay in i, I get

$$\log \frac{\mu_{in,t}}{\mu_{ii,t}} = -\frac{1}{\nu} m_{in,t} + \frac{\beta}{\nu} \left(U_{n,t+1} - U_{i,t+1} \right). \tag{33}$$

This equation implies that any change in migration cost $m_{in,t}$ can impact the future value of being in location n through the second term on the right-hand side, which captures the GE effects. Hence, a simple DiD design with a dummy variable for A^* and the post-policy period is inadequate to account for such changes in option values.

To address this issue, I construct the Head-Ries index (Head and Ries, 2001), which is defined as

$$y_{in,t} \equiv \log \left(\frac{\mu_{in,t}}{\mu_{ii,t}} \frac{\mu_{ni,t}}{\mu_{nn,t}} \right) = -\frac{1}{\nu} (m_{in,t} + m_{ni,t})$$

where I refer the LHS, $y_{in,t}$, as the Head Ries (HR) Index. Since the HR is symmetric for pairs i, n, and n, i, I only consider locations where $i < n$ to avoid duplicating observations. Taking the time difference of $y_{in,t}$ yields

$$y_{in,post} - y_{in,pre} = -\frac{1}{\nu} \left(\Delta_{in} + \Delta_{ni} \right).$$

In Figure 4, I plot the LHS of this equation–the logarithm of the ratio between the HR in 2009 and the HR in 1999–two types of flows: R-R (RR) and A^*-A^* (UU). The mean of each distribution is denoted next to the dashed line.

To estimate the temporal changes in Ho Khau cost, Δ_T, I rely on the mean of HR changes for RR flows, as shown in the left panel of Figure 4. On average, changes in Ho Khau cost for RR migration should be symmetric. Thus, the logarithm of the ratio of HRs for RR flows corresponds to $\frac{-2}{\nu}\Delta_T$. The main identifying assumption is that other time-varying changes are relatively minor compared to the changes in the Ho Khau policy, on average.

Furthermore, since $\nu > 0$, both means displayed in Figure 4 indicate declines in migration costs over time for both flow types, aligning with the policy-driven reduction in Ho Khau costs over time. More significantly, the decline in RR is substantially larger than in UU, consistent with the spatial variation of the policy, where the reduction in requirements for A^* destinations is less pronounced than in R ones.

Therefore, I use the difference in means between these two distributions to estimate spatial variation, Δ_L, after the Ho Khau reform. Alternatively, another approach involves specifying and estimating a DiDiD regression, where the outcome variable is the HR, and the main independent variable is an interaction of dummies for A^* origin, A^* destination, and Post 2005. Appendix D provides detailed discussions on other identification strategies for the spatial variation in Ho Khau cost post-reform.

In conclusion, the estimated temporal and spatial variations in Ho Khau policies are both scaled by the migration elasticity parameter, ν. With the calibrated value of ν, I can calculate the changes in migration costs resulting from the Ho Khau reform, denoted as $\widehat{mpol}_{in,t}$, which is equal to $\exp(mpol'_{in,t} - mpol_{in,t})$.

5.3 Internal Trade Flows

To calculate trade shares, I use Equation (24), which depends on trade costs d^j_{in} and TFPs $A^j_{i,t}$. These trade costs are modeled based on physical distance, following Monte et al. (2018), where $d^j_{in} = (\text{distance}_{in})^{\kappa^j}$ and κ^j represents sector-specific elasticity of trade costs to distance. Then, taking the log of (24) yields the following cross-sectional relationship:

$$\log(\lambda^j_{in}) = (1-\sigma)\kappa^j \log(\text{distance}_{in}) + \text{Origin FE } + \text{Destination FE } + \varepsilon^j_{in}.$$

I digitized inter-provincial trade data for the year 2000 from JICA (2000). I determine truck distances between province pairs using the 1999 IPUMS map and apply ArcGIS network analysis tools. With trade data and truck distance in hand, I estimate $(1-\sigma)\kappa^j$ using PPML. Figure A10 displays these estimates, all of which closely resemble the value of -1.29 reported by Monte et al. (2018) for the US.

6 Policy Evaluation and Counterfactual Policies

In this section, I integrate estimated parameters and policy changes to evaluate the effects of actual and counterfactual place-based tax incentives, migration barriers, and their interactions. The analysis starts with tax policies, followed by migration barriers, and then their combined effects.

The first step is aligning establishment and household data. Since household migration data are recorded every five years, each model period corresponds to five years. The initial period with migration data covers 1994 to 1999, which does not perfectly align with the firm data. To reconcile them, I use establishment entry and exit flows from 2000 to 2003 as the model's first period. Subsequent periods maintain consistency, with both data sets spanning 2004 to 2009. For the final period, I combine firm data from 2009 to 2014 with migration data from 2014 to 2019. This results in three distinct periods: pre-policy, during policy, and post-policy. From the last data period, I solve the model forward until it reaches a steady state following Proposition 1 and merge it with the given data to create the baseline economy.

Employment data from establishment surveys are aggregated to estimate the labor stock $L_{i,t}$, and deflated wage bills are used for wage measurements. Since migration data are available only at the provincial level, the tax categories A, B, and C are redefined accordingly. This step involves aggregating data based on the 1999 provincial population shares in B and C districts as illustrated in Figure A9.

6.1 Place-based Tax Incentives

This analysis covers three tax policies: (1) The actual 2003 Profit Tax Policy with age-specific place-based tax variation (Figure 2a), (2) an "Age-Neutral Tax Incentive" with uniform place-based incentives across firm ages (after 2003, A: 28%, B: 10%, C: 8% indefinitely), and (3) a "Uniform Tax Drop" with an equal tax reduction for all regions and firm ages (28% indefinitely, after 2003).

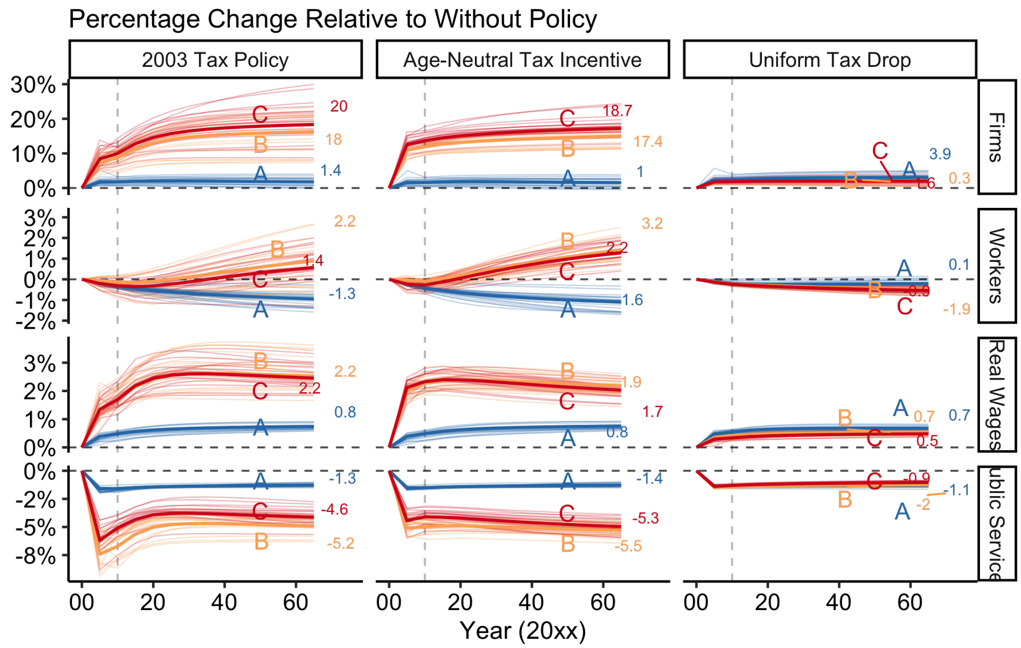
Figure 5 displays the percentage changes in establishment numbers, workforce size, real wages, and per capita public services under these tax scenarios. Outcomes are arranged in rows, and tax policies are categorized in columns. Thicker lines represent aggregate effects within each tax policy type, and aggregate real wage changes are weighted by initial employment. Each panel ends with steady-state values, differentiated by region-type colors.

Under the 2003 tax policy, firm numbers increase across all regions, since entrepreneurship becomes more attractive after tax cuts. This rise is more pronounced in targeted regions B and C, with a short-term boost of about 10% compared to a 1% increase in A. In the steady state, the average increase in the number of firms in B and C reaches 20%, while in A, it is a modest 1.4%.

Employment and real wages also rise in B and C relative to A, despite an initial overall workforce decrease. In the steady state, employment increases by 2.2% and 1.4% in regions B and C, respectively, with a similar 2% increase in real wages. A experiences a 1.3% employment decline and a slight 0.8% real wage increase. These changes are small compared to firm number changes. Per capita public services fall in all regions due to reduced tax rates, with a larger 5% loss in B and C relative to 1% in A.

These real wage effects differ from the modest gains for disadvantaged regions in Atalay et al. (2023), which interprets place-based industrial policies as local TFP changes in Caliendo

Figure 5: Effects of Tax Policies on Allocations and Prices



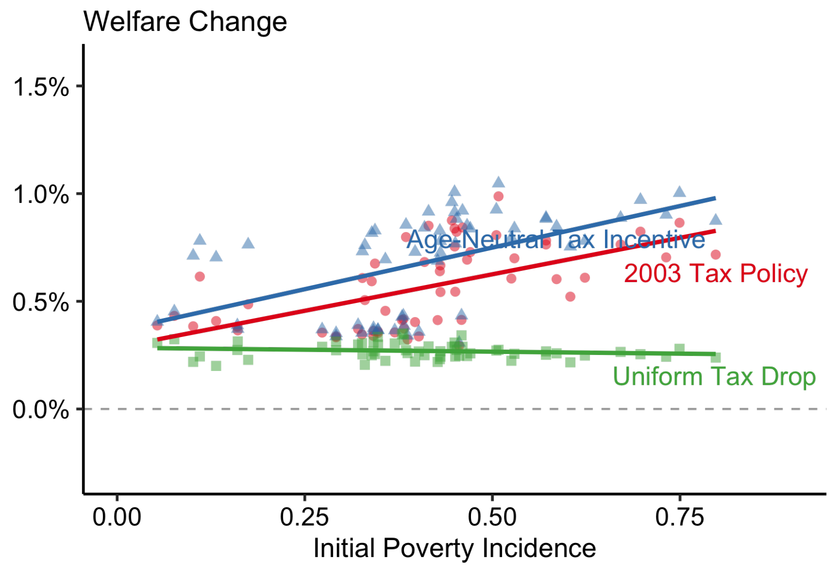
Notes: The figure shows the percentage change in outcomes when comparing an economy with a tax policy to one without. Outcomes are shown in rows, tax scenarios in columns. Thicker lines indicate aggregate effects, with real wage changes weighted by initial employment. Provinces are grouped by 2003 tax categories. Their steady-state values at each panel's end are color-coded by region type. A dashed line marks the data period's end.

et al. (2019)'s model. Their findings show limited gains mainly due to endogenous migration to improved areas. However, this paper's model, which includes occupational choice, public services, and endogenous firm location responses, suggests more substantial benefits from place-based policies in less developed regions if government services are not compromised substantially.

The success of place-based tax policies heavily depends on firm behaviors. The descriptive analysis suggests that changing the distribution of firms, particularly for non-tradeable sectors, is complex. If firms do not move to targeted areas or the firm entry elasticity is low, reducing taxes simply decreases welfare across the board.

The 2003 tax policy appears effective at reducing spatial inequality. Figure 6 depicts the welfare impacts, showing the correlation between policy-induced welfare changes and initial poverty incidence across provinces, using data from Minot et al. (2003). Welfare effects for each province, calculated according to (28), represent the change in expected lifetime utility (measured in consumption equivalence) for a representative worker residing in that province

Figure 6: Distributional Welfare Effects of Tax Policies



Notes: Each point in the figure represents a province under a specific tax policy. Welfare change is measured as compensating variation, as defined in Equation 28, while initial poverty incidence is from Minot et al. (2003).

before the policy introduction, considering thus both stayers and movers. All provinces gain from this policy, with an average welfare increase of 0.5%. The positive slope of the best-fit line indicates that inequality in welfare reduces, as initially poorer provinces tend to gain more (around 0.7%) compared to the richest ones (only 0.4%).

In a counterfactual scenario where the tax rate reduction is not contingent on firm age—4 percentage points in A locations, 17 points in B, and 18.5 points in C—I find a similar set of results. Compared to the actual 2003 reform, the increase in firm numbers in this hypothetical policy is marginally lower in the steady state, by approximately 2 percentage points in B and C, and 0.4 points in A. However, employment experiences a greater boost in B and C under this scenario, rising by 1 percentage point more than in the 2003 reform, with a slight additional decrease of 0.3 points in A. These results suggest that prolonged tax reductions help retain firms for longer periods in targeted areas, thereby fostering greater employment expansion.

Under the age-neutral policy, despite lower steady-state levels of per capita public services and real wages in B and C compared to the 2003 tax policy, the counterfactual scenario shows considerably less initial fluctuation in these services. This stability results in a more effective reduction of spatial welfare inequality in Figure 6. In general, implementing a one-time, moderate tax reduction is particularly beneficial for poorer regions. High volatility in funding public services in these areas can impede the influx of workers and firms. Therefore, more consistent tax policies contribute to a more stable environment, supporting the sustainability of public services and attracting both workforce and business establishments.

When assessing the efficacy of age-neutral tax incentives, two cautions are necessary. First, while these incentives might match the effectiveness of age-contingent ones, this result is based on the model's premise that age-contingent policies aim to balance firm attraction with public service maintenance. However, age-contingent policies can have different motives to support younger, less productive firms, a factor not yet considered in the model. In scenarios where young firms rely on tax relief for growth, age-neutral incentives might be less effective in retaining firms compared to age-contingent policies.

