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

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Abstract

Most low-income countries prioritize economic growth, but growth can increase inequality, especially regional disparities. This paper quantifies the effects of place-based tax incentives and easing migration barriers on spatial inequality in Vietnam. To this end, I develop a dynamic spatial general equilibrium model that captures interactions between policies, occupational choices, migration, congestion, and agglomeration effects. Using firm and household data spanning two decades, combined with model-consistent difference-in-differences strategies, I identify key parameters governing policy effects: the firm entry elasticity and the changes in migration costs. I find that place-based tax incentives diminish spatial inequality when coupled with robust public services. Easing migration barriers to developed areas, while reducing inequality, also decreases welfare in these cities. Combining easing migration barriers to cities and tax incentives in underdeveloped regions is more effective at reducing spatial inequality.

Keywords: Place-based Policy, Migration, Inequality, Ho Khau, Vietnam

JEL codes: O18, O25, R58, H25, H70

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1 Introduction

Most low-income countries prioritize economic growth, but growth can increase inequality, a concern highlighted by Kuznets (1955). Specifically, rapid development often exacerbates regional disparities, as it tends to concentrate economic activities towards productive regions, leaving less developed areas behind.

To address spatial inequality, policymakers worldwide, particularly in developing countries, confront two common yet opposing approaches. Place-based incentives aim to attract firms to disadvantaged areas, while migration policies encourage people to leave these regions for better opportunities. What are the individual and combined effects of large-scale changes in these policies on spatial inequality?

These questions are important but remain inadequately addressed. Existing studies overlook key factors that influence spatial inequality such as the dynamic decisions of entrepreneurs, congestion externalities, public services provision, and occupational choices. Moreover, large-scale policy changes are understudied, limiting our understanding of the general equilibrium responses to individual policies and the combined effects of policies.

In this study, I examine the unique context of Vietnam where both policies were implemented on a national scale. In 2003, the Vietnamese government classified 600 districts in Vietnam into three groups (A, B, or C) 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 registration (*Ho Khau*) restrictions that limited regional migration, with a milder relaxation for migration to centrally-administered provinces (A^*) compared to the rest of Vietnam (R).

The implementation of these policies in Vietnam presents an unprecedented opportunity to examine economic forces crucial to spatial inequality. They also reflect concerns central to policymakers, as indicated by the policy specifics. These forces include the dynamic decisions of entrepreneurs, congestion externalities, public service provision, and occupational choices.

Given this unique context, I aim to quantify the effects of place-based incentives and relaxed migration restrictions on Vietnam's spatial inequality. In particular, I construct a dynamic spatial general equilibrium model, integrating policy interactions with firm dynamics, occupational choices, migration, congestion, and agglomeration. By analyzing firm and household data over twenty years and employing model-implied difference-in-differences strategies, I identify key structural parameters driving policy effects: the firm entry elasticity and the changes in migration costs associated with the Ho Khau policy.

In Section 3, I present the establishment and household data, encompassing all registered firms and representing the entire population over two decades. Three facts emerge. From

2000 to 2015, spatial inequality in Vietnam, measured by the regional labor income Gini coefficient, decreased. Second, while migration increased post-2005 reforms, it differed based on migrant origin and destination. Third, manufacturing firms responded strongly to post-2003 incentives in disadvantaged regions, boosting local employment in this sector. The latter two facts underscore the role of spatial frictions in the movement of people and goods.

These facts and policies motivate a dynamic spatial general equilibrium model. The 2003 place-based tax incentives, varying with firm age, highlight the need for dynamic firm decisions. This policy feature aims to balance attracting new firms with sustaining local government budgets crucial for public services. Given that profit taxes contribute a substantial part of government income, reducing these taxes poses a risk to public service funding, which needs to be balanced by an increase in firm numbers or through alternative revenue channels.

The Ho Khau policy reflects the concerns of policymakers about increasing congestion in public service use such as healthcare and education with rising immigration. Consequently, easing migration barriers can raise congestion, complicating its effect on welfare.

Finally, the model incorporates occupational choice, drawing on Lucas (1978), enabling households to choose between entrepreneurship and wage employment in their local areas. While workers can migrate for job opportunities, entrepreneurs are required to stay local to manage their firms. Thus, reducing taxes raises aggregate entrepreneurship, while easing migration barriers has the opposite effect.

As the model yields ambiguous impacts of policies on spatial inequality, a quantitative analysis is necessary. Solving a dynamic multi-region model 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). This approach is used to address the central counterfactual question: "How would spatial inequality in Vietnam, measured by expected lifetime utility, change as a result of each policy (or a combination of policies) given that all other external factors evolved as they did?"

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 across 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 Ries, 2001). Using this index, I can isolate migration costs from the appeal of origin or destination areas on migration. I examine the temporal changes in HR indices for migration flows between regions that experienced varied 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.

Finally, I quantify the welfare effects of actual and counterfactual place-based and migration policies. Focusing first on tax policy, while keeping Ho Khau policy unchanged, I find that the 2003 tax policy increases the number of firms, employment, real wages, and welfare in targeted areas without compromising the provision of public services.

Regarding migration barriers, I find that the 2005 Ho Khau reform increases employment and firms in disadvantaged regions, as workers move there, reducing wages, and encouraging firm entry. However, this policy has minimal impact on spatial welfare inequality.

In contrast, a counterfactual policy that eases migration costs exclusively into A^* provinces reduces spatial inequality but at the cost of welfare losses in the two largest ones, Ha Noi and Ho Chi Minh City, because of increased congestion and reduced wages. This policy, while effectively reducing inequality, also exemplifies the practical challenges of balancing the interests of different groups.

Combining this migration strategy with the 2003 Tax Policy mitigates welfare losses in central provinces and continues to lessen spatial inequality. This combination balances congestion in major cities by offering tax incentives for businesses to move to underdeveloped areas. This approach, aligning with recommendations from place-based and migration policy studies, demonstrates how seemingly opposing policies can create a more equitable distribution of welfare.

Related literature. 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. The model is introduced in Section 4, with details on how to bring the model to data for estimation in Section 5. The policy evaluation and counterfactual results can be found in Section 6.

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 businesses in disadvantaged districts, central government redistribution mechanisms, and reforms to the household registration (Ho Khau) system, which restricts internal migration.

[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)

2.1 2003 Enterprise Income Tax Law

The 2003 revisions to the Enterprise Income Tax Law by the National Assembly, as illustrated in Figure A1, constitute a place-based tax policy that can directly 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 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].

Second, in accordance with Decree 164/2003/ND-CP, the government categorized districts for tax incentives, classifying them into three groups: those facing special socio-economic difficulties (referred to as Challenged - C), those with socio-economic difficulties (Burdened - B), and those without economic difficulties (Advantaged - A). While the precise criteria for these categories remain undisclosed, Figure 1c shows how the pre-reform poverty distributions across districts vary by tax policy labels. The 1999 poverty data comes from Minot et al. (2003), based on the 1999 population census and multiple poverty indicators. Poverty incidence clearly rises from A to C, but not perfectly. Moreover, Table A1 offers additional statistics derived from the establishment data detailed in section 3. It reveals that B and C districts have lower population densities, more ethnic minorities, lower urbanization rates, and lower wages than A districts.

The tax incentives provided to B and C districts vary over the life cycle of the firms, which is a common feature of place-based policies around the world[4]. As demonstrated in Figure 1a, 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. Conversely, 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.

[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.

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

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 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 A5 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 A2, 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].

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. Figure A1 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.

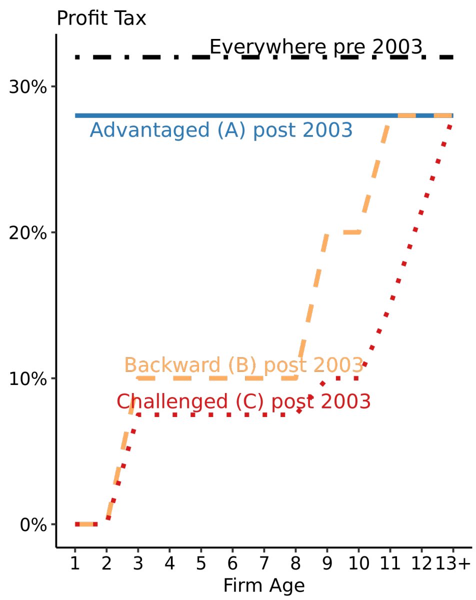
Since I do not have access to redistribution of lower level than provinces, I aggregate the A, B, and C labels from the tax policy to the province level which use 1999 population shares in B and C and try to keep the similar shares of A, B, C across provinces as in across districts. Figure A7 displays the map of these provinces with A, B, and C labels next to the

[5]Decree 88/2004/TT-BTC

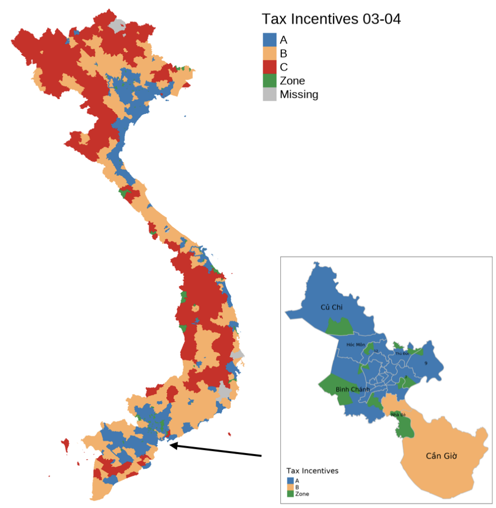
[6]See Section III Article 1 of Decree 128/2003/TT-BTC and Item 6.1.2 of Decree 88/2004/TT-BTC.

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

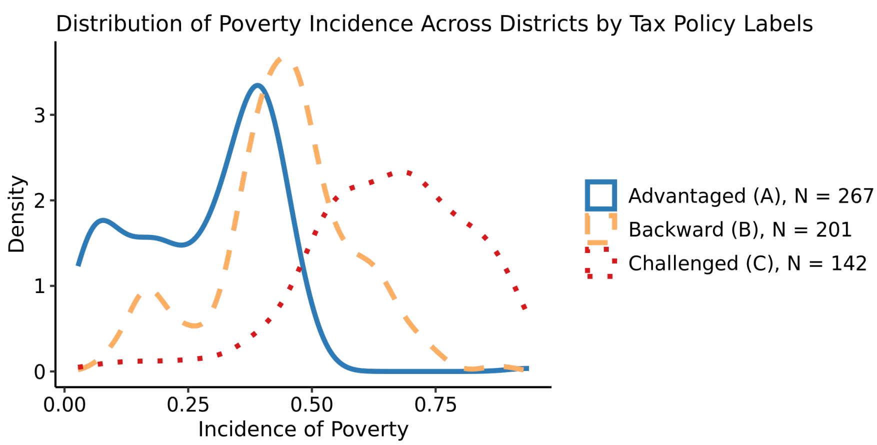
Figure 1: Enterprise Profit Tax Varies over Time, across Districts, and Firm Ages



(a) Tax Schedule Before and After 2003



(b) Map of Tax Policy Labels



(c) Poverty Incidence in 1999 and Tax Policy Labels

Sources: Decrees 164/2003/ND-CP and 88/2004/TT-BTC; Poverty incidence estimates from Minot et al. (2003). *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.

map of the official labels at the districts levels.

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 redistributes 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 prerequisites 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

[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.

[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

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 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 A4.

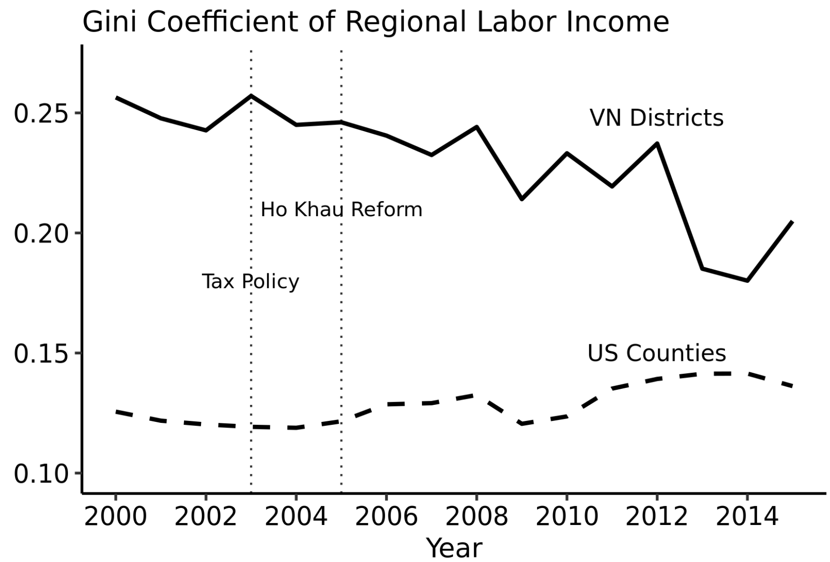
I follow McCaig et al. (2022) to create consistent firm identifiers, 4-digit ISIC industry codes, and locations. I also take advantage of employment and wage bill information. Additional details concerning these variables can be found in Appendix A.

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.

2006 81/2006/QH11 reduces the requirement to at least one year.

Figure 2: Spatial Inequality Trends in Vietnam and the USA, 2000-2015



Sources: Vietnamese Annual Establishment Surveys and the US Bureau of Economic Analysis (2000-2015).

Nonetheless, it is likely to be a good indicator of permanent migration.

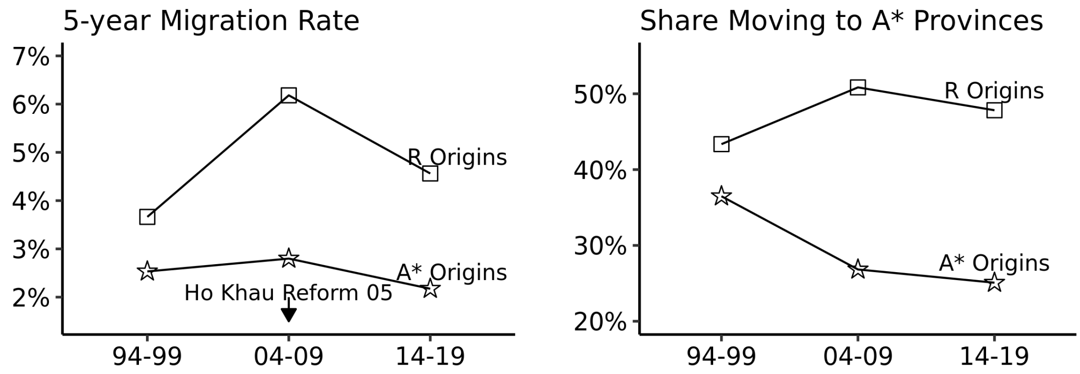
Internal Trade Data. I use inter-provincial trade data for the year 2000 from JICA (2000). Using the 1999 IPUMS map, I calculated truck distances between provinces with ArcGIS network analysis tools. This data will help me analyze the link between trade and distance, further detailed in subsection 5.3.

3.2 Descriptive Facts

Spatial inequality in Vietnam, measured by labor income, reduced between 2000 and 2015. I analyzed the trend in spatial inequality across Vietnamese districts and compared it to US counties using the Gini coefficient, as depicted in Figure 2. I derived this metric by compiling wage and employment data from Vietnamese establishment surveys and used labor income data for US counties from the Bureau of Economic Analysis.

Figure 2 highlights two main points. First, Vietnam's spatial inequality is consistently higher than that of the US during this timeframe. This pronounced inequality was likely to contribute to the policies outlined in section 2 in Vietnam. Additionally, Vietnam experienced a notable reduction in spatial inequality between 2000 and 2015.

Figure 3: Trends in Vietnamese Migration Patterns: 1999, 2009, 2019



(a) 5-year Migration Rate

(b) Share Moving to A^*

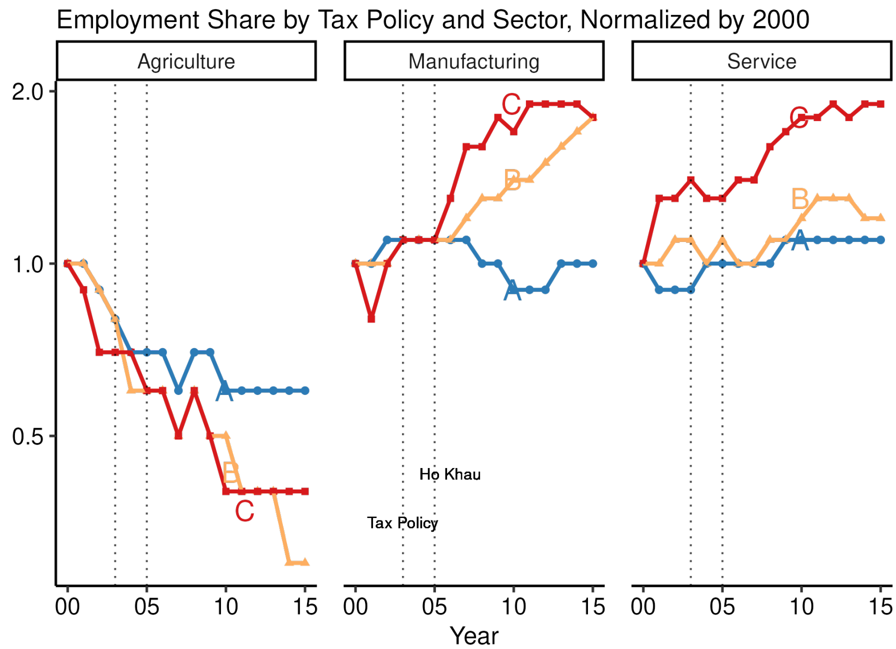
Sources: Population and Housing Census data from 1999, 2009, and 2019. *Notes:* A^* signifies centrally administered provinces, while R refers to Vietnam's other provinces. Panel (a) displays the percentage of people from each origin type migrating from year t to $t+5$. Panel (b) illustrates the proportion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