Secondly, governments must consider the effects of tax cuts on public goods in less affluent regions. Substantial one-time tax cuts in B and C might not strain budgets in this model due to fiscal redistribution from wealthier areas and increased land income. However, this effect brings to light a paper limitation of the assumption that all land income is collected solely by local governments. Future research could benefit from a refined model that considers diverse recipients of land revenues for a more thorough analysis.

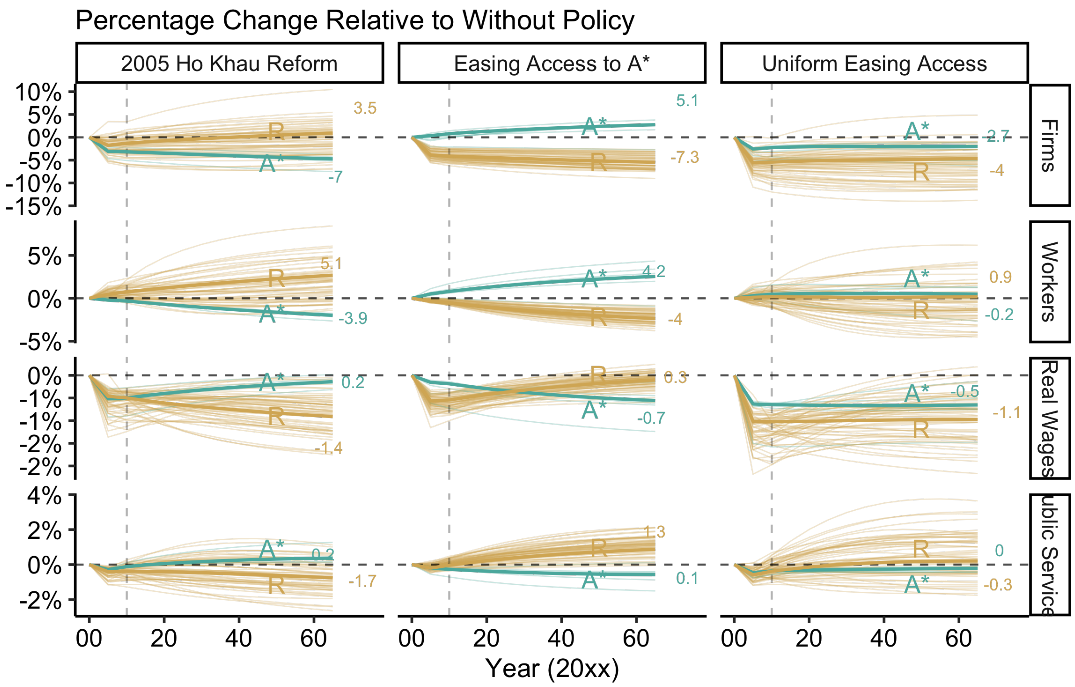
The third tax policy scenario, Uniform Tax Drop, considers an equal 4 percentage point tax reduction across all regions. This policy leads to an overall welfare increase due to a rise in entrepreneurship and subsequent real wage growth. However, it exacerbates spatial inequality. Firms tend to gravitate towards more productive A regions, where agglomeration effects attract even more firms and workers, deepening the spatial divide. This scenario highlights the intricate outcomes of uniform tax cuts, which, despite their apparent neutrality, can result in significant place-based disparities.

6.2 Migration Barriers

Similarly to the previous subsection on tax policy, I analyze three migration barrier reduction policies: (1) the actual 2005 Ho Khau Reform, primarily targeting barrier reductions in poorer regions, (2) "Easing Access to A^*," which is the reverse of the actual reform and focuses on reducing migration barriers exclusively to A^* regions, and (3) "Uniform Easing Access," implementing an equal reduction in migration barriers across all regions. Figure 7 serves as a parallel to Figure 5, illustrating the percentage changes in establishment numbers, workforce size, real wages, and public services per capita for each of these migration barrier reduction scenarios.

The 2005 Ho Khau reform, by lowering migration costs, enhances the appeal of employ-

Figure 7: Effects of Migration Policies on Allocations and Prices

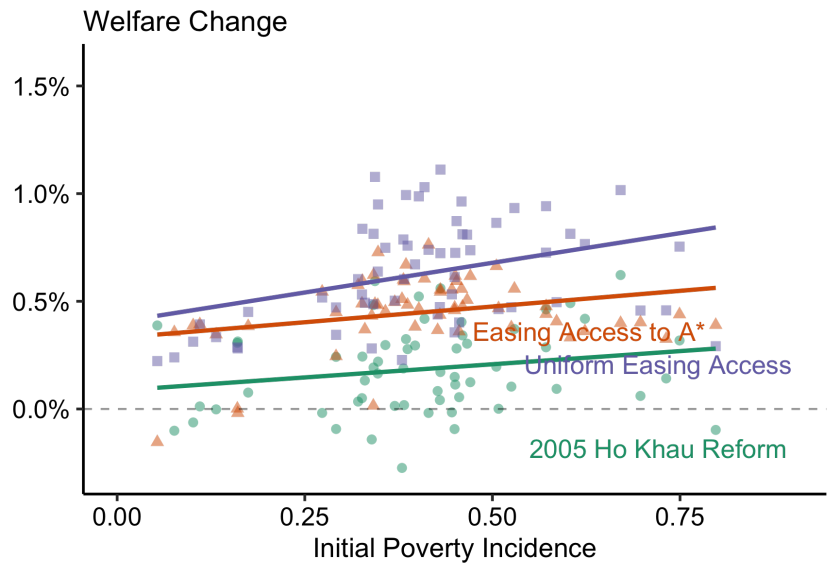


Notes: Provinces are grouped by the 2005 Ho Khau reform. See footnote in Figure 5 for details.

ment relative to entrepreneurship across all regions. Initially, the workforce increases while simultaneously the number of firms decreases. This dynamic, reflecting a balance between increased migration incentives and reduced entrepreneurial activity, resonates with findings from Mobarak et al. (2023). Their study notes that Bangladeshi households with members winning work opportunities in Malaysia are less inclined to start nonfarm businesses than those not winning the lottery. However, I additionally find that this decline in entrepreneurship also leads to a decrease in real wages everywhere, attributable to diminished labor demand and a reduction in the varieties.

Following the 2005 Ho Khau reform, the rest of Vietnam R experience a more pronounced increase in both employment and firm numbers compared to A^*, with considerable variation within each category. This effect stems from the reform's focus on lowering migration barriers into these less affluent areas, thereby redistributing firms and workers more toward them. Given the influx of workers and firms in these disadvantaged regions, real wages decline in R relative to A^*. Additionally, congestion in R rises relatively, further highlighting the complex outcomes of the reform. In essence, the rise in employment and businesses in R, while beneficial in some aspects, culminates in reduced real wages and welfare there.

Figure 8: Distributional Welfare Effects of Varied Migration Policies



Notes: Same as Figure 6.

Figure 8 illustrates the welfare effects of various migration barrier reductions, paralleling Figure 6. Following the 2005 Ho Khau Reform, the best-fit line is relatively flat, suggesting that, although reducing migration barriers to less affluent areas leads to an uptick in firm numbers and employment, spatial welfare inequality may change little. The increase in firms may not sufficiently offset the downward pressure on wages of a larger labor supply and the congestion on public services, resulting in a net decline in welfare in this case.

The 2005 Ho Khau reform, while significant in the Vietnamese context for reducing migration barriers to disadvantaged regions, contrasts with more commonly studied policies that facilitate migration to larger cities. Therefore, I conduct a counterfactual analysis named "Easing Access to A^*," where migration barriers are reduced only for the five largest cities to the same extent as the R regions in the 2005 Ho Khau Reform. This experiment mirrors many policies promoting rural-urban migration, as discussed in recent works like Lagakos et al. (2023) and Imbert and Papp (2020).

Under this counterfactual "Easing Access to A^*" policy, employment and entrepreneurship shifts in favor of advantaged provinces A^*, with a 4.2 percent increase in employment in A^* and decreases of 4 percent in R. This labor movement triggers a 5.1 percent increase in the number of firms in A^* due to reduced wages, contrasting with declines of 7.3 percent in R. Initially, real wages in R fall relative to A^*, but as migration shifts towards A^*, wages in R start to increase. In the steady state, real wages in R rise by about 0.3 percent, while in A^* they decrease by 0.7 percent.

This counterfactual policy effectively reduces spatial inequality, as it disadvantages only the two largest cities, Ho Chi Minh City and Ha Noi, while benefiting other regions. In Figure 8, welfare increases everywhere with a rise of 0.22 percent on average. Additionally, the assumption that local governments reinvest all revenue into public services might be overly optimistic. In reality, delays in public funding release and the time-consuming nature of constructing public services could exacerbate congestion issues in major cities. Such congestion not only affects welfare but could also have broader implications on economic growth. All in all, reducing migration barriers to major cities can effectively reduce inequality but harm the big cities.

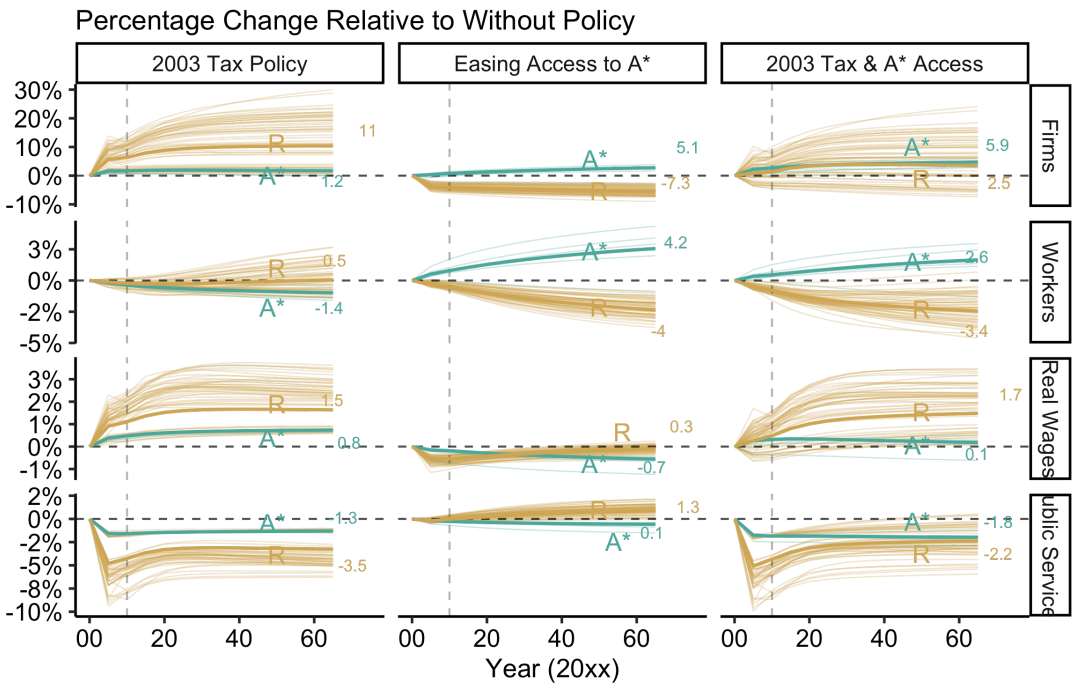
In a model where occupational choice is absent and there is no firm entry or exit, existing firms still make profits through monopolistic competition. Reducing migration costs to major cities A^* still lowers spatial inequality. Here, since occupational choices are absent, there is no drop in real wages caused by a decrease in job variety or lower labor demand following reduced mobility costs. As more individuals migrate to larger cities, wages there decrease, further reducing inequality. Additionally, profits in wealthier areas rise because of stable competition levels and falling wages. This increase in firm profits enables the government to collect more revenue, helping to sustain public services despite the growing workforce.

The third policy scenario, Uniform Easing Access, involves uniformly reducing migration barriers in both major cities (A^*) and the rest of Vietnam (R). Initially, due to the high wages of big cities, employment in A^* increases more than in R on average, as people migrate to cities when migration barriers drop equally. Similar to other migration policies, reducing migration barriers leads to a general decrease in the number of firms as more individuals opt for paid employment, attracted by the newfound mobility benefits. However, the decline is less pronounced in A due to the influx of workers, which in turn lowers wages there.

While the short-run worker and firm responses are similar to the "Easing Access to A^*" policy, the key difference here is the reduced migration costs from A^* to R. This addition enables residents of A^* to escape congestion as firms and workers accumulate in the cities. Initially, employment increases in A^*, but, over time, as congestion grows in A^* and real wages rise in R, some residents of A^* capitalize on the reduced barriers to moving to R, shifting the employment dynamics. In the steady state, employment in R grows slightly more than in A^*, even though A^* sees a smaller firm reduction.

In summary, reducing migration costs universally proves more effective in curbing spatial inequality compared to reducing migration barriers solely to major cities as seen in the welfare effects of Figure 8. In particular, it improves welfare across the board rather than

Figure 9: Effects of Policy Combinations on Allocations and Prices



Notes: Provinces are grouped by the 2005 Ho Khau reform. See footnote in Figure 5 for more details.

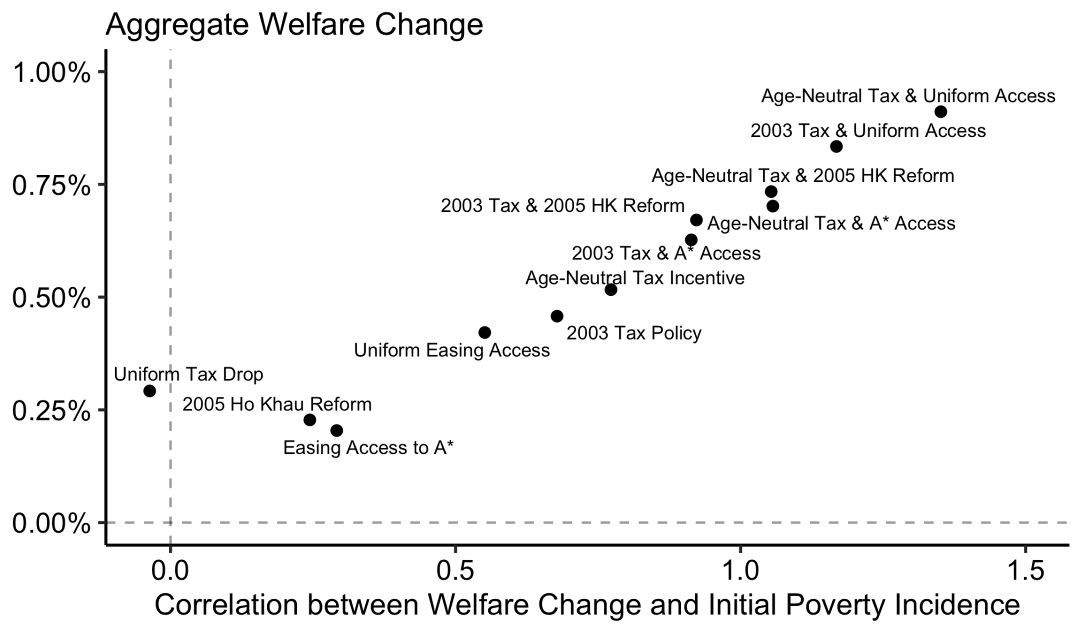
burdening the cities alone.

6.3 Place-based Incentives and Migration Barriers

After examining the impact of individual policies and their alternatives, I now investigate how combining place-based and migration policies affects welfare. Figure 9 reproduces the effects of the 2003 Tax Policy and Easing Access to A^* from before and adds their combined effect in the last column. The policy combination results in a partial substitution effect rather than amplification, due to overlap in treatment locations. The combined policy's impact on the number of firms, workers, and real wages is slightly less than the sum of individual policies but greater than each alone.

Figure 10 plots the results of various policy combinations on an efficiency-equity plane. The horizontal axis represents the slope of the best-fit lines for each policy combination, similar to those in Figures 6 and 7. The vertical axis shows the average welfare change, weighted by the initial employment share of provinces. Policies further to the northeast region of the graph are more effective at reducing inequality and increasing overall welfare.

Figure 10: Efficiency-Equity Effects of Policy Combinations



Notes: Each point denotes a policy combination. The horizontal axis shows the slope of the best-fit lines for each policy, as in Figures 6 and 7. The average welfare change is weighted by provinces' initial employment share.

Let's consider the "2003 Tax & A^* Access" and "Uniform Easing Access". What makes the combination of policies distinct yet similar to Uniform Easing Access is its approach to congestion. As people migrate to A^* areas due to the reduction in migration barriers, potentially causing congestion, offering incentives for firms to set up in R balances the dynamics. These incentives slow down the influx into A^* regions, mitigating congestion issues there. Essentially, this strategy harmonizes the objectives of both place-based and migration policies, which might appear contradictory at first glance, leading to a more equitable distribution of welfare across regions.

Let's compare a policy mix that retains the 2003 Tax Policy but incorporates "Uniform Easing Access." This combination, featuring moderate firm incentives and uniform migration barrier reductions, contrasts with a fourth scenario: "Age-Neutral Tax & 2005 Ho Khau Reform." The latter resembles a policy approach focused on intensively promoting rural development by actively drawing both firms and workers to these areas. However, this aggressive strategy for rural advancement proves less effective in minimizing spatial inequality than a balanced approach combining moderate place-based tax incentives with equal mobility opportunities for workers.

Overly concentrating firms and workers in poorer regions, as seen in the aggressive rural development policy, has its drawbacks. This approach leads to excessive employment in regions B and C, resulting in heightened congestion and further decreased wages, despite an increase in firm numbers. In contrast, a more measured policy approach, combining moderate incentives and uniform migration changes, allows for a more balanced distribution of employment and firm growth, avoiding the pitfalls of overburdening less affluent areas. This comparison underscores the complexity of policy impacts and the importance of considering both spatial and economic dynamics in policy design.

7 Conclusion

This paper examines the impact of two prominent policies on spatial inequality: place-based tax incentives and reducing migration barriers. These policies, widely implemented globally, are typically studied independently in their respective literatures. The paper connects these policy approaches, both theoretically and empirically, in the unique context of Vietnam, where they were implemented simultaneously and on a large scale.

The key findings are threefold. First, age-contingent place-based policies can effectively reduce spatial inequality by attracting firms without excessively compromising public services due to reduced tax rates. Second, easing migration barriers to large cities diminishes spatial inequality but can negatively impact the welfare of urban areas. An equal reduction in migration barriers everywhere is equally effective at reducing spatial inequality but mitigates adverse effects on large cities. Third, a policy combination of attracting firms to less developed areas with facilitated migration to more developed regions proves more efficient than pushing both firms and workers towards disadvantaged regions.

Future research could explore how place-based and migration policies influence housing costs, input-output linkages, and the intricacies of occupational choice and labor market dynamics. An important addition would be to assess how these policies impact economic growth. Understanding the complex interactions between various policies is vital as global efforts to reduce spatial inequalities increase. This study provides a foundational toolkit for future investigations to create more sophisticated and thoughtful policy solutions.

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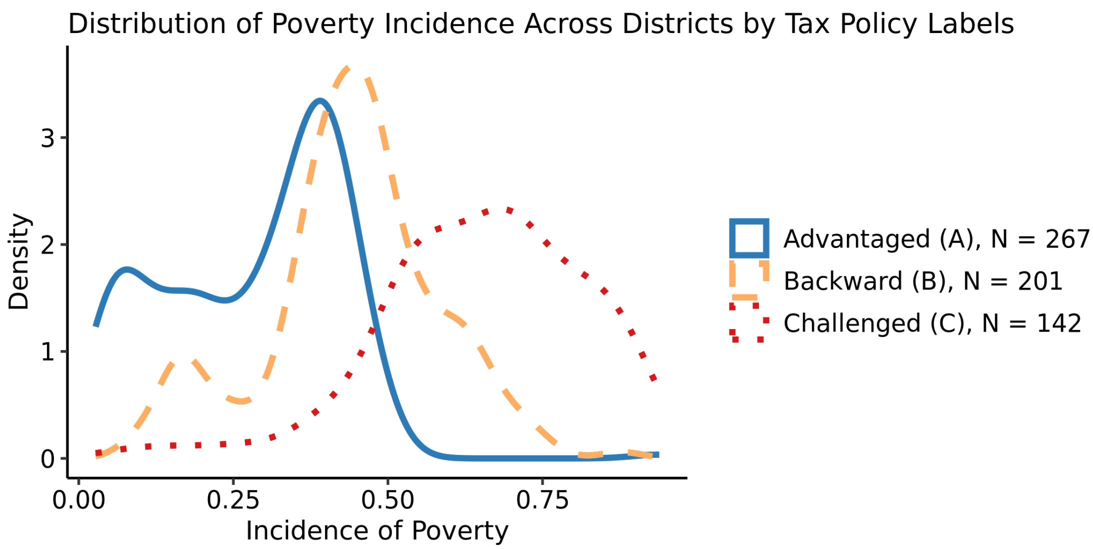
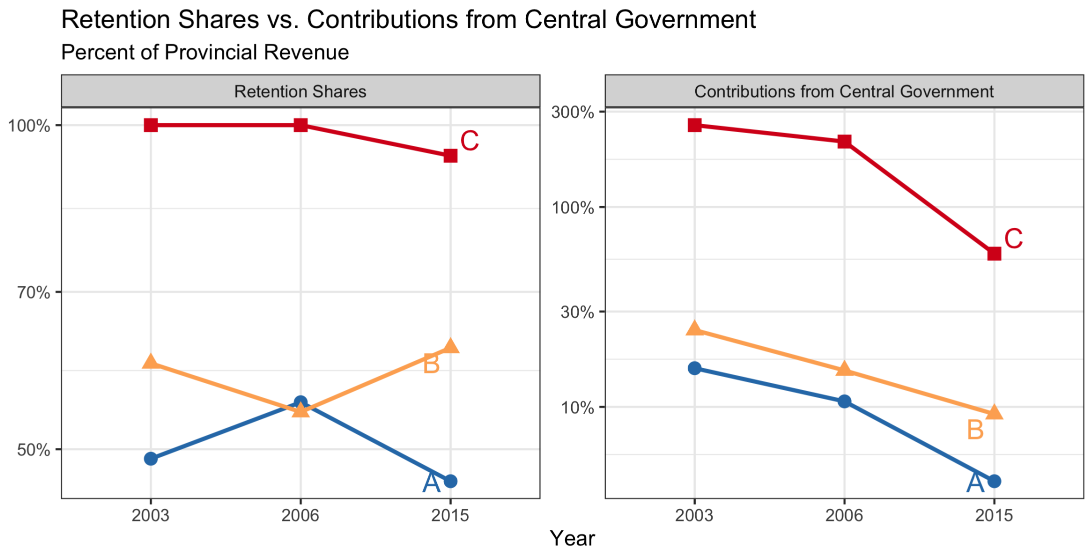
A Additional Figures and Tables

Figure A1: Distribution of Poverty Incidence by Tax Policy Label in 1999



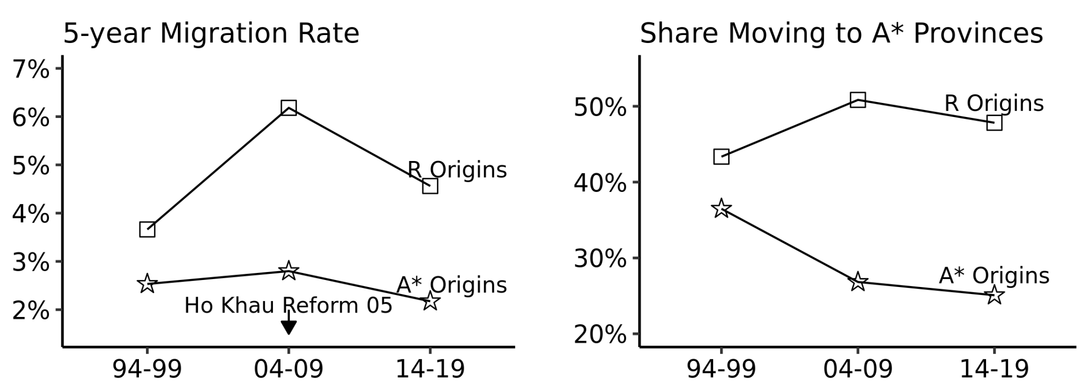
Sources: Minot et al. (2003) *Notes*: The labels A, B, and C denote Advanced, Backward, and Challenged districts, respectively, as per Decree 164/2003/ND-CP. Poverty incidence refers to the percentage of poor households in a district in 1999.

Figure A2: Revenue Redistribution Policy



Sources: Ministry of Finance, Decisions 757/2003/QD-BTC, 4526/QD-BTC, and 3137/QD-BTC. *Notes*: The A, B, and C labels are at the provincial levels, constructed using the 1999 population share in B and C districts within each province. See Figure A9 for a map of these provincial labels.

Figure A3: Trends in Vietnamese Migration Patterns: 1999, 2009, 2019

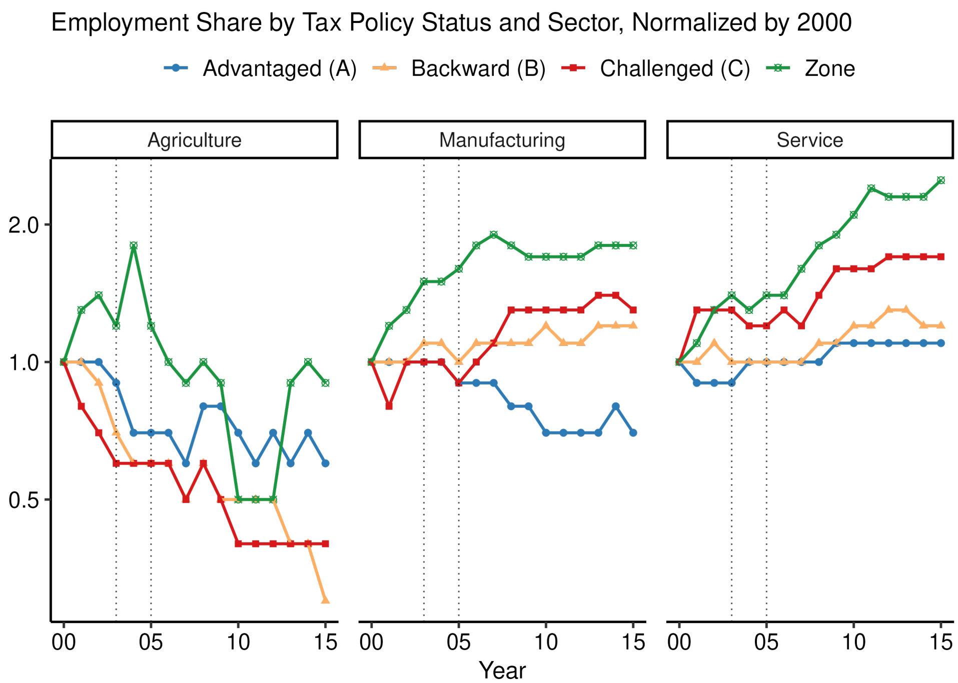


(a) 5-year Migration Rate

(b) Share Moving to A^*

Sources: Population and Housing Census data from 1999, 2009, and 2019.
Notes: A^* signifies centrally administered provinces, while R refers to Vietnam's other provinces. Panel (a) displays the percentage of people from each origin type migrating from year t to $t+5$. Panel (b) illustrates the proportion of these migrants choosing A^* destinations.