Significant changes in migration post-reforms, varied by origin and destination. The period following the tax and Ho Khau policy reforms, from 2004 to 2009, witnessed a substantial rise in migration relative to the period between 1994 and 1999. Figure 3a presents the out-migrant share across periods, aggregated by Ho Khau labels. R households, who constituted around 80% of the Vietnamese total population in 1999, tend to migrate much more often than A^* ones. Furthermore, migration's appeal has increased from 1999 to 2009, irrespective of whether individuals originate in R or A^* areas. Notably, the out-migration share from R origins nearly doubled during the 2004-2009 period compared to 1994-1999.

When examining destination preferences of out-migrants, I find that individuals from R provinces increasingly favor A^* destinations, while the reverse holds true for those originating from A^*. This pattern is evident in Figure 3b, displaying the share of out-migrants choosing A^* destinations based on their origin types. After the Ho Khau reform, more migrants from R regions chose A^*, while those from A^* leaned towards R areas. Although the Ho Khau policy did not differentiate migrants based on origin, the migration pattern suggests that the stricter requirements for A^* Ho Khau post-reform could both lessen in-migration from R to A^* and had an even more significant effect on those from A^*.

In sum, migration costs differ based on migrants' origin and destination, and the Ho Khau policy can influence these costs. I integrate this aspect into the dynamic model in

Figure 4: 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.

section 4. In section 5, I demonstrate how the Ho Khau policy's effects on migration costs can be deduced from migration flow variations, informed by the model's structure.

Post-reform increase in manufacturing firm entry and employment. 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 4 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 A2. 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 4, particularly in poorer districts. Table A3 presents data on entrants and exiters 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 A3. 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.

[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.

3.3 Difference-in-Difference Analysis

In this subsection, I use a Difference-in-Differences (DiD) 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 4, the answer may differ across sectors.

The unit of analysis is the district-zone level, as illustrated in Figure 1b. 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 specification:

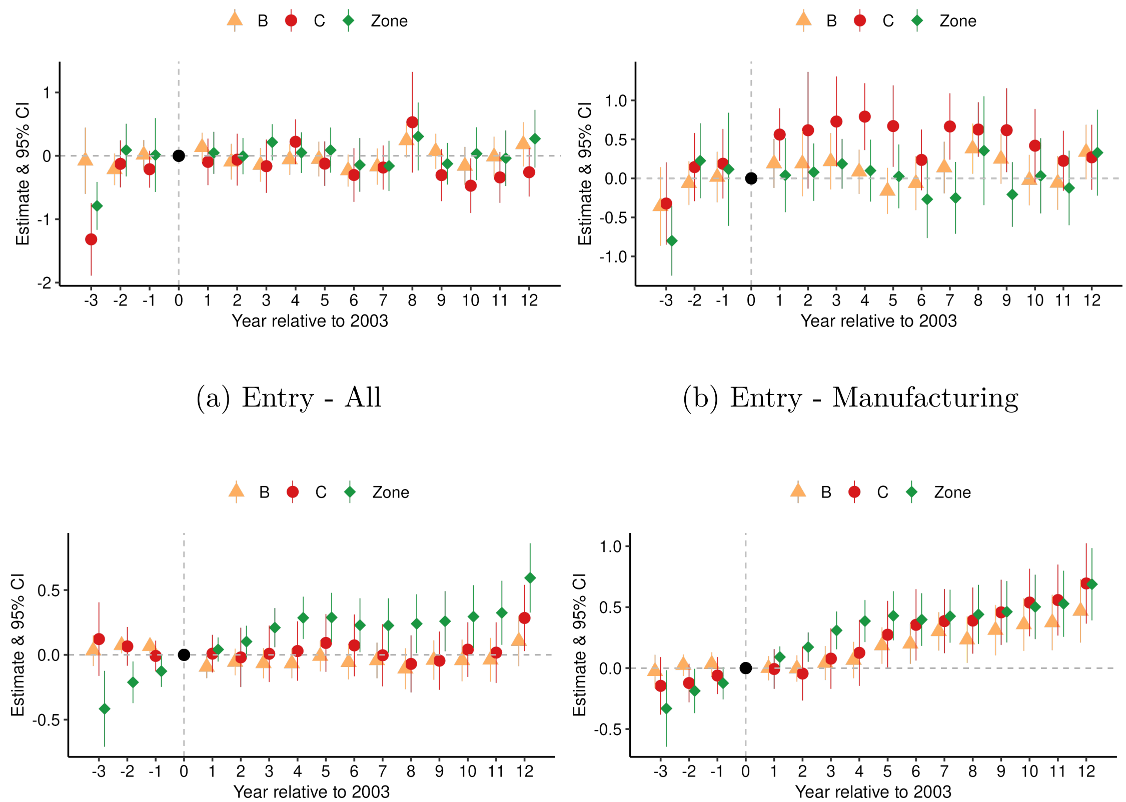
$$Y_{ist} = \sum_{j \in \{-3,\ldots,0,\ldots,12\}} \boldsymbol{\beta}_j^P \cdot \mathbf{Treat}_i \cdot \mathbf{1}_{t-j} + \underbrace{\alpha_i}_{\text{Region FE}} + \underbrace{\theta_s \cdot \delta_t}_{\text{Sector-Region FE}} + \varepsilon_{ist}, \tag{1}$$

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).

The introduction of tax incentives in B and C districts, as shown in Figure 5a and Figure 5c, did not yield increases in entry or employment when running regression Equation 1 on all establishments. This outcome can potentially be explained by heterogeneous effects

Figure 5: Event-Study Analysis of Firm Entry and Employment



(a) Entry - All

(b) Entry - Manufacturing

(c) Employment - All

(d) Employment - Manufacturing

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.

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 major sectors, I find an increase in both entry rates and employment within manufacturing. 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 time, as depicted in Figure 5b. 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 Figure 5d.

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 DiD analysis reveals that tax policy has the potential to stimulate structural transformation in less affluent districts. Table A4 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 DiD 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 fulfill three key objectives. First, it enables a welfare evaluation of national-scale policies, factoring in general equilibrium responses. Second, it improves upon previous DiD analyses by more effectively connecting data with policies, yielding novel predictions across richer policy variations and data dimensions. Finally, beyond evaluating existing policies, the model is instrumental in examining counterfactual ones with varying tax rates and migration barriers, enhancing our understanding of these policies' impacts and their interplay.

The model incorporates an occupational choice element, inspired by Lucas (1978), allowing households to decide whether to be workers or entrepreneurs within a spatial framework. This trade-off adds novel interactions between place-based and migration policies. Additionally, the model builds upon the work of Caliendo and Parro (2020) by introducing heterogeneity among entrepreneurs based on their firm age. This extension incorporates tax schedules that vary across space, time, and firm age to align with the tax policy outlined in subsection 2.1.

4.1 Environment

The economy evolves in discrete time, indexed by $t \geq 0$, and consists of N locations indexed by $i, n \in \{1, \ldots, N\}$, and J sectors indexed by $j, k \in \{1, \ldots, J\}$. Each location is home to infinitely-lived households, which are broadly classified into workers and entrepreneurs.

In each location i, households of type-h (workers or entrepreneurs) gain utility from consuming per capita public services ($G_{i,t}/\mathcal{L}_{i,t}$) and goods $c^h_{i,t}$ with the following preferences

$$\mathbb{E}_t \left[\sum_{t'=t}^{\infty} \beta^{t'-t} \left(\gamma \log \left(G_{i,t'}/\mathcal{L}_{i,t'} \right) + (1-\gamma) \log \left(c^h_{i,t'} \right) \right) \right],$$

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 workers $L_{i,t}$ and entrepreneurs $E_{i,t}$, i.e. $\mathcal{L}_{i,t} = L_{i,t} + E_{i,t}$.