Figure A4: Employment Distribution by 2003 Tax Policy and Zone Status



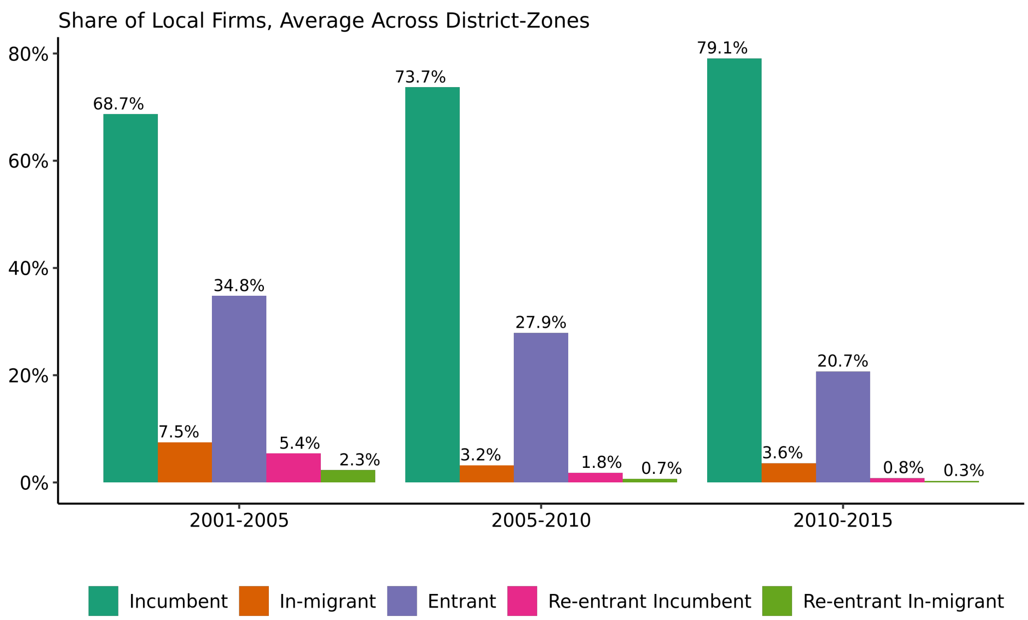
Source: Annual Establishment Surveys 2000-2015. *Notes*: Zone indicates a commune with at least one special economic zone (including types like high-tech and export zones) from 2000 to 2015.

Table A1: 2000 Multi-Plant Firm Shares

Shares of Multi-plant	Firms	Sales	Employment
All	0.011	0.078	0.077
SOE	0.068	0.136	0.119
Private	0.002	0.006	0.018
Foreign	0.006	0.006	0.013

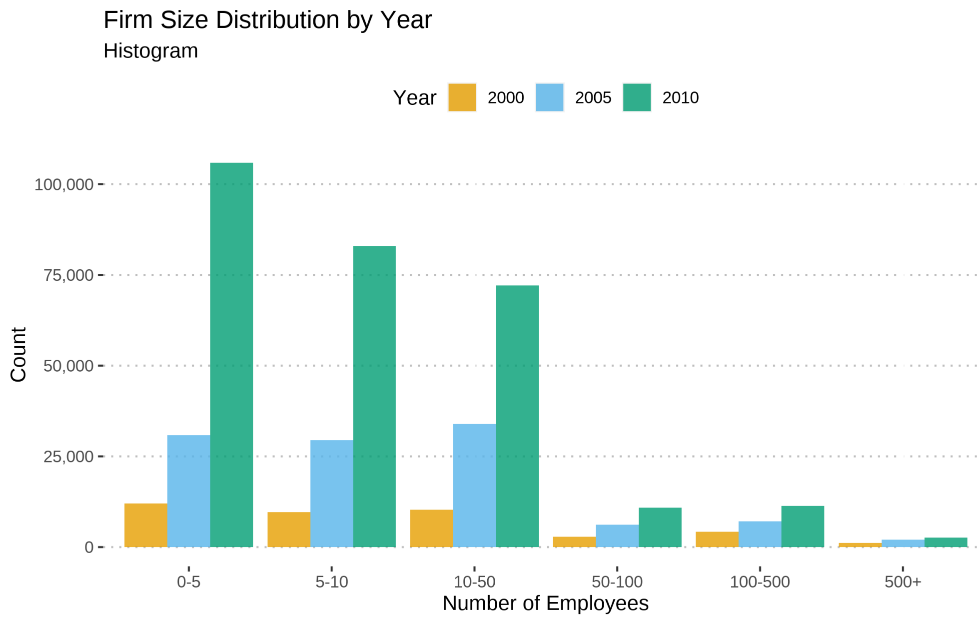
* *Source:* Annual Establishment Surveys, 2000

Figure A5: Shares of Different Types of Firm Dynamics at District-Zone level



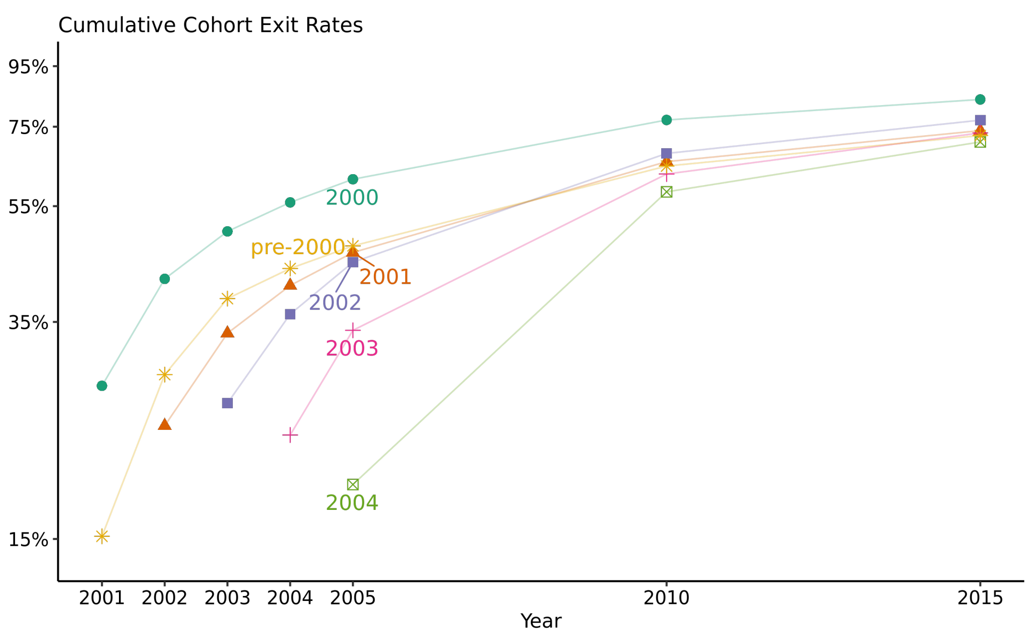
Source: Annual Establishment Surveys 2000-2015. *Notes*: The figure categorizes firm dynamics at the local level between periods t and t'. "Incumbent" denotes firms remaining in the same location, "In-migrant" for firms relocating to the current location, "Entrant" for newly observed firms, "Re-entrant incumbent" for firms returning to their previous location, and "Re-entrant in-migrant" for firms re-entering after a year or more from a different location.

Figure A6: Firm Size Distribution 2000, 2005, and 2010



Source: Annual Establishment Surveys (2000, 2005, 2010)

Figure A7: Cohort-Based Exit Rates Over Time



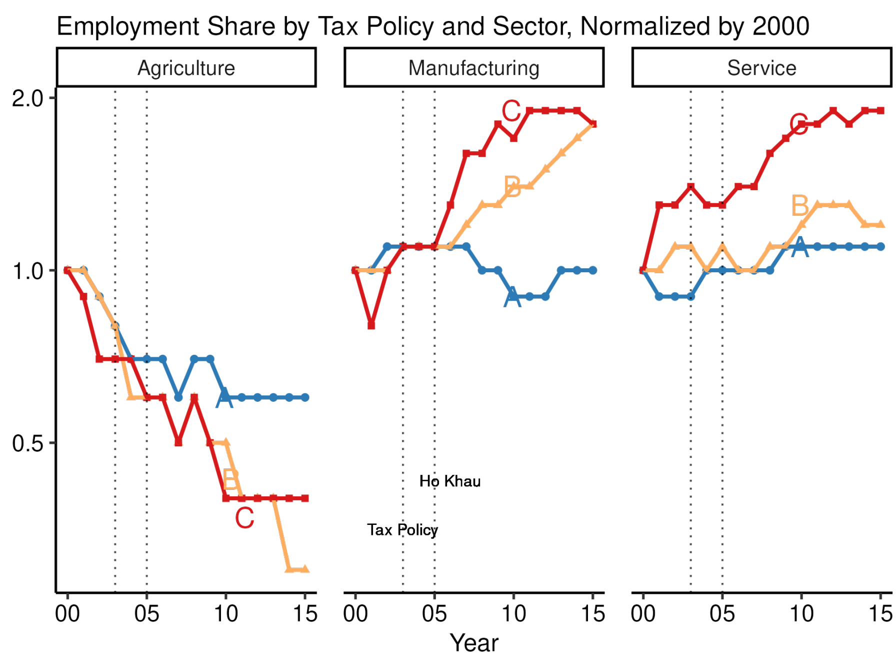
Source: Annual Establishment Surveys 2000-2015. *Notes*: Each point represents the cumulative exit rate for a cohort in a given year, showing the percentage of firms from cohort year x that have exited by year t.

Table A2: Firm Turnover: 2000 vs. 2015 Comparison

Shares of	Firms	Employment	Revenue
All			
Entrants	0.98	0.85	0.83
Exiters	0.74	0.47	0.49
A			
Entrants	0.96	0.88	0.90
Exiters	0.76	0.49	0.56
B			
Entrants	0.98	0.88	0.97
Exiters	0.82	0.62	0.74
C			
Entrants	0.98	0.85	0.84
Exiters	0.74	0.48	0.50

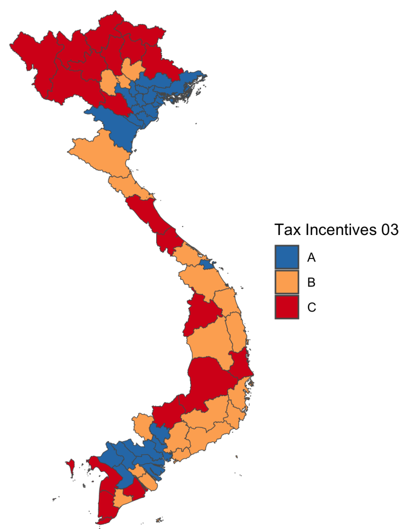
* *Notes:* An entrant is defined as an establishment in year t but not in year $t-1$, while an exiter is present in year $t-1$ but not in year t. For example, the first-row-second-column cell indicates that 98% of establishments present in 2015 did not exist in 2000. The first-row-second-column cell shows that these entrants accounted for 85% of total employment in 2015. The second-row-second column cell reports that 74% of establishments in 2000 were no longer operating in 2015. This group of exiters accounted for 47% of employment in 2000.

Figure A8: Employment Share Trends by Tax Policy Label and Sector, 2000-2015



Source: Annual Establishment Surveys (2000-2015).
Notes: Firm-level employment is aggregated to district tax labels and three major sectors. Each data point reflects the employment share in a particular district-sector category for a specific year, relative to its share in 2000.

Figure A9: Map of Tax Policy Labels at Province level



Notes: The map shows provinces in Vietnam belonging to different tax categories. These labels are based on 1999 population shares in B and C districts within each province from Decree 164/2003/ND-CP.

Table A3: DiD Analysis of Sector-Specific Policy Effects

Sector	Agriculture		Manufacturing		Service	
	Entry	Labor	Entry	Labor	Entry	Labor
	(1)	(2)	(3)	(4)	(5)	(6)
B x Post	-0.45**	-0.28***	0.23**	0.23**	0.24**	-0.03
	(0.20)	(0.09)	(0.11)	(0.09)	(0.12)	(0.09)
C x Post	-0.32	-0.16	0.54***	0.43***	0.37*	0.23**
	(0.20)	(0.11)	(0.15)	(0.13)	(0.19)	(0.10)
Zone x Post	-0.04	0.00	0.10	0.56***	0.59***	0.42**
	(0.25)	(0.28)	(0.18)	(0.13)	(0.18)	(0.18)
# DistrictZone	724	724	759	759	760	760
Observations	32,788	32,788	135,974	135,974	131,335	131,335
Control mean	0.38%	190	0.47%	420	0.48%	195

Source: Annual Establishment Surveys (2000-2015).
Notes: Unit of observation is district-zone-sector-year. Each row reports a coefficient in Equation 1 collapsed to a two-way fixed effects DiD model. All regressions include district-zone and sector-year fixed effects and are estimated by PPML. Standard errors are clustered at the district-zone level and reported in parenthesis.
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

B Model Derivations

B.1 Migration Shares

To derive results in Section 4.1, I follow Appendix 1, section 11.2, in Aguirregabiria (2021). First, I derive the distribution of the maximum utility. Denote by $\bar{\delta}_{in,t}$ for the value of working in n for an individual being in location i at time t, i.e.,

$$\bar{\delta}_{in,t} \equiv \beta U_{n,t+1} - m_{in,t}.$$

Let $\bar{\delta_{i,t}}^*$ be the random variable that represents the maximum utility from choosing a location, that is, $\bar{\delta_{i,t}}^* \equiv \max_{n \in \mathcal{R}} \left\{ \bar{\delta}_{in,t} + \epsilon_{n,t} \right\}$.

I want to derive the distribution of the maximum utility $\bar{\delta_{i,t}}^*$, denoted by $\bar{H}_i(\bar{\delta})$.

$$\begin{aligned}
\bar{H}_i(\bar{\delta}) \equiv \Pr\left(\bar{\delta_{i,t}}^* \leq \bar{\delta}\right) &= \prod_n \Pr\left(\epsilon_{n,t} \leq \bar{\delta} - \bar{\delta}_{in,t}\right) \\
&= \prod_n \exp\left\{-\exp\left(-\frac{\bar{\delta} - \bar{\delta}_{in,t}}{\nu} - \bar{\gamma}\right)\right\} \\
&= \exp\left\{-\exp\left(-\frac{\bar{\delta}}{\nu} - \bar{\gamma}\right)\mathcal{U}_t\right\},
\end{aligned}$$

where $\bar{\gamma}$ is the Euler–Mascheroni constant.

$$\mathcal{U}_t \equiv \sum_{n=1}^{N} \exp\left(\frac{\bar{\delta}_{in,t}}{\nu}\right).$$

Thus, the density function of $\bar{\delta_{i,t}}^*$ is given by

$$\bar{h}_i(\bar{\delta}) = \bar{H}_i'(\bar{\delta}) = \exp\left\{-\exp\left(-\frac{\bar{\delta}}{\nu} - \bar{\gamma}\right)\mathcal{U}_t\right\}\frac{\mathcal{U}_t}{\nu}\exp\left(-\frac{\bar{\delta}}{\nu} - \bar{\gamma}\right)$$

The expected maximum value is therefore given by

$$\begin{aligned}
\Xi_{i,t} &= \int_{-\infty}^{+\infty} \bar{\delta_{i,t}}^* h\left(\bar{\delta_{i,t}}^*\right) d\bar{\delta_{i,t}}^* \\
&= \int_{-\infty}^{+\infty} \bar{\delta_{i,t}}^* \exp\left\{-\exp\left(-\frac{\bar{\delta_{i,t}}^*}{\nu} - \bar{\gamma}\right)\mathcal{U}_t\right\}\frac{\mathcal{U}_t}{\nu}\exp\left(-\frac{\bar{\delta_{i,t}}^*}{\nu} - \bar{\gamma}\right) d\bar{\delta}_t^{i*}.
\end{aligned}$$

Applying the following change in variable: $\bar{z} = \exp\left(-\frac{\bar{\delta_{i,t}}^*}{\nu} - \bar{\gamma}\right)$, such that $\bar{\delta_{i,t}}^* =$

$-\nu\left(\log(\bar{z})+\bar{\gamma}\right)$, and $d\bar{\delta_{i,t}}^{*}=-\nu(d\bar{z}/\bar{z})$. Then,

$$
\begin{aligned}
\Xi_{i,t} &= \int_{+\infty}^{0} -\nu(\log(\bar{z})+\bar{\gamma})\exp\{-\bar{z}\mathcal{U}_t\}\frac{\mathcal{U}_t}{\nu}\bar{z}\left(-\nu\frac{d\bar{z}}{\bar{z}}\right) \\
&= -\nu\mathcal{U}_t\int_{0}^{+\infty}\log(\bar{z})\exp\{-\bar{z}\mathcal{U}_t\}d\bar{z}-\nu\bar{\gamma}\mathcal{U}_t\int_{0}^{+\infty}\exp\{-\bar{z}\mathcal{U}_t\}d\bar{z}
\end{aligned}
$$

And using Laplace transformation where $\int_0^{+\infty}\log(\bar{z})\exp\{-\bar{z}\mathcal{U}_t\}d\bar{z}=-\frac{\log(\mathcal{U}_t)+\bar{\gamma}}{\mathcal{U}_t}$

$$
\begin{aligned}
\Xi_{i,t} &= \nu\mathcal{U}_t\left(\frac{\log(\mathcal{U}_t)+\bar{\gamma}}{\mathcal{U}_t}\right)-\nu\bar{\gamma} \\
&= \nu\log(\mathcal{U}_t),
\end{aligned}
$$

which is similar to (8).

The choice probability $\mu_{in,t}$ follows from Williams-Daly-Zachary (WDZ) theorem by differentiating $\Xi_{i,t}$ w.r.t $\bar{\delta}_{n,t}$, that is,

$$
\mu_{in,t}=\nu\frac{1}{\mathcal{U}_t}\frac{\partial\mathcal{U}_t}{\partial\bar{\delta}_{n,t}}=\frac{\exp\left(\beta U_{n,t+1}-m_{in,t}\right)^{1/\nu}}{\sum_{c=1}^{N}\exp\left(\beta U_{c,t+1}-m_{in,t}\right)^{1/\nu}},
$$

which is (9).

B.2 Firms with continuous stages

This subsection extends the entrepreneur discrete stages to a continuous one where I denote each stage as $s\in\{1,\dots,S\}$. The value functions of $s-$entrepreneurs are given by

$$
V_{i,t}^{js}=\log\left((1-\tau_{i,t}^{s})\frac{\pi_{i,t}^{j}}{P_{i,t}}\right)+\chi\log\left[\exp(V_{i,t+1}^{js+1})^{\frac{\beta}{\chi}}+\exp(U_{i,t+1})^{\frac{\beta}{\chi}}\right] \tag{B.1}
$$

$$
\varsigma_{i,t}^{js}=\frac{\exp\left(V_{i,t+1}^{js+1}\right)^{\frac{\beta}{\chi}}}{\exp\left(V_{i,t+1}^{js+1}\right)^{\frac{\beta}{\chi}}+\exp(U_{i,t+1})^{\frac{\beta}{\chi}}} \tag{B.2}
$$

Recall that $\psi_{i,t}^{j}$ denotes the fraction of informal entrepreneurs that choose to locate in i among all informal entrepreneurs in sector j between t and $t+1$

$$
\psi_{i,t}^{j}=\frac{\exp\left(\beta V_{i,t+1}^{j1}-f_{i,t}^{j}\right)^{1/\chi}}{\sum_{n=1}^{N}\exp\left(\beta V_{n,t+1}^{j1}-f_{n,t}^{j}\right)^{1/\chi}} \tag{B.3}
$$

From here, I follow the same steps as in Section 5.1 by first taking log of the entry equation $\psi_{i,t}^j$

$$\log \psi_{i,t}^j = -\frac{1}{\chi} f_{i,t}^j + \frac{\beta}{\chi} V_{i,t+1}^{j1} - \log \sum_{n=1}^{N} \exp \left(V_{n,t+1}^{j1} - f_{n,t}^j \right)^{1/\chi}.$$

Next, I substitute the expected value of 1-year-old firms $V_{i,t+1}^{j1}$ to get

$$\log \psi_{i,t}^j = \frac{\beta}{\chi} \log \left((1 - \tau_{i,t+1}^1) \frac{\pi_{i,t+1}^j}{P_{i,t+1}} \right) + \beta \log \left[\exp \left(V_{i,t+2}^{j2} \right)^{\frac{\beta}{\chi}} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}} \right] - \frac{1}{\chi} f_{i,t}^j + \Theta_t^{j1}. \tag{B.4}$$

Rearranging terms and taking the log of (B.2) yield

$$\log \left(\exp \left(V_{i,t+2}^{j2} \right)^{\frac{\beta}{\chi}} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}} \right) = \frac{\beta}{\chi} U_{i,t+1} - \log(1 - \varsigma_{i,t+1}^{j1}) \tag{B.5}$$

Substituting this expression into (B.4) yields

$$\log \left(\psi_{i,t}^j (1 - \varsigma_{i,t+1}^{j1})^{\beta} \right) = \frac{\beta}{\chi} \log \left((1 - \tau_{i,t+1}^1) \frac{\pi_{i,t+1}^j}{P_{i,t+1}} \right) - \frac{1}{\chi} f_{i,t}^j + \frac{\beta^2}{\chi} U_{i,t+1} + \Theta_t^{j1}. \tag{B.6}$$

To further exploit the variation across age groups, consider the ratio between the fraction of s-year-old firms that stay and the fraction of them that exit for stage $s > 1$ based on (B.2)

$$\frac{\varsigma_{i,t}^{js-1}}{1 - \varsigma_{i,t}^{js-1}} = \exp \left(V_{i,t+1}^{js} - U_{i,t+1} \right)^{\frac{\beta}{\chi}}.$$

Taking log both sides and substituting the value (B.1) yields

$$\log \frac{\varsigma_{i,t}^{js-1}}{1 - \varsigma_{i,t}^{js-1}} = \frac{\beta}{\chi} \log \left((1 - \tau_{i,t+1}^s) \frac{\pi_{i,t+1}^j}{P_{i,t+1}} \right) + \beta \log \left(\exp(V_{i,t+2}^{js+1})^{\beta/\chi} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}} \right) - \frac{\beta}{\chi} U_{i,t+1}.$$

Applying (B.5) yields

$$\log \frac{\varsigma_{i,t}^{js-1}}{1 - \varsigma_{i,t}^{js-1}} (1 - \varsigma_{i,t+1}^{js})^{\beta} = \frac{\beta}{\chi} \log \left((1 - \tau_{i,t+1}^s) \frac{\pi_{i,t+1}^j}{P_{i,t+1}} \right) - \frac{\beta}{\chi} U_{i,t+1} + \frac{\beta^2}{\chi} U_{i,t+1}.$$

If an old firm's profit tax increases, the young firms are more likely to stay than exit, which is captured by the relative tendency to stay. Still, the young ones are also likely to exit in the next period also increases due to an increase in market competition for marginal firms.

Finally, by subtracting each side of this equation from the corresponding side of the entry equation (B.6), I obtain

$$\log \frac{\psi^{j}_{i,t}(1-\varsigma^{j1}_{i,t+1})^{\beta}}{\frac{\varsigma^{js-1}_{i,t}}{1-\varsigma^{js-1}_{i,t}}(1-\varsigma^{js}_{i,t+1})^{\beta}} = \frac{\beta}{\chi}\log\frac{(1-\tau^{1}_{i,t+1})}{(1-\tau^{s}_{i,t+1})} - \frac{1}{\chi}f^{j}_{i,t} + \frac{\beta}{\chi}U_{i,t+1} + \Theta^{j1}_{t} \tag{B.7}$$

which is (32).

B.3 Welfare

Consider the share of stayers from (9)

$$\mu_{ii,t} = \frac{e^{(\beta U_{i,t+1}-m_{ii,t})/\nu}}{\sum_{c=1}^{N} e^{(\beta U_{c,t+1}-m_{ic,t})/\nu}}$$

Taking log yields

$$\log(\mu_{ii,t}) = \frac{\beta}{\nu}U_{i,t+1} - \log\sum_{c=1}^{N} e^{(\beta U_{c,t+1}-m_{ic,t})/\nu}$$

Thus

$$\Xi_{i,t} = \beta U_{i,t+1} - \nu\log(\mu_{ii,t})$$

$$\log(\psi^{0}_{i,t}) = \frac{1}{\chi}\Xi_{i,t} - \log\left(\exp(\Xi_{i,t})^{1/\chi} + \sum_{j}\exp(V^{j\mathrm{I}}_{i,t+1})^{\beta/\chi}\right)$$

Iterating this equation forward yields

$$U_{n,t} = \sum_{h=t}^{\infty}\beta^{h-t}\log\left(\left(\frac{G_{n,h}}{L_{n,h}}\right)^{\gamma^{i}}\left(\frac{w_{n,h}}{P_{n,h}}\right)^{1-\gamma^{i}}\right) - \nu\sum_{h=t}^{\infty}\beta^{h-t}\log(\mu_{nn,h})$$

I can write the expected lifetime utility as

$$U_{n,t} = \sum_{h=t}^{\infty}\beta^{h-t}\log\frac{\left(\frac{G_{n,h}}{L_{n,h}}\right)^{\gamma^{i}}\left(\frac{w_{n,h}}{P_{n,h}}\right)^{1-\gamma^{i}}}{(\mu_{nn,h})^{\nu}}$$

Let the scalar Ω_n be the compensating variation in consumption for location n at time $t = 0$

$$U'_{n,t} = U_{n,t} + \sum_{h=0}^{\infty}\beta^{h}\log(\Omega_n)$$

Thus, I obtain the welfare change between the counterfactual economy and the actual economy

$$\widehat{W}_i = (1-\beta)\sum_{t=1}^{\infty}\beta^t \log \frac{\left(\frac{\widehat{G}_{n,h}}{\widehat{L}_{n,h}}\right)^{\gamma^i}\left(\frac{\widehat{w}_{n,h}}{\widehat{P}_{n,h}}\right)^{1-\gamma^i}}{(\widehat{\mu}_{nn,h})^{\nu}}$$

C Proofs

C.1 Dot Algebra

The equilibrium conditions are characterized by the following system of equations:

$$\dot{v}_{i,t}^{j\mathrm{III}} = \dot{c}_{i,t}^{\mathrm{III}} \left[\varsigma_{i,t-1}^{j\mathrm{III}} \left(\dot{v}_{i,t+1}^{j\mathrm{III}} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,t-1}^{j\mathrm{III}}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.1}$$

$$\dot{v}_{i,t}^{j\mathrm{II}} = \dot{c}_{i,t}^{\mathrm{II}} \left[\varsigma_{i,t-1}^{j\mathrm{II}} \left(\dot{v}_{i,t+1}^{j\mathrm{III}} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,t-1}^{j\mathrm{II}}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.2}$$

$$\dot{v}_{i,t}^{j\mathrm{I}} = \dot{c}_{i,t}^{\mathrm{I}} \left[\varsigma_{i,t-1}^{j\mathrm{I}} \left(\dot{v}_{i,t+1}^{j\mathrm{II}} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,t-1}^{j\mathrm{I}}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.3}$$

$$\dot{\Xi}_{i,t} = \left(\sum_{n=1}^{N} \mu_{in,t-1} (\dot{u}_{n,t+1})^{\frac{\beta}{\nu}} (\dot{m}_{in,t})^{\frac{-1}{\nu}} \right)^{\nu} \tag{C.4}$$

$$\dot{u}_{i,t} = \left(\frac{\dot{G}_{i,t}}{\dot{M}_{i,t}} \right)^{\gamma_i} \left(\frac{\dot{w}_{i,t}}{\dot{P}_{i,t}} \right)^{1-\gamma_i} \left[\psi_{i,t-1}^{0} \left(\dot{\Xi}_{i,t} \right)^{\frac{1}{\chi}} + \sum_{j=1}^{J} \psi_{i,t-1}^{j} (\dot{v}_{i,t+1}^{j\mathrm{I}})^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.5}$$

$$\varsigma_{i,t}^{j\mathrm{III}} = \frac{\varsigma_{i,t-1}^{j\mathrm{III}} \left(\dot{v}_{i,t+1}^{j\mathrm{III}} \right)^{\frac{\beta}{\chi}}}{\varsigma_{i,t-1}^{j\mathrm{III}} \left(\dot{v}_{i,t+1}^{j\mathrm{III}} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,t-1}^{j\mathrm{III}}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}}} \tag{C.6}$$