The Ho Khau policy, aimed at reducing congestion in public services like hospitals and schools, is driven by the nature of these services as rival goods. This approach to modeling their consumption is based on Fajgelbaum et al. (2018), highlighting the policy's role in managing demand for these services.

Households exhibit a nested constant elasticity of substitution (CES) preference structure. The outermost Cobb-Douglas nest allocates a consumption share γ to public services, while the second nest, also Cobb-Douglas, assigns share α^j to goods from sector j, represented as $c^h_{i,t} = \prod_j (c^{hj}_{i,t})^{\alpha^j}$. The innermost nest, a CES function with elasticity σ, applies to a continuum of varieties produced by entrepreneurs across the country.

The local price index $P_{i,t}$ is derived from the second nest:

$$P_{i,t} = \prod_{j=1}^{J} \left(\frac{P^j_{i,t}}{\alpha^j} \right)^{\alpha^j}, \quad 0 < \alpha^j < 1 \text{ and } \sum_j \alpha^j = 1, \tag{2}$$

where $P^j_{i,t}$ represents the location-sector price index. Plus, given CES preference in the innermost nest, the location-sector price index can be expressed as

$$P_{i,t}^{j} = \left(\sum_{n=1}^{N} E_{n,t}^{j} (p_{ni,t}^{j})^{1-\sigma} \right)^{1/(1-\sigma)}, \tag{3}$$

where $E_{n,t}^{j}$ 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}. Thus, the location-sector price index $P_{i,t}^{j}$ highlights the first interaction between locations, involving the spatial frictions in the movement of goods.

4.2 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. Each worker then draws a vector of productivity across sectors $\boldsymbol{\varepsilon}_t = \{\varepsilon_t^j\}_{j=0,1,\ldots,J}$ where $j = 0$ denotes paid employment and 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

$$u_{i,t} = \gamma \log\left(G_{i,t}/\mathcal{L}_{i,t}\right) + (1-\gamma) \log\left(w_{i,t}/P_{i,t}\right) + \max\left\{\Xi_{i,t} + \chi\varepsilon_t^0, \beta V_{i,t+1}^{1,\mathrm{I}} + \chi\varepsilon_t^1, \ldots, \beta V_{i,t+1}^{J,\mathrm{I}} + \chi\varepsilon_t^J\right\} \tag{4}$$

where $V_{i,t+1}^{j,\mathrm{I}}$ is 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.

The lifetime utility of a worker in location i, derived in Appendix B, can be expressed as

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

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 $U_{n,t+1} \equiv \mathbb{E}_{\epsilon}[u_{n,t+1}]$, 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 Caliendo et al. (2021), 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.

4.3 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 $\tau_{i,t}^{s}$ 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 1a. Similar to workers, entrepreneurs consume locally and spend their entire net profits on goods without saving.

4.3.1 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.

4.3.2 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 $E_{i,t}^{j,s}$, in each location-sector ij decides whether to continue their business or switch to employment, considering productivity shocks similar to those of workers. Let $v_{i,t}^{j,s}$ 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 $V_{i,t+1}^{j,s} \equiv \mathbb{E}_t[v_{i,t+1}^{j,s}]$. The value for an s entrepreneur in location-sector ij at time t is given by

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

where I_s accounts for the transition to the next stage for younger firms, but not for the final stage ($s = \text{III}$), i.e. $\mathrm{I}_s = \text{I}$ for $s < \text{III}$ and 0 if $s = \text{III}$. 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.

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.

4.4 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 assumes that local governments collect all land rent, a simplification that excludes private landlords, unlike the approach in Kleinman et al. (2023). This is motivated by the substantial revenue local governments in Vietnam, particularly in special economic zones, derive from land rent. This simplification avoids budgetary constraints for the government despite tax reductions and limited central support, a point revisited in the place-based policy analysis.

Lastly, the assumption that local governments spend all income on public services bypasses complexities like bureaucratic delays or revenue losses due to other political motives. Incorporating dynamic public finance interactions between local and central governments is outside this paper's scope.

4.5 Equilibrium

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

$$\lambda^j_{in,t} = E^j_{i,t}\frac{p^j_{in,t}y^j_{in,t}}{X^j_{n,t}} = E^j_{i,t}\left(\frac{p^j_{in,t}}{P^j_{n,t}}\right)^{1-\sigma} = \frac{E^j_{i,t}(d^j_{in}x^j_{i,t})^{1-\sigma}(A^j_{i,t})^{\sigma-1}}{\sum_{n'=1}^N E^j_{n',t}(d^j_{n'n}x^j_{i,t})^{1-\sigma}(A^j_{n',t})^{\sigma-1}}, \tag{24}$$

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

$$\Pi_{i,t} = P_{i,t}G_{i,t} + \sum_{j=1}^J\left(w_{i,t}L^j_{i,t} + \pi^j_{i,t}\sum_{s=\mathrm{I}}^{\mathrm{III}}E^{j,s}_{i,t}(1-\tau^s_{i,t})\right) \tag{25}$$

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

$$w_{i,t}L^j_{i,t} = \frac{\sigma-1}{\sigma}\sum_{n=1}^N\lambda^j_{in,t}X^j_{n,t}. \tag{27}$$

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 $\mathcal{F}_t \equiv \{d^j_{in}, A^j_{i,t}, m_{in}\}_{i,n,j}$ which includes trade costs, local TFPs, and non-policy migration cost, and the set of policies be $\mathcal{P}_t \equiv \{\tau^s_{i,t}, mpol_{in,t}\}_{i,n,s}$ which comprises profit tax and Ho Khau policy. The state variables consist of the distribution of workers and entrepreneurs $\mathcal{S}_t \equiv \{L_{i,t}, E^{j,\mathrm{I}}_{i,t}, E^{j,\mathrm{II}}_{i,t}, E^{j,\mathrm{III}}_{i,t}\}_{i,j,s}$.

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 (2), (3), (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.

4.6 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 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 D, 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 B, 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 parameter χ. While profit tax figures are readily available, quantifying the Ho Khau policy's impact on migration costs in utils is more challenging. Additionally, estimating the dispersion parameter χ, which influences spatial firm entry elasticity, is both novel and essential.

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, employing a difference-in-difference-in-difference design. 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 subsection 3.3, 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

$$\log \psi_{i,t}^{j} - \log \psi_{i,t}^{0} = \frac{\beta}{\chi} V_{i,t+1}^{j,\mathrm{I}} - \frac{1}{\chi}\Xi_{i,t},$$

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

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

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,

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

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, $c^{j,\mathrm{I}}_{i,t}$. 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

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

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

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

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

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

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 $\left(\frac{\varsigma^{j,\mathrm{I}}_{i,t}}{1-\varsigma^{j,\mathrm{I}}_{i,t}}\right)$, while also increasing the likelihood of exit in the next period for II firms due to heightened market competition, captured in $\left(\frac{1-\varsigma^{j,\mathrm{II}}_{i,t+1}}{\varsigma^{j,\mathrm{II}}_{i,t+1}}\right)^{\beta}$.

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

$$\log \frac{\frac{\psi^{j}_{i,t}}{\psi^{0}_{i,t}}(1-\varsigma^{j,\mathrm{I}}_{i,t+1})^{\beta}}{\frac{\varsigma^{j,\mathrm{I}}_{i,t}}{1-\varsigma^{j,\mathrm{I}}_{i,t}}\left(\frac{1-\varsigma^{j,\mathrm{II}}_{i,t+1}}{\varsigma^{j,\mathrm{II}}_{i,t+1}}\right)^{\beta}} = \frac{\beta}{\chi}(1-\gamma)\log\frac{(1-\tau^{\mathrm{I}}_{i,t+1})}{(1-\tau^{\mathrm{II}}_{i,t+1})} + \mathbf{\Sigma}^{j}_{i,t} \tag{31}$$

where the location-sector-time fixed effects $\mathbf{\Sigma}^{j}_{i,t}$ 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 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 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 1 presents the estimate for γ_F of 1.59, statistically significant at the 1 percent level. Given the calibrated parameters for β and γ, I obtain $\chi = 0.5$.

Table 1: Difference-in-Difference-in-Differences Estimate of Firm Entry Elasticity

Dependent Variable:	Local Age-Specific Turnover Rate
	(1)
Log(Net Tax Rate Ratio)	1.59^{***}
	(0.56)
Observations	46,809
# District-AgeGroup	1,364

Source: Annual Establishment Surveys (2000-2015).
Notes: The analysis observes units by district-zone, 2-digit ISIC sector, age group, and year. Regression (32) incorporates district-sector-year, age group-year, and district-age group fixed effects, 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.