$$\varsigma_{i,t}^{j\mathrm{II}} = \frac{\varsigma_{i,t-1}^{j\mathrm{II}} \left(\dot{v}_{i,t+1}^{j\mathrm{III}} \right)^{\frac{\beta}{\chi}}}{\varsigma_{i,t-1}^{j\mathrm{III}} \left(\dot{v}_{i,t+1}^{j\mathrm{III}} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,t-1}^{j\mathrm{II}}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}}} \tag{C.7}$$

$$\varsigma_{i,t}^{j\mathrm{I}} = \frac{\varsigma_{i,t-1}^{j\mathrm{I}} \left(\dot{v}_{i,t+1}^{j\mathrm{II}} \right)^{\frac{\beta}{\chi}}}{\varsigma_{i,t-1}^{j\mathrm{I}} \left(\dot{v}_{i,t+1}^{j\mathrm{II}} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,t-1}^{j\mathrm{I}}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}}} \tag{C.8}$$

$$\psi_{i,t}^{j} = \frac{\psi_{i,t-1}^{j} \left(\dot{v}_{i,t+1}^{j\mathrm{I}} \right)^{\frac{\beta}{\chi}}}{\psi_{i,t-1}^{0} \dot{\Xi}_{i,t}^{\frac{1}{\chi}} + \sum_{j'=1}^{J} \psi_{i,t-1}^{j'} (\dot{v}_{i,t+1}^{j'\mathrm{I}})^{\frac{\beta}{\chi}}}, \forall j > 0 \tag{C.9}$$

$$\psi_{i,t}^{0} = \frac{\psi_{i,t-1}^{0} \dot{\Xi}_{i,t}^{\frac{1}{\chi}}}{\psi_{i,t-1}^{0} \dot{\Xi}_{i,t}^{\frac{1}{\chi}} + \sum_{j'=1}^{J} \psi_{i,t-1}^{j'} (\dot{v}_{i,t+1}^{j'\mathrm{I}})^{\frac{\beta}{\chi}}} \tag{C.10}$$

$$\mu_{in,t} = \frac{\mu_{in,t-1} \left(\dot{u}_{n,t+1} \right)^{\frac{\beta}{\nu}} \left(\dot{m}_{in,t} \right)^{\frac{-1}{\nu}}}{\sum_{c=1}^{N} \mu_{ic,t-1} (\dot{u}_{c,t+1})^{\frac{\beta}{\nu}} (\dot{m}_{ic,t})^{\frac{-1}{\nu}}} \tag{C.11}$$

Evolution

$$L_{i,t+1} = \sum_{n=1}^{N} \mu_{ni,t}\psi^{0}_{n,t}L_{n,t} + \sum_{j=1}^{J}\sum_{s\in\{\mathrm{I,II,III}\}} \left(1-\varsigma^{js}_{i,t}\right)E^{js}_{i,t}. \tag{C.12}$$

$$E^{j\mathrm{III}}_{i,t+1} = \varsigma^{j\mathrm{III}}_{i,t}E^{j\mathrm{III}}_{i,t} + \varsigma^{j\mathrm{II}}_{i,t}E^{j\mathrm{II}}_{i,t} \tag{C.13}$$

$$E^{j\mathrm{II}}_{i,t+1} = \varsigma^{j\mathrm{II}}_{i,t}E^{j\mathrm{I}}_{i,t} \tag{C.14}$$

$$E^{j\mathrm{I}}_{i,t+1} = \psi^{j}_{i,t}L_{i,t} \tag{C.15}$$

Temporary equilibrium

$$\dot{P}^{j}_{i,t+1} = \left(\sum_{n}\lambda^{j}_{ni,t}\dot{E}^{j}_{n,t+1}\left(\dot{p}^{j}_{ni,t+1}\right)^{1-\sigma}\right)^{1/(1-\sigma)} \tag{C.16}$$

$$\dot{r}_{i,t+1} = \dot{w}_{i,t+1}\frac{\sum_j \frac{1-\xi^j}{\xi^j}L^{j}_{i,t+1}}{\sum_j \frac{1-\xi^j}{\xi^j}L^{j}_{i,t}},\ \text{if } \xi^j = \xi^{j'}, \forall j' \neq j; = \dot{w}_{i,t+1}\dot{L}_{i,t+1} \tag{C.17}$$

$$\dot{P}_{i,t+1} = \prod_{j=1}^{J}(\dot{P}^{j}_{i,t+1})^{\alpha^j} \tag{C.18}$$

$$\dot{p}^{j}_{in,t+1} = \dot{x}^{j}_{i,t+1} = (\dot{w}_{i,t+1})(\dot{L}_{i,t+1})^{1-\xi^j} \tag{C.19}$$

$$\dot{\lambda}^{j}_{in,t+1} = \dot{E}^{j}_{i,t+1}\left(\frac{\dot{p}^{j}_{in,t+1}}{\dot{P}^{j}_{n,t+1}}\right)^{1-\sigma} \tag{C.20}$$

$$\pi^{j}_{i,t+1} = \frac{1}{\sigma}\sum_{n=1}^{N}(\dot{x}^{j}_{i,t+1})^{1-\sigma}(\dot{P}^{j}_{n,t+1})^{\sigma-1}\frac{\lambda^{j}_{in,t}}{E^{j}_{i,t}}X^{j}_{n,t+1} \tag{C.21}$$

$$X_{i,t+1} = \alpha^j\left(P_{i,t+1}G_{i,t+1} + \sum_{j=1}^{J}\dot{w}_{i,t+1}w_{i,t}\dot{L}^{j}_{i,t+1}L^{j}_{i,t} + \sum_{j=1}^{J}\sum_{s}(E^{js}_{i,t+1}(1-\tau^{s}_{i,t+1}))\pi^{j}_{i,t+1}\right) \tag{C.22}$$

$$P_{i,t+1}G_{i,t+1} = \Omega_{i,t+1}\Lambda_{t+1} + \omega_{i,t+1}\sum_{j=1}^{J}\left(\frac{1-\xi^j}{\xi^j}w_{i,t+1}L^{j}_{t+1} + \sum_{s}(E^{js}_{i,t+1}\tau^{s}_{i,t+1})\pi^{j}_{i,t+1}\right) \tag{C.23}$$

$$\dot{w}_{i,t+1}\dot{L}^{j}_{i,t+1}w_{i,t}L^{j}_{t} = \xi^j\frac{\sigma-1}{\sigma}\sum_{n=1}^{N}\dot{\lambda}^{j}_{in,t+1}\lambda^{j}_{in,t}X^{j}_{n,t+1} \tag{C.24}$$

The following algorithm solves the model

1. Guess $\dot{w}_{i,t+1}\dot{L}^{j}_{i,t+1}$, get $\dot{P}$, $\dot{\lambda}$

2. Guess $X^{j}_{n,t+1}$, get $\pi^{j}_{i,t+1}$

3. Get $P_{i,t+1}G_{i,t+1}$

4. Update $X^{j}_{i,t+1}$. Fixed point

5. Update $\dot{w}$ until convergence

C.2 Dynamic Hat Algebra

Dynamic Hat algebra Value functions for $t > 1$

$$\widehat{v}^{j\mathrm{III}}_{i,t} = \widehat{c}^{j\mathrm{III}}_{i,t}\left[{\varsigma'}^{j\mathrm{III}}_{i,t-1}\dot{\varsigma}^{j\mathrm{III}}_{i,t}\left(\widehat{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{j\mathrm{III}}_{i,t-1})'(1-\dot{\varsigma}^{j\mathrm{III}}_{i,t})\left(\widehat{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}\right]^{\chi} \tag{C.25}$$

$$\widehat{v}^{js}_{i,t} = \widehat{c}^{js}_{i,t}\left[{\varsigma'}^{js}_{i,t-1}\dot{\varsigma}^{js}_{i,t}\left(\widehat{v}^{js+\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{js}_{i,t-1})'(1-\dot{\varsigma}^{js}_{i,t})\left(\widehat{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}\right]^{\chi}, s \in \{\mathrm{I},\mathrm{II}\} \tag{C.26}$$

$$\widehat{\Xi}_{i,t} = \left(\sum_{n=1}^{N} {\mu'}_{in,t-1}\dot{\mu}_{in,t}(\widehat{u}_{n,t+1})^{\frac{\beta}{\nu}}(\widehat{m}_{in,t})^{\frac{-1}{\nu}}\right)^{\nu} \tag{C.27}$$

$$\widehat{u}_{i,t} = \widehat{c}_{i,t}\left[{\psi'}^{0}_{i,t-1}\dot{\psi}^{0}_{i,t}(\widehat{\Xi}_{i,t})^{\frac{1}{\chi}} + \sum_{j'=1}^{J}{\psi'}^{j'}_{i,t-1}\dot{\psi}^{j'}_{i,t}(\widehat{v}^{j'\mathrm{I}}_{i,t+1})^{\frac{\beta}{\chi}}\right]^{\chi} \tag{C.28}$$

$${\varsigma'}^{js}_{i,t} = \frac{{\varsigma'}^{js}_{i,t-1}\dot{\varsigma}^{js}_{i,t}(\widehat{v}^{js+\mathrm{I}}_{i,t+1})^{\frac{\beta}{\chi}}}{{\varsigma'}^{js}_{i,t-1}\dot{\varsigma}^{js}_{i,t}(\widehat{v}^{js+\mathrm{I}}_{i,t+1})^{\frac{\beta}{\chi}} + (1-{\varsigma'}^{js}_{i,t-1})(1-\dot{\varsigma}^{js}_{i,t})(\widehat{u}_{i,t+1})^{\frac{\beta}{\chi}}} \tag{C.29}$$

$${\psi'}^{j}_{i,t} = \frac{{\psi'}^{j}_{i,t-1}\dot{\psi}^{j}_{i,t}(\widehat{v}^{j\mathrm{I}}_{i,t+1})^{\frac{\beta}{\chi}}}{{\psi'}^{0}_{i,t-1}\dot{\psi}^{0}_{i,t}(\widehat{\Xi}_{i,t})^{\frac{1}{\chi}} + \sum_{j'=1}^{J}{\psi'}^{j'}_{i,t-1}\dot{\psi}^{j'}_{i,t}(\widehat{v}^{j'\mathrm{I}}_{i,t+1})^{\frac{\beta}{\chi}}} \tag{C.30}$$

$${\mu'}_{in,t} = \frac{{\mu'}_{in,t-1}\dot{\mu}_{in,t}(\widehat{u}_{n,t+1})^{\frac{\beta}{\nu}}(\widehat{m}_{in,t})^{\frac{-1}{\nu}}}{\sum_{n'=1}^{N}{\mu'}_{in',t-1}\dot{\mu}_{in',t}(\widehat{u}_{n',t+1})^{\frac{\beta}{\nu}}(\widehat{m}_{in',t})^{\frac{-1}{\nu}}} \tag{C.31}$$

For $t = 1$,

$$\widehat{v}_{i,1}^{j\text{III}} = \widehat{c}_{i,1}^{j\text{III}} \left[\varsigma_{i,1}^{j\text{III}} \left(\widehat{v}_{i,1}^{j\text{III}}\right)^{\frac{\beta}{\chi}} \left(\widehat{v}_{i,2}^{j\text{III}}\right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,1}^{j\text{III}}) \left(\widehat{u}_{i,1}\right)^{\frac{\beta}{\chi}} \left(\widehat{u}_{i,2}\right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.32}$$

$$\widehat{v}_{i,1}^{js} = \widehat{c}_{i,1}^{js} \left[\varsigma_{i,1}^{js} \left(\widehat{v}_{i,1}^{js+\text{I}}\right)^{\frac{\beta}{\chi}} \left(\widehat{v}_{i,2}^{js+\text{I}}\right)^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,1}^{js}) \left(\widehat{u}_{i,1}\right)^{\frac{\beta}{\chi}} \left(\widehat{u}_{i,2}\right)^{\frac{\beta}{\chi}} \right]^{\chi}, s \in \{\text{I}, \text{II}\} \tag{C.33}$$

$$\widehat{\Xi}_{i,1} = \left(\sum_{n=1}^{N} \mu_{in,1} (\widehat{u}_{n,1})^{\frac{\beta}{\nu}} (\widehat{u}_{n,2})^{\frac{\beta}{\nu}} (\widehat{m}_{in,1})^{\frac{-1}{\nu}} \right)^{\nu} \tag{C.34}$$

$$\widehat{u}_{i,1} = \widehat{c}_{i,1} \left[\psi_{i,1}^{0} (\widehat{\Xi}_{i,1})^{\frac{1}{\chi}} + \sum_{j'=1}^{J} \psi_{i,1}^{j'} (\widehat{v}_{i,1}^{j'\text{I}})^{\frac{\beta}{\chi}} (\widehat{v}_{i,2}^{j'\text{I}})^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.35}$$

$$\varsigma'^{js}_{i,1} = \frac{\varsigma_{i,1}^{js} (\widehat{v}_{i,1}^{js+\text{I}})^{\frac{\beta}{\chi}} (\widehat{v}_{i,2}^{js+\text{I}})^{\frac{\beta}{\chi}}}{\varsigma_{i,1}^{js} (\widehat{v}_{i,1}^{js+\text{I}})^{\frac{\beta}{\chi}} (\widehat{v}_{i,2}^{js+\text{I}})^{\frac{\beta}{\chi}} + (1 - \varsigma_{i,1}^{js}) (\widehat{u}_{i,1})^{\frac{\beta}{\chi}} (\widehat{u}_{i,2})^{\frac{\beta}{\chi}}} \tag{C.36}$$

$$\psi'^{j}_{i,1} = \frac{\psi_{i,1}^{j} (\widehat{v}_{i,1}^{j\text{I}})^{\frac{\beta}{\chi}} (\widehat{v}_{i,2}^{j\text{I}})^{\frac{\beta}{\chi}}}{\psi_{i,1}^{0} (\widehat{\Xi}_{i,1})^{\frac{1}{\chi}} + \sum_{j'=1}^{J} \psi_{i,1}^{j'} (\widehat{v}_{i,1}^{j'\text{I}})^{\frac{\beta}{\chi}} (\widehat{v}_{i,2}^{j'\text{I}})^{\frac{\beta}{\chi}}} \tag{C.37}$$

$$\mu'_{in,1} = \frac{\mu_{in,1} (\widehat{u}_{n,1})^{\frac{\beta}{\nu}} (\widehat{u}_{n,2})^{\frac{\beta}{\nu}} (\widehat{m}_{in,1})^{\frac{-1}{\nu}}}{\sum_{n'=1}^{N} \mu_{in',1} (\widehat{u}_{n',1})^{\frac{\beta}{\nu}} (\widehat{u}_{n',2})^{\frac{\beta}{\nu}} (\widehat{m}_{in',1})^{\frac{-1}{\nu}}} \tag{C.38}$$

Evolution

$$L'_{i,t+1} = \sum_{n=1}^{N} \mu'_{ni,t} \psi'^{0}_{n,t} L'_{n,t} + \sum_{j=1}^{J} \sum_{s \in \{\text{I},\text{II},\text{III}\}} \left(1 - \varsigma'^{js}_{i,t}\right) E'^{js}_{i,t}. \tag{C.39}$$

$$E'^{j\text{III}}_{i,t+1} = \varsigma'^{j\text{III}}_{i,t} E'^{j\text{III}}_{i,t} + \varsigma'^{j\text{II}}_{i,t} E'^{j\text{II}}_{i,t} \tag{C.40}$$

$$E'^{j\text{II}}_{i,t+1} = \varsigma'^{j\text{II}}_{i,t} E'^{j\text{I}}_{i,t} \tag{C.41}$$

$$E'^{j\text{I}}_{i,t+1} = \psi'^{j}_{i,t} L'_{i,t} \tag{C.42}$$

Derivations: Define $\widehat{y}_{t+1} \equiv \frac{\dot{y}'_{t+1}}{\dot{y}_{t+1}}$ where $\dot{y}'_{t+1} = \frac{y'_{t+1}}{y'_t}$

At time 0 when there is no policy change yet, (15) becomes

$$V_{i,0}^{j\text{III}} = \log c_{i,0}^{j\text{III}} + \chi \log \left[\exp\left(V_{i,1}^{j\text{III}}\right)^{\frac{\beta}{\chi}} + \exp(U_{i,1})^{\frac{\beta}{\chi}} \right]$$

After the change in policy

$$V'^{j\text{III}}_{i,1} = \log c'^{j\text{III}}_{i,1} + \chi \log \left[\exp\left(V'^{j\text{III}}_{i,2}\right)^{\frac{\beta}{\chi}} + \exp(U_{i,2})^{\frac{\beta}{\chi}} \right]$$

Time differences

$$V'^{j\mathrm{III}}_{i,1} - V^{j\mathrm{III}}_{i,0} = \log c'^{j\mathrm{III}}_{i,1} - \log c^{j\mathrm{III}}_{i,0} + \chi \log \left[\frac{\exp\left(V'^{j\mathrm{III}}_{i,2}\right)^{\frac{\beta}{\chi}} + \exp(U_{i,2})^{\frac{\beta}{\chi}}}{\exp\left(V^{j\mathrm{III}}_{i,1}\right)^{\frac{\beta}{\chi}} + \exp(U_{i,1})^{\frac{\beta}{\chi}}} \right]$$

$$V'^{j\mathrm{III}}_{i,1} - V^{j\mathrm{III}}_{i,0} = \log c'^{j\mathrm{III}}_{i,1} - \log c^{j\mathrm{III}}_{i,0} + \chi \log \left[\varsigma^{j\mathrm{III}}_{i,0} \frac{\exp\left(V'^{j\mathrm{III}}_{i,1}\right)^{\frac{\beta}{\chi}}}{\exp\left(V^{j\mathrm{III}}_{i,1}\right)^{\frac{\beta}{\chi}}} \frac{\exp\left(V'^{j\mathrm{III}}_{i,2}\right)^{\frac{\beta}{\chi}}}{\exp\left(V'^{j\mathrm{III}}_{i,1}\right)^{\frac{\beta}{\chi}}} + (1 - \varsigma^{j\mathrm{III}}_{i,0}) \right]$$

Thus,

$$\dot{v}'^{j\mathrm{III}}_{i,1} = \frac{c'^{j\mathrm{III}}_{i,1}}{c^{j\mathrm{III}}_{i,0}} \left[\varsigma^{j\mathrm{III}}_{i,0} (\widehat{v}^{j\mathrm{III}}_{i,1})^{\frac{\beta}{\chi}} (\dot{v}'^{j\mathrm{III}}_{i,2})^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\mathrm{III}}_{i,0}) (\widehat{u}_{i,1})^{\frac{\beta}{\chi}} (\dot{u}'_{i,2})^{\frac{\beta}{\chi}} \right]^{\chi}$$

Taking the ratio between $\dot{v}'^{j\mathrm{III}}_{i,1}$ and $\dot{v}^{j\mathrm{III}}_{i,1}$ yields

$$\widehat{v}^{j\mathrm{III}}_{i,1} = \frac{\dot{v}'^{j\mathrm{III}}_{i,1}}{\dot{v}^{j\mathrm{III}}_{i,1}} = \widehat{c}^{j\mathrm{III}}_{i,1} \left[\frac{\varsigma^{j\mathrm{III}}_{i,0} \left(\widehat{v}^{j\mathrm{III}}_{i,1}\right)^{\frac{\beta}{\chi}} (\dot{v}'^{j\mathrm{III}}_{i,2})^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\mathrm{III}}_{i,0}) (\widehat{u}_{i,1})^{\frac{\beta}{\chi}} (\dot{u}'_{i,2})^{\frac{\beta}{\chi}}}{\varsigma^{j\mathrm{III}}_{i,0} (\dot{v}^{j\mathrm{III}}_{i,2})^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\mathrm{III}}_{i,0}) (\dot{u}_{i,2})^{\frac{\beta}{\chi}}} \right]^{\chi}$$

where

$$\widehat{c}^{j\mathrm{III}}_{i,1} = \left(\frac{\widehat{G}_{i,1}}{\widehat{M}_{i,1}} \right)^{\gamma} \left(\frac{1 - \tau'^{\mathrm{III}}_{i,1}}{1 - \tau^{\mathrm{III}}_{i,1}} \frac{\widehat{\pi}^{j}_{i,1}}{\widehat{P}_{i,1}} \right)^{1-\gamma}$$

Then,

$$\widehat{v}^{j\mathrm{III}}_{i,1} = \widehat{c}^{j\mathrm{III}}_{i,1} \left[\varsigma^{j\mathrm{III}}_{i,1} \left(\widehat{v}^{j\mathrm{III}}_{i,1}\right)^{\frac{\beta}{\chi}} (\widehat{v}^{j\mathrm{III}}_{i,2})^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\mathrm{III}}_{i,1}) (\widehat{u}_{i,1})^{\frac{\beta}{\chi}} (\widehat{u}_{i,2})^{\frac{\beta}{\chi}} \right]^{\chi}$$

Similarly,

$$\widehat{v}^{j\mathrm{II}}_{i,1} = \widehat{c}^{j\mathrm{II}}_{i,1} \left[\varsigma^{j\mathrm{II}}_{i,1} \left(\widehat{v}^{j\mathrm{III}}_{i,1}\right)^{\frac{\beta}{\chi}} (\widehat{v}^{j\mathrm{III}}_{i,2})^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\mathrm{II}}_{i,1}) (\widehat{u}_{i,1})^{\frac{\beta}{\chi}} (\widehat{u}_{i,2})^{\frac{\beta}{\chi}} \right]^{\chi}$$

$$\widehat{\Xi}_{i,1} = \left(\sum_{n=1}^{N} \mu_{in,1} (\widehat{u}_{i,1})^{\frac{\beta}{\nu}} (\widehat{u}_{i,2})^{\frac{\beta}{\nu}} \right)^{\nu}$$

Flows

$$\psi'^{j}_{i,1} = \frac{(v'^{j\mathrm{I}}_{i,2})^{\frac{\beta}{\chi}}}{\Xi'^{\frac{1}{\chi}}_{i,1} + \sum_{j'=1}^{J} (v'^{j'\mathrm{I}}_{i,2})^{\frac{\beta}{\chi}}}$$

Dividing by $\psi_{i,1}^{j}$ yields

$$\frac{{\psi'}_{i,1}^{j}}{\psi_{i,1}^{j}} = \frac{({v'}_{i,2}^{j\mathrm{I}}/v_{i,2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}}{\psi_{i,1}^{0}(\frac{{\Xi'}_{i,1}}{\Xi_{i,1}})^{\frac{1}{\chi}} + \sum_{j'=1}^{J}\psi_{i,1}^{j'}(\frac{{v'}_{i,2}^{j'\mathrm{I}}}{v_{i,2}^{j'\mathrm{I}}})^{\frac{\beta}{\chi}}} = \frac{(\widehat{v}_{i,2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}(\widehat{v}_{i,1}^{j\mathrm{I}})^{\frac{\beta}{\chi}}}{\psi_{i,1}^{0}(\widehat{\Xi}_{i,1})^{\frac{1}{\chi}} + \sum_{j'=1}^{J}\psi_{i,1}^{j'}(\widehat{v}_{i,2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}(\widehat{v}_{i,1}^{j\mathrm{I}})^{\frac{\beta}{\chi}}}$$

Thus,

$${\psi'}_{i,1}^{j} = \frac{\psi_{i,1}^{j}(\widehat{v}_{i,2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}(\widehat{v}_{i,1}^{j\mathrm{I}})^{\frac{\beta}{\chi}}}{\psi_{i,1}^{0}(\widehat{\Xi}_{i,1})^{\frac{1}{\chi}} + \sum_{j'=1}^{J}\psi_{i,1}^{j'}(\widehat{v}_{i,2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}(\widehat{v}_{i,1}^{j\mathrm{I}})^{\frac{\beta}{\chi}}}$$

Similarly,

$${\varsigma'}_{i,1}^{js} = \frac{\varsigma_{i,1}^{js}(\widehat{v}_{i,2}^{js+\mathrm{I}})^{\frac{\beta}{\chi}}(\widehat{v}_{i,1}^{js+\mathrm{I}})^{\frac{\beta}{\chi}}}{\varsigma_{i,1}^{js}(\widehat{v}_{i,1}^{js+\mathrm{I}})^{\frac{\beta}{\chi}}(\widehat{v}_{i,2}^{js+\mathrm{I}})^{\frac{\beta}{\chi}} + (1-\varsigma_{i,1}^{js})(\widehat{u}_{i,2})^{\frac{\beta}{\chi}}(\widehat{u}_{i,1})^{\frac{\beta}{\chi}}}$$

$$\widehat{u}_{i,1} = \widehat{c}_{i,1}\left[\psi_{i,1}^{0}(\widehat{\Xi}_{i,1})^{\frac{1}{\chi}} + \sum_{j'=1}^{J}\psi_{i,1}^{j'}(\widehat{v}_{i,1}^{j'\mathrm{I}})^{\frac{\beta}{\chi}}(\widehat{v}_{i,2}^{j'\mathrm{I}})^{\frac{\beta}{\chi}}\right]^{\chi}$$

Migration flows

$${\mu'}_{in,1} = \frac{\exp\left(\beta U_{n,2} - m_{in,1}\right)^{1/\nu}}{\sum_{n=1}^{N}\exp\left(\beta U_{n,2} - m_{in,1}\right)^{1/\nu}}.$$

Dividing it by $\mu_{in,1}$ yields

$$\frac{{\mu'}_{in,1}}{\mu_{in,1}} = \frac{\frac{(u'_{n,2})^{\beta/\nu}(m'_{in,1})^{-1/\nu}}{(u_{n,2})^{\beta/\nu}(m_{in,1})^{-1/\nu}}}{\sum_{n=1}^{N}\frac{\left(u'_{n,2}\right)^{\beta/\nu}(m'_{in,1})^{-1/\nu}}{\sum_{n=1}^{N}(u_{n,2})^{\beta/\nu}(m_{in,1})^{-1/\nu}}} = \frac{\widehat{u}_{n,2}^{\beta/\chi}\widehat{u}_{n,1}^{\beta/\chi}\widehat{m}_{in,1}^{-1/\nu}}{\sum_{n=1}^{N}\mu_{n,1}\widehat{u}_{n,2}^{\beta/\chi}\widehat{u}_{n,1}^{\beta/\chi}\widehat{m}_{in,1}^{-1/\nu}}$$

Or

$${\mu'}_{in,1} = \frac{\mu_{in,1}\widehat{u}_{n,1}^{\beta/\chi}\widehat{u}_{n,2}^{\beta/\chi}\widehat{m}_{in,1}^{-1/\nu}}{\sum_{n=1}^{N}\mu_{n,1}\widehat{u}_{n,2}^{\beta/\chi}\widehat{u}_{n,1}^{\beta/\chi}\widehat{m}_{in,1}^{-1/\nu}}$$