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

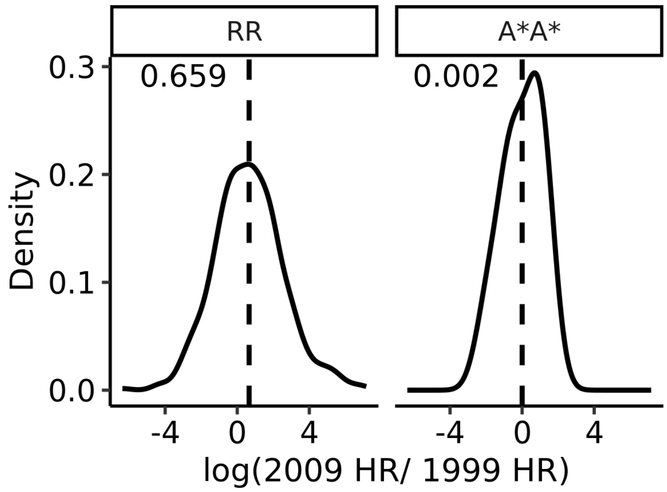
$$\Delta_{in} = mpol_{in,post} - mpol_{in,pre},$$

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

Figure 6: Temporal and Spatial Variations in Migration Costs Linked to Ho Khau Policy



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.

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 6, 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 6. 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 6 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 E 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 A8 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.

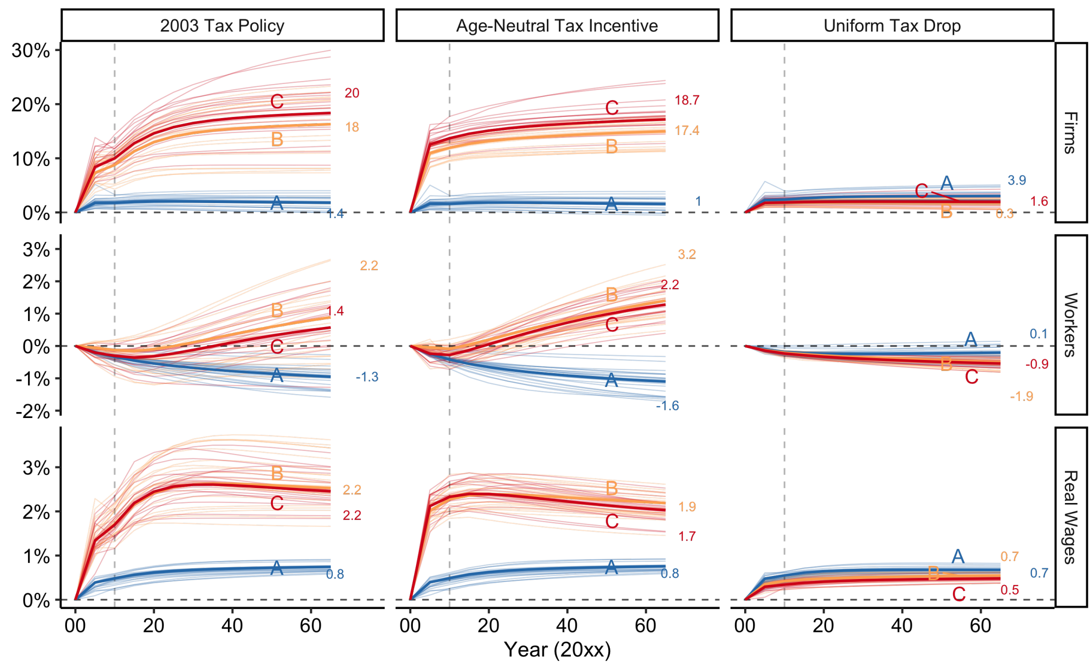
Employment data from establishment surveys are aggregated to estimate the labor stock $L_{i,t}$, and deflated wage bills are used for wage measurements. Since migration data are available only at the provincial level, the tax categories A, B, and C are redefined accordingly. This step involves aggregating data based on the 1999 provincial population shares in B and C districts. Figure A7 illustrates the provinces categorized by their tax status.

6.1 Place-based Tax Incentives

This analysis covers three tax policies: (1) the actual 2003 Profit Tax Policy, (2) "Age-Neutral Tax Incentive" with uniform place-based incentives across firm ages, and (3) "Uniform Tax Drop" with an equal tax reduction in all regions for all firm ages. Figure 7 displays the percentage changes in establishment numbers, workforce size, and real wages under these tax scenarios. The outcomes are arranged in rows, while the tax policies are categorized in columns. Thicker lines represent aggregate effects, and aggregate real wage changes are weighted based on 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

Figure 7: Effects of Varied Tax Policies on Firm Counts, Employment, and Real Wages



Notes: The figure shows the percentage change in establishment numbers, workforce size, and real wages when comparing an economy with a hypothetical tax schedule to one without. The scenarios include (1) the actual 2003 Profit Tax Policy, (2) "Age-Neutral Tax Incentive" with place-based incentives but uniform across firm ages, and (3) "Uniform Tax Drop" with a consistent tax rate reduction across all regions and for all firm ages. Provinces are grouped by 2003 tax categories A, B, and C. Outcomes are shown in rows, tax scenarios in columns. Thicker lines indicate aggregate effects, with real wage changes weighted by initial employment. Their steady-state values at each panel's end are color-coded by region type. A dashed line marks the data period's end, followed by model projections assuming constant fundamentals and policies until the economy reaches its steady state.

a modest 1.4%.

Accompanying the increase in firms, both employment and real wages also rise in B and C relative to A, despite an initial decrease in the workforce across the board. In the steady state, employment in regions B and C goes up by 2.2% and 1.4% respectively, with a similar 2% increase in real wages. In contrast, A experiences a 1.3% decline in employment and a slight 0.8% increase in real wages.

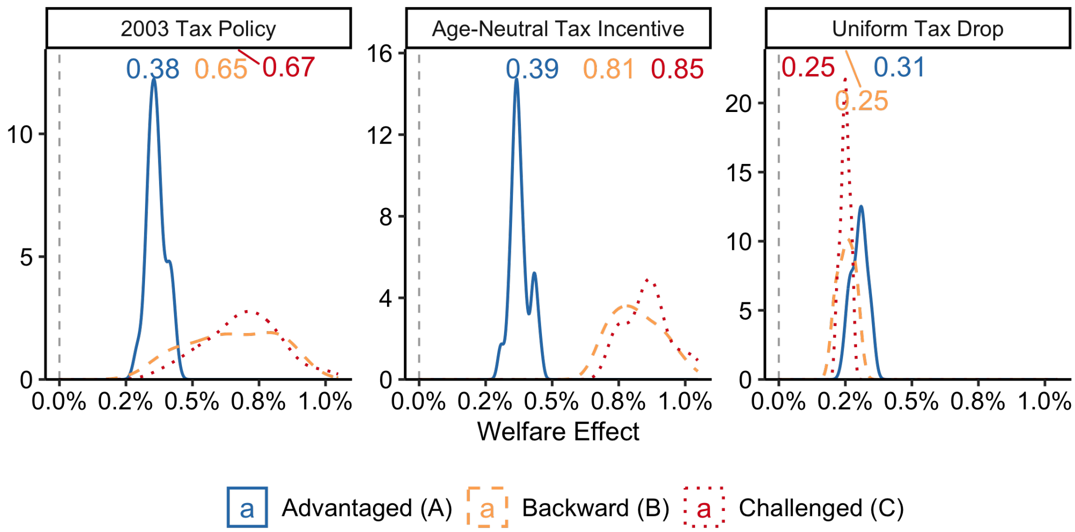
The real wage effects observed differ significantly from the modest gains for disadvantaged regions reported in Atalay et al. (2023), which interprets place-based industrial policies in Turkey as changes to local TFPs in Caliendo et al. (2019)'s model. Their findings show limited gains mainly due to the endogenous migration response to improved areas following place-based policies. However, the model in this paper, which includes occupational choice, public services, and firm responses, suggests more substantial benefits from place-based policies in less developed regions. Place-based tax cuts initially draw firms to targeted areas, and the subsequent immigration alleviates wage pressure. The increase in labor supply helps maintain low wage levels in these areas, which in turn encourages further firm entry.

Thus, the success of place-based tax policies depends heavily on how firms react. My descriptive analysis indicates that altering firm locations, particularly for those in non-tradeable sectors, is complex. In a world where firms do not move to targeted areas of place-based policy, reducing taxes simply decreases welfare across the board.