For $t > 1$,

$$\widehat{v}_{i,t+1}^{js} = \widehat{c}_{i,t+1}^{js}\left[{\varsigma'}_{i,t}^{js}\dot{\varsigma}_{i,t+1}^{js}\left(\widehat{v}_{i,t+2}^{js+\mathrm{I}}\right)^{\frac{\beta}{\chi}} + (1-\varsigma_{i,t}^{js})'(1-\dot{\varsigma}_{i,t+1}^{js})\left(\widehat{u}_{i,t+2}\right)^{\frac{\beta}{\chi}}\right]^{\chi}$$

$${\psi'}_{i,t}^{j} = \frac{{\psi'}_{i,t-1}^{j}\dot{\psi}_{i,t}^{j}(\widehat{v}_{i,t+1}^{j\mathrm{I}})^{\frac{\beta}{\chi}}}{{\psi'}_{i,t-1}^{0}\dot{\psi}_{i,t}^{0}(\widehat{\Xi}_{i,t})^{\frac{1}{\chi}} + \sum_{j'=1}^{J}{\psi'}_{i,t-1}^{j'}\dot{\psi}_{i,t}^{j'}(\widehat{v}_{i,t+1}^{j'\mathrm{I}})^{\frac{\beta}{\chi}}}$$

$${\varsigma'}_{i,t}^{js} = \frac{{\varsigma'}_{i,t-1}^{js}\dot{\varsigma}_{i,t}^{js}(\widehat{v}_{i,t+1}^{js+\mathrm{I}})^{\frac{\beta}{\chi}}}{{\varsigma'}_{i,t-1}^{js}\dot{\varsigma}_{i,t}^{js}(\widehat{v}_{i,t+1}^{js+\mathrm{I}})^{\frac{\beta}{\chi}} + (1-{\varsigma'}_{i,t-1}^{js})(1-\dot{\varsigma}_{i,t}^{js})(\widehat{u}_{i,t+1})^{\frac{\beta}{\chi}}}$$

$$\widehat{u}_{i,t} = \widehat{c}_{i,t} \left[{\psi'}^{0}_{i,t-1} \dot{\psi}^{0}_{i,t} (\widehat{\Xi}_{i,t})^{\frac{1}{\chi}} + \sum_{j'=1}^{J} {\psi'}^{j'}_{i,t-1} \dot{\psi}^{j'}_{i,t} (\widehat{v}^{j'\mathrm{I}}_{i,t+1})^{\frac{\beta}{\chi}} \right]^{\chi}$$

$$\dot{\Xi'}_{i,t} = \left(\sum_{n=1}^{N} {\mu'}_{in,t-1} (\dot{u}'_{n,t+1})^{\frac{\beta}{\nu}} (\dot{m'}_{in,t})^{\frac{-1}{\nu}} \right)^{\nu}$$

$$\widehat{\Xi}_{i,t} = \left(\sum_{n=1}^{N} {\mu'}_{in,t-1} \dot{\mu}_{in,t} (\widehat{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widehat{m}_{in,t})^{\frac{-1}{\nu}} \right)^{\nu}$$

Dividing migration flows

$${\mu'}_{in,t+1} = \frac{{\mu'}_{in,t} \dot{\mu}_{in,t+1} (\widehat{u}_{n,t+2})^{\frac{\beta}{\nu}} (\widehat{m}_{in,t+1})^{\frac{-1}{\nu}}}{\sum_{n'=1}^{N} {\mu'}_{in',t} \dot{\mu}_{in',t} (\widehat{u}_{n',t+2})^{\frac{\beta}{\nu}} (\widehat{m}_{in',t+1})^{\frac{-1}{\nu}}}$$

Temporary equilibrium

$$\widehat{P}^{j}_{i,t} = \left(\sum_{n} {\lambda'}^{j}_{ni,t-1} \dot{\lambda}^{j}_{ni,t} \widehat{E}^{j}_{n,t} (\widehat{x}^{j}_{n,t})^{1-\sigma} \right)^{1/(1-\sigma)} \tag{C.43}$$

$$\widehat{p}^{j}_{in,t+1} = \frac{\dot{p'}_{in,t+1}}{\dot{p}_{in,t}} = \widehat{x}^{j}_{i,t+1} = (\widehat{w}_{i,t+1}) \left(\widehat{L}_{i,t+1} \right)^{1-\xi^{j}} \tag{C.44}$$

$${\lambda'}^{j}_{in,t+1} = {\lambda'}^{j}_{in,t} \dot{\lambda}^{j}_{in,t+1} \widehat{E}^{j}_{i,t+1} (\widehat{x}^{j}_{i,t+1})^{1-\sigma} (\widehat{P}^{j}_{n,t+1})^{\sigma-1} \tag{C.45}$$

$${\pi'}^{j}_{i,t+1} = \frac{1}{\sigma} \sum_{n=1}^{N} \frac{{\lambda'}^{j}_{in,t+1}}{{E'}^{j}_{i,t+1}} X'_{n,t+1} \tag{C.46}$$

$$P'_{i,t} G'_{i,t} = \omega'_{i,t} \sum_{j=1}^{J} \left(\sum_{s} (E^{js\prime}_{i,t} \tau^{s\prime}_{i,t}) \pi^{j\prime}_{i,t} + \frac{1-\xi^{j}}{\xi^{j}} \widehat{w}_{i,t+1} \widehat{L}^{j}_{i,t+1} \dot{w}_{i,t+1} \dot{L}^{j}_{i,t+1} {w'}_{i,t} {L'}^{j}_{i,t} \right) + \Omega'_{i,t} \Lambda'_{t} \tag{C.47}$$

$$\Lambda'_{t} = (1-\omega'_{i,t}) \sum_{j=1}^{J} (\sum_{s} (E^{js\prime}_{i,t} \tau^{s\prime}_{i,t}) \pi^{j\prime}_{i,t} + \frac{1-\xi^{j}}{\xi^{j}} \widehat{w}_{i,t+1} \widehat{L}^{j}_{i,t+1} \dot{w}_{i,t+1} \dot{L}^{j}_{i,t+1} {w'}_{i,t} {L'}^{j}_{i,t}) \tag{C.48}$$

$${X'}^{j}_{i,t+1} = \alpha^{j} \left({P'}_{i,t+1} {G'}_{i,t+1} + \sum_{j=1}^{J} \widehat{w}_{i,t+1} \widehat{L}^{j}_{i,t+1} \dot{w}_{i,t+1} \dot{L}^{j}_{i,t+1} {w'}_{i,t} {L'}^{j}_{i,t} + \sum_{j,s} ({E'}^{js}_{i,t+1} (1 - {\tau'}^{s}_{i,t+1})) {\pi'}^{j}_{i,t+1} \right) \tag{C.49}$$

$$\widehat{w}_{i,t+1} \widehat{L}^{j}_{i,t+1} = \frac{\xi^{j} \frac{\sigma-1}{\sigma}}{{w'}_{i,t} {L'}^{j}_{i,t} \dot{w}_{i,t+1} \dot{L}^{j}_{i,t+1}} \sum_{n=1}^{N} {\lambda'}^{j}_{in,t+1} {X'}^{j}_{n,t+1} \tag{C.50}$$

D Estimation

D.1 Identifying the spatial variation in HoKhau-related costs

This subsection first discusses the challenge of using a simple difference-in-difference strategy with a dummy for destination A^* and Post 2005 and how heterogeneous effects driven by different origins complicate the estimates. It then specifies different specifications that overcome this challenge to complement the simple approach described in subsection 5.2 that led to Figure 4.

The aim is to uncover the estimand $\Delta_L = \mathbb{E}[\Delta_{,A^*} - \Delta_{,R}]$, multiplied by $-1/\nu$, which represents the expected spatial variation in migration costs between A^* provinces and the rest of Vietnam R using the timing and spatial variation of the Ho Khau policy. Consider the following DiD design:

$$y_{ab,t} = \gamma \mathbf{1}(b \in A^*, t > 2005) + \xi_{ab} + \theta_t + \varepsilon_{ab,t}, \tag{D.1}$$

where $y_{ab,t}$ is the Head Ries index for locations a and b defined in subsection 5.2, the dummy $\mathbf{1}(b \in A^*, t > 2005)$ is equal to 1 if destination b is an A^* province and year t is larger than 2005. Based on (**??**), the DiD estimator is related to changes in Ho Khau costs in the following way

$$\widehat{\gamma} = -\frac{1}{\nu}\frac{1}{N}\sum_{i=1}^{N}\left(\Delta_{iA^*} - \Delta_{iR} + \Delta_{A^*i} - \Delta_{Ri}\right).$$

To identify the object of interest $\frac{1}{N}\sum_{i=1}^{N}\left(\Delta_{iA^*} - \Delta_{iR}\right)$, I need to assume that

$$\frac{1}{N}\sum_{i=1}^{N}\left(\Delta_{A^*i} - \Delta_{Ri}\right) = 0. \tag{D.2}$$

Column (1) of Table A4 reports the result of this regression. Both estimates $\widehat{\gamma}$ in 2009 and the long-run effect in 2019 are positive and imprecisely estimated. In other words, Δ_L is not identified. I argue next that heterogeneous effects lead to this imprecise estimate. Let's examine how realistic the identification assumption (D.2) is by considering two cases of i.

Case 1: $i \in A^*$. Assumption (D.2) implies no difference between the growth in migration costs between A^*-to-A^* and R-to-A^*. Since the Ho Khau policy applies similarly regardless of migrant's origins, this assumption should hold regardless of i is A^* or R.

However, the Ho Khau policy change is not the only change over this period that could alter migration costs. Hence, we need to consider whether other time-varying variables in

Table A4: Estimation of spatial variation in Ho Khau cost

Dependent variable:	log(Head Ries Index)			
	-$A*$, -R	A^*A^*, A^*R	A^*A^*, RR	DiDiDiD
	(1)	(2)	(3)	(4)
γ_{2009}	0.14	-0.77***	-0.55**	
	(0.18)	(0.14)	(0.27)	
γ_{2019}	0.08	-0.83***	-0.55*	
	(0.23)	(0.15)	(0.28)	
$\mathbf{1}(i \in A^*, n \in A^*, t > 2005)$				-0.94**
				(0.37)
# Origin-Destination	1,573	329	1,274	1,530
Standard-Errors		Destination		Origin-Destination
Observations	3,519	744	2,841	2,261
R^2	0.92	0.97	0.89	0.97
Origin-Destination fixed effects	✓	✓	✓	✓
Year fixed effects (3)	✓	✓	✓	
Destination-Year fixed effects (116)				✓
Origin-Year fixed effects (116)				✓

Source: Household and Population Census 1999, 2009, 2019.
Notes: The table shows different regression specifications to identify the spatial variation in Ho Khau cost after the reform in 2005. The column name corresponds to the treatment and control flows. For instance, column (1) compares flows to R and A^* provinces, and column (2) uses flows between A^*-A^* as treatment and R-A^* as control. The Standard-Errors row shows the level of clustering of the standard errors.

practice can violate our assumption. I believe this assumption is likely to hold because other time-varying factors affecting migration costs, such as road networks, favor A^* destinations equally.

To isolate the case, I run the following regression

$$y_{ab,t} = \gamma \mathbf{1}(a \in A^*, b \in A^*) \times \mathbf{1}(t > 2005) + \xi_{ab} + \theta_t + \varepsilon_{ab,t} \qquad \text{(D.3)}$$

where

$$\mathbf{1}(a \in A^*, b \in A^*) = \begin{cases} 1 \text{ if } a \in A^*, b \in A^* \\ 0 \text{ if } a \in A^*, b \in R \end{cases}$$

Column (2) of Table A4 reports estimates $\widehat{\gamma}$ for the short-run and long-run effects. Both estimates are negative and statistically significant which are consistent with the hypothesis that the Ho Khau reform reduces migration costs on average.

Case 2: $i \in R$ In this case, for condition (D.2) to hold, I need the growth in migration costs between A^*-to-R and R-to-R to be equal. This assumption is more problematic than the first case. If, in addition to the Ho Khau policy, other policies promote connectivity between A^*-to-R more than R-to-R (such as road networks that tend to connect A^*-R more than R-R), we could get

$$\Delta^{U,R} - \Delta^{R,R} < 0,$$

resulting in a positive estimate for $\widehat{\gamma}$.

Why do cases 1 and 2 not cancel each other when running the regression in equation (D.1)? The reason is that there are significantly more R than A^* areas in the sample (with only 5 A^* areas), so the Δ_{A^*i} terms for $i \in R$ will dominate the Δ_{Ri} terms for $i \in A^*$. As a result, when combining cases 1 and 2, case 2 dominates on average.

Thus, identification would require another level of variation at the origin, where I argue that A^* origins would respond stronger to the policy changes than R origins. The fact that the policy drops many requirements over this period should encourage migration from R to A^* as seen in Figure A3b. Despite a relatively larger cost after the policy change between R and A^*, this cost may not deter the incentives to move from R origins as much as A^* origins who already enjoy many amenities of the A^* areas. Thus, this intuition suggests a triple difference-in-difference design:

$$y_{in,t} = \gamma \mathbf{1}(i \in A^*, n \in A^*, t > 2005) + \alpha_{in} + \theta_{i,t} + \varphi_{n,t} + \varepsilon_{in,t}$$

where the dummy $\mathbf{1}(i \in A^*, n \in A^*, t > 2005)$ is equal to 1 if origin i is an A^*, destination n is an $A*$, and year t is after 2005, and $y_{in,t}$ is the HR index of in. I include the full set of fixed effects including the origin-destination $\alpha^{i,n}$, origin-year θ_t^i and destination-year φ_t^c fixed effects. Standard errors are clustered at the origin-destination levels. I only use the 1999 and 2009 censuses for this regression to avoid future changes in migration costs that are unrelated to the Ho Khau reform.

The identification assumption for γ follows from Olden and Møen (2022). That is, the differential in the HR index of A^* and A^* versus R and A^* trends similarly to the differential in the HR index of A^* to R and R to R group A and group B in the absence of the policy change. So if the road network is improved between A^* to R, then this assumption only requires that the road improvement between A^* to R does not change the gap A^*-R and

A^*-A^* versus A^*-R and R-R.

Column (4) of Table A4 reports the result where $\widehat{\gamma} = -\frac{1}{\nu}\widehat{\Delta}_L = -0.94$ with standard error of 0.34. This estimate is similar to the simple comparison in means of the HR distributions in Figure 4. In fact, the comparison between two means is akin to running a regression of the type (D.3) and using the flows RR as the control instead of A^*R. Column (3) of Table A4 reports the result of such regression and shows that the difference in means is around -0.55 and statistically different.

In sum, according to Figure 4 and the current results, I estimate the migration cost change between a counterfactual world, prime notation, and the actual economy (with Ho Khau reform or a reduction in migration cost) as

$$mpol'_{in,t} - mpol_{in,t} = \Delta'_{in} - \Delta_{in} = 0 - (0.659 * \nu/(-2)), \forall i \neq n, n \notin A^*, t \geq 2005,$$

and

$$mpol'_{in,t} - mpol_{in,t} = \Delta'_{i,n} - \Delta_{i,n} = 0 - (0.002 * \nu/(-2)), \forall n \in A^*.$$

D.2 Distance elasticity

Figure A10: Estimates of distance elasticities $(1-\sigma)\kappa^j$

Notes: Inter-provincial trade flows data come from JICA (2000). Standard errors are clustered at the origin-destination level.

References for Appendix

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