The 2003 tax policy appears effective in diminishing spatial inequality, with an average welfare increase of 0.7% in B and C, compared to a smaller increase of 0.38% in A. The welfare impacts are depicted in Figure 8, which shows the distribution of welfare effects across various policy scenarios for provinces classified by their tax labels. Welfare effects for a specific province according to (28) represent the change in expected lifetime utility, measured in terms of consumption equivalence, for a representative worker residing in that province before the introduction of policies. Thus, the welfare effects take into account both stayers and movers. The aggregate values of these local effects are weighted by initial population shares and color-coded to align with the respective region categories.

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 slightly different 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

Figure 8: Distributional Welfare Effects of Varied Tax Policies



Notes: Each panel in the figure shows the distribution of welfare effects across different region labels under a tax policy. Welfare is measured as compensating variation, as defined in Equation 28. Displayed numbers represent the aggregate welfare effects, weighted by initial population shares and color-matched to their corresponding region categories.

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 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.

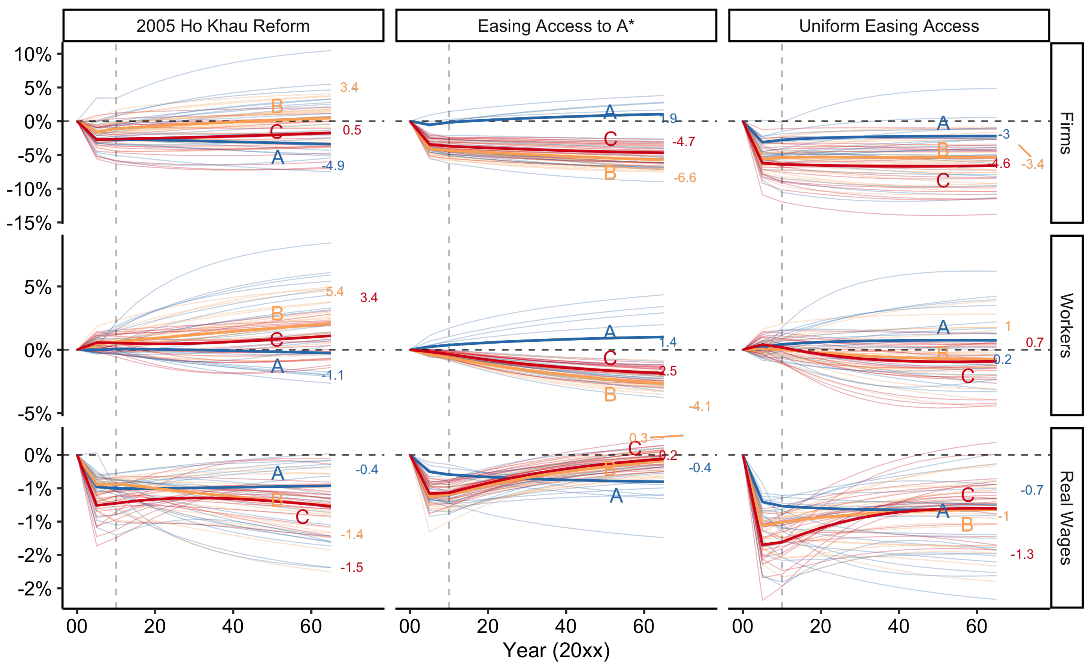
6.2 Migration Barriers

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 9 serves as a parallel to Figure 7, illustrating the percentage changes in establishment numbers, workforce size, and real wages for each of these migration barrier reduction scenarios.

The 2005 Ho Khau reform, by lowering migration costs, enhances the appeal of employment 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.

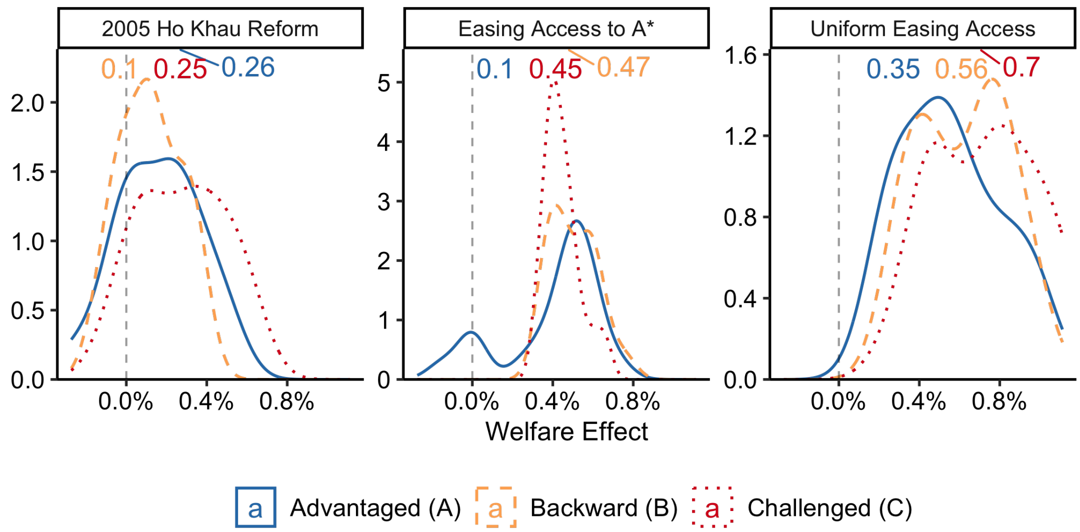
Following the 2005 Ho Khau reform, B and C experience a more pronounced increase in both employment and firm numbers compared to A, with considerable variation within each category. Notably, Da Nang, an A^* province, experiences the largest gains in firms and workers while other major provinces like Ho Chi Minh City and Ha Noi see declines. On average, however, B and C see more substantial accumulations of workers and firms. This

Figure 9: Effects of Varied Migration Policies on Firm Counts, Employment, and Real Wages



Notes: The figure shows the percentage change in establishment numbers, workforce size, and real wages when comparing an economy with a counterfactual migration policy to one without. The scenarios are (1) the actual 2005 Ho Khau Reform, (2) "Easing Access to A^*" lowering migration barriers to A^* to the 2005 Reform level of R while maintaining preexisting barriers to R, and (3) "Uniform Easing Access" reducing migration barriers across all regions equally. For additional details, refer to the footnote in Figure 7.

Figure 10: Distributional Welfare Effects of Varied Migration Policies



Notes: Each panel in the figure shows the distribution of welfare effects across different region labels under a migration policy. Displayed numbers represent the aggregate welfare effects, weighted by initial population shares and color-matched to their corresponding region categories.

effect stems from the reform's focus on lowering migration barriers into these less affluent areas, thereby redistributing firms and workers more toward them.

Despite the influx of workers and firms in these disadvantaged regions, I see a decline in real wages in B and C relative to A. Additionally, congestion in regions B and C rises relatively, further highlighting the complex outcomes of the reform. In essence, the rise in employment and businesses in B and C, while beneficial in some aspects, culminates in reduced real wages and welfare there.

Figure 10 illustrates the welfare effects of various migration barrier reductions, paralleling Figure 8. Following the 2005 Ho Khau Reform, the most advantaged areas experience the largest welfare increase of 0.26%, while the poorer regions C and B see smaller increases of 0.25% and 0.1%, respectively. These results suggest that, although reducing migration barriers to less affluent areas leads to an uptick in firm numbers and employment, it may inadvertently exacerbate spatial welfare inequality. 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 over B and C regions, with a 1.4 percent increase in employment in A and decreases of 4.1 and 2.5 percent in B and C, respectively. This labor movement triggers a 1.9 percent increase in the number of firms in A due to reduced wages, contrasting with declines of 6.6 and 4.7 percent in B and C. Initially, real wages in B and C fall relative to A, but as migration shifts towards A, wages in B and C start to increase. In the steady state, real wages in B and C rise by about 0.3 percent, while in A they decrease by 0.4 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 10, welfare increases everywhere with a rise of 0.5 percent for B and C and a modest rise of 0.1 percent in A with two major cities seeing welfare loss. This loss is likely to be underestimated in this study because the model also overlooks critical factors like housing costs, which are significant in urban studies. 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 wage of big cities, employment in A increases more than in B and C, 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 B and C. 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 B and C, some residents of A capitalize on the reduced barriers to move to B and C, shifting the employment dynamics. In the steady state, employment in B and C grows slightly more than in A, even though A sees a smaller firm reduction.

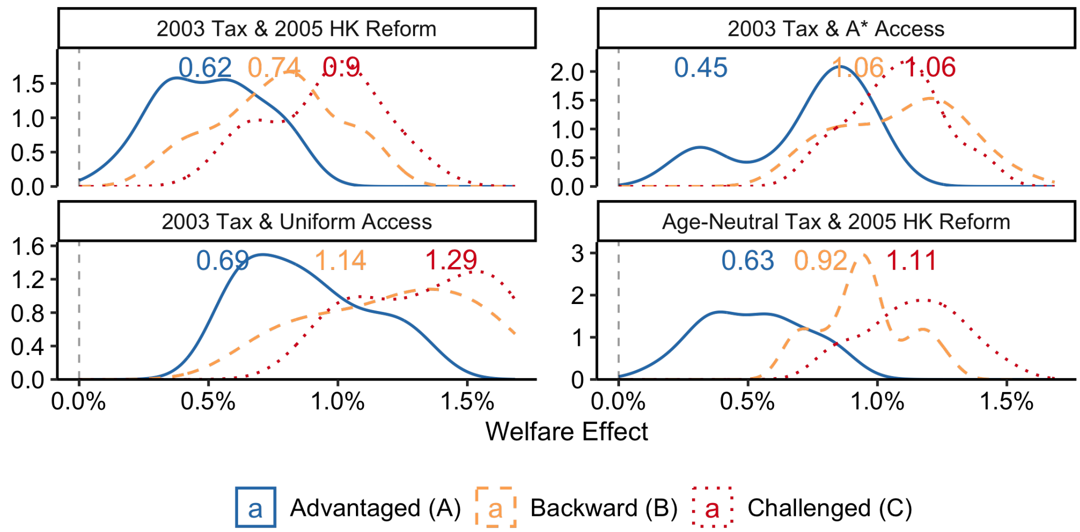
In summary, reducing migration costs universally proves less effective in curbing spatial inequality compared to reducing migration barriers solely to major cities as seen in the welfare effects of Figure 10. However, it improves welfare across the board rather than burdening the cities alone.

6.3 Place-based Incentives and Migration Barriers

After analyzing the effects of individual policies and their counterfactual alternatives, I now explore how the combination of place-based and migration policies influences welfare. Figure 11 reports the welfare effects of four different policy combinations. The first combination is the actual "2003 Tax Policy and 2005 Ho Khau Reform". Previous results show that while the tax policy reduces spatial inequality, the migration policy does not have the same effect. Combining these policies results in a dampening effect rather than amplification, with the combined welfare impact being slightly less than the sum of their individual effects. Nevertheless, this actual policy mix in Vietnam ultimately results in a welfare increase: 0.9% in C, 0.74% in B, and 0.62% in A, thereby effectively reducing spatial inequality.

In the second policy combination, called "2003 Tax & A^* Access", I maintain the 2003 Tax Policy but replaces the 2005 Ho Khau Reform with "Easing to A^* Access". This setup aligns with the broader policy recommendations from the majority of previous studies studying place-based policy and migration policy individually where studies where place-based strategies encourage firms to establish in disadvantaged areas, and migration policies facilitate worker movement from rural to urban areas. While both policies individually aim to promote spatial equality, easing migration barriers to large cities risks welfare losses in some A^* locations. However, this combination effectively counteracts such losses and proves to be highly effective in reducing spatial inequality. It boosts welfare in B and C by an average of 1.06%, and in A by about 0.45%. This improvement is greater than the "Uniform Easing Access" scenario, which also reduces migration barriers but does not address congestion in

Figure 11: Distributional Welfare Effects of Place-based and Migration Policy Combinations



Notes: Each panel in the figure illustrates the distribution of welfare impacts across various regions under combined place-based tax and migration policies.

A regions as effectively.

What makes this combination distinct yet similar to Uniform Easing Access is its approach to congestion. As people migrate to A^* areas, potentially causing congestion, offering incentives for firms to set up in B and C 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.

Comparing this with a third policy mix, "2003 Tax Policy with Uniform Easing Access", and contrasting it against a fourth scenario, "Age-Neutral Tax with 2005 Ho Khau Reform", which aims to aggressively promote rural development, reveals interesting insights. The latter combination, though aggressively promoting rural development, is less effective at reducing spatial inequality than a more balanced approach with moderate place-based incentives and uniform worker mobility gains. Overly directing firms and workers to poorer areas leads to excessive employment and congestion in B and C, reducing wages despite an increase in firms.

Let's compare a third 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 less effective at reducing spatial inequality but mitigates adverse effects on large cities. Directing lowered barriers only towards disadvantaged areas shows minimal impact on reducing inequality. 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.

These insights into the dynamics of spatial inequality provide a clearer picture of how geography, market forces, and government interventions intertwine. This understanding is crucial for policymakers and economists alike, as they navigate the challenges of regional development and strive to create more balanced economic landscapes.

Future research should 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 Appendix: Additional Figures and Tables

Table A1: 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)
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)

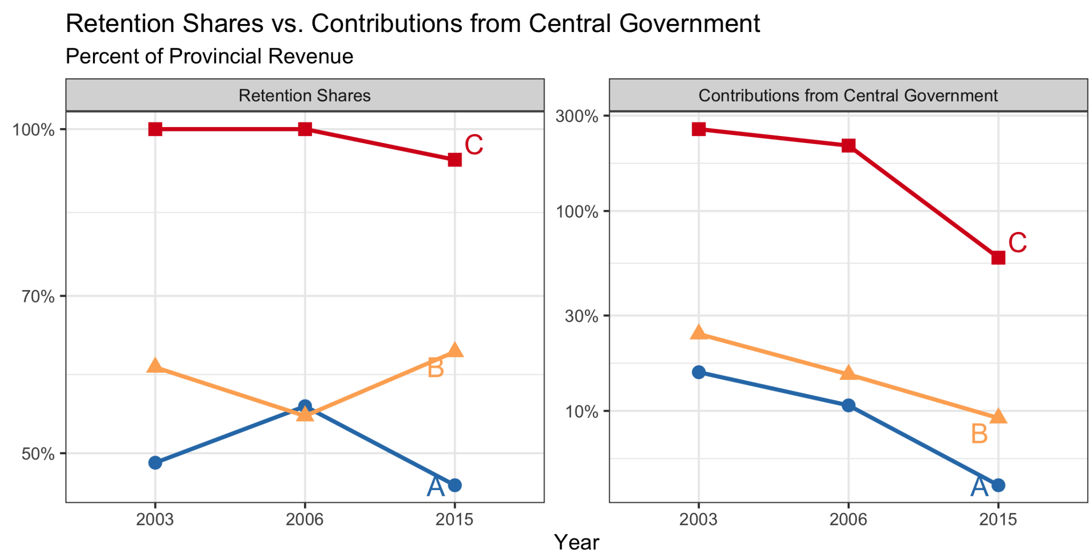
Sources: Data from Minot et al. (2003) for rows 1-4, Annual Establishment Surveys (2000-2002) for row 5, and Population Census 1999 for the remaining rows.
Notes: Presented as Mean (Standard Deviation). District labels A, B, and C represent Advantaged, Backward, and Challenged districts, as defined in Decree 164/2003/ND-CP. Average wage calculations cover the period from 2000 to 2002.

Table A2: 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

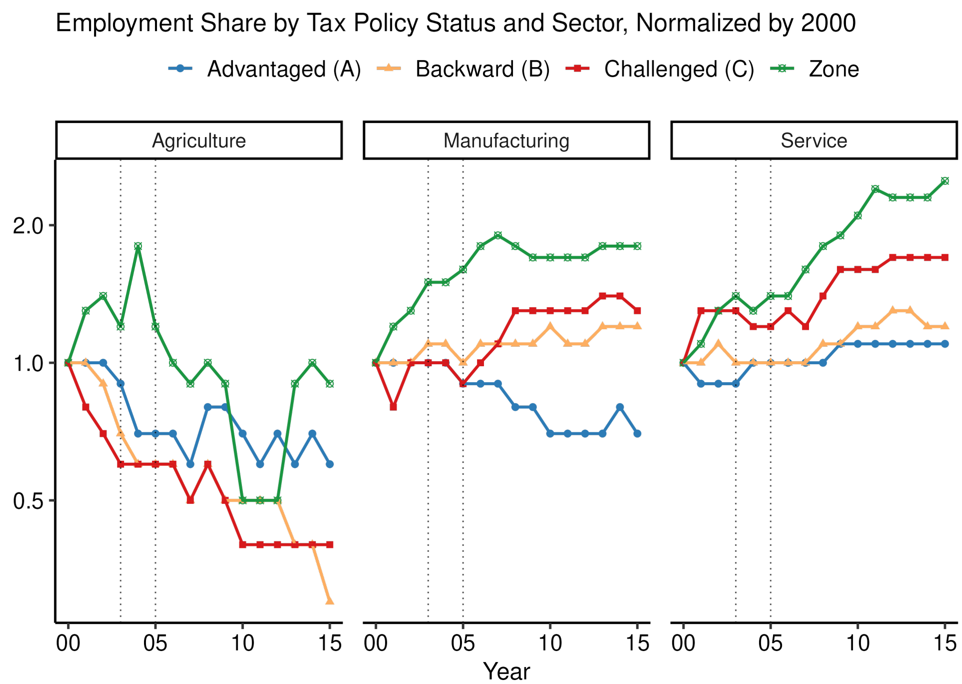
* *Source:* Annual Establishment Surveys, 2000

Figure A1: Revenue Redistribution Policy



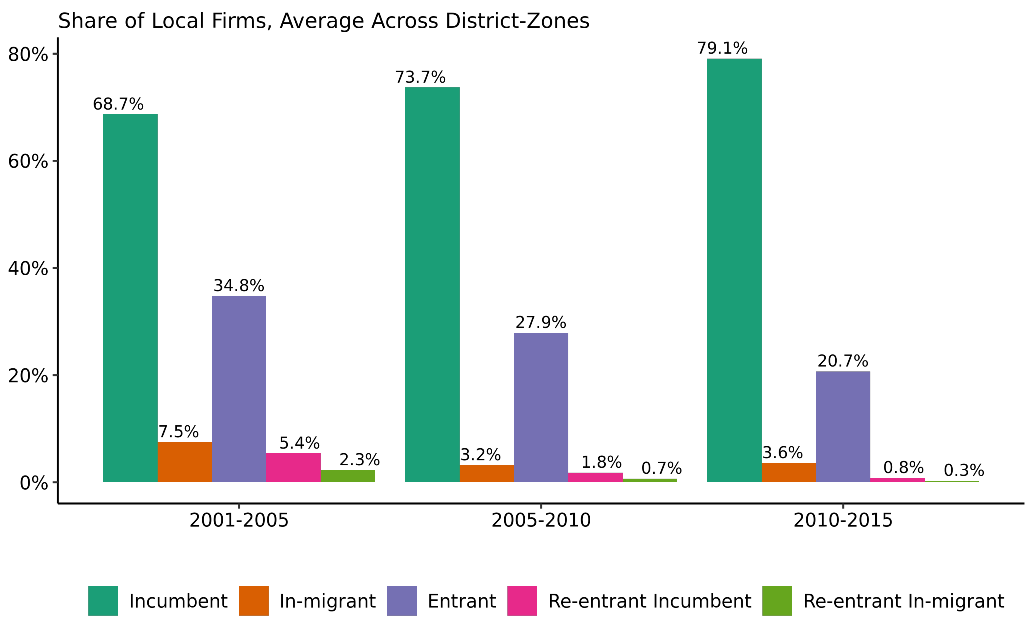
Sources: Ministry of Finance, Decisions 757/2003/QD-BTC, 4526/QD-BTC, and 3137/QD-BTC. *Notes*: The A, B, and C labels are at the provincial levels, constructed using the 1999 population share in B and C districts within each province. See Figure A7 for a map of these provincial labels.

Figure A2: Employment Distribution by 2003 Tax Policy and Zone Status



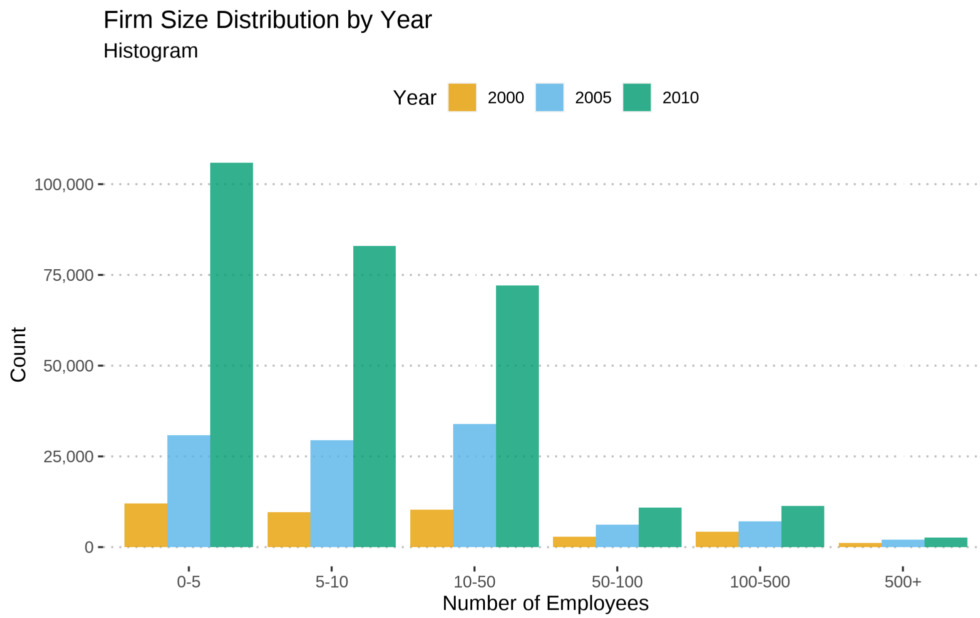
Source: Annual Establishment Surveys 2000-2015. *Notes*: Zone indicates a commune with at least one special economic zone (including types like high-tech and export zones) from 2000 to 2015.

Figure A3: Shares of Different Types of Firm Dynamics at District-Zone level



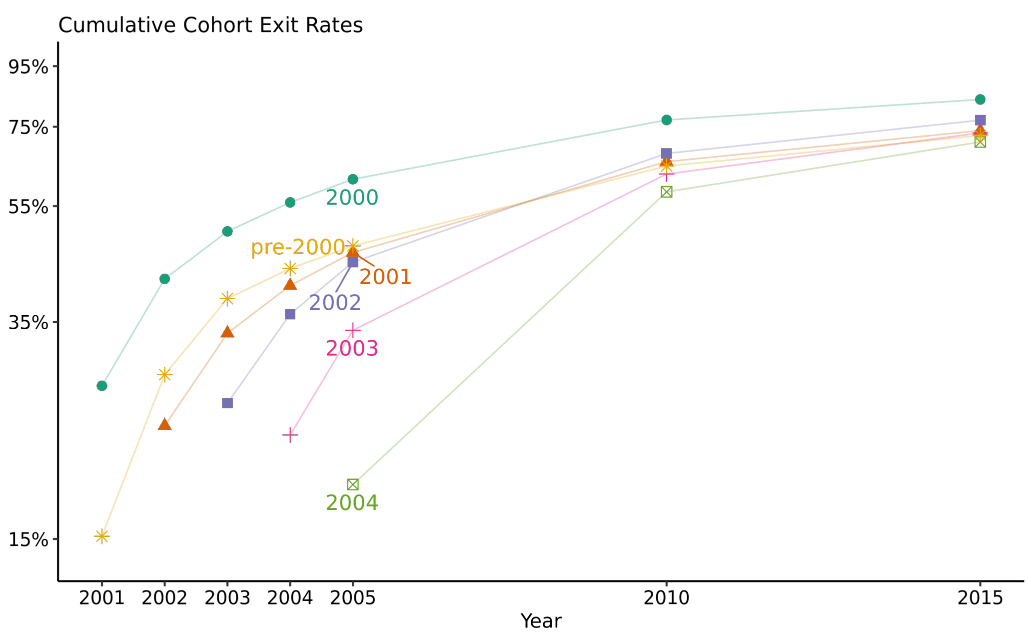
Source: Annual Establishment Surveys 2000-2015. *Notes*: The figure categorizes firm dynamics at the local level between periods t and t'. “Incumbent” denotes firms remaining in the same location, “In-migrant” for firms relocating to the current location, “Entrant” for newly observed firms, “Re-entrant 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 A4: Firm Size Distribution 2000, 2005, and 2010



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

Figure A5: Cohort-Based Exit Rates Over Time



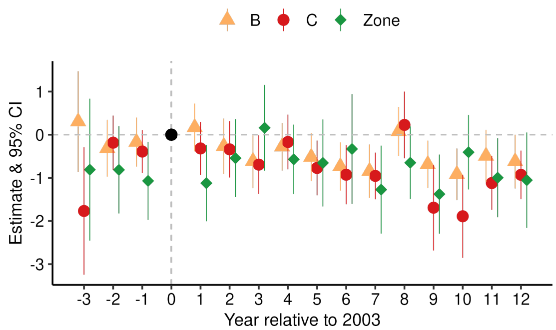
Source: Annual Establishment Surveys 2000-2015. *Notes*: Each point represents the cumulative exit rate for a cohort in a given year, showing the percentage of firms from cohort year x that have exited by year t.

Table A3: Firm Turnover: 2000 vs. 2015 Comparison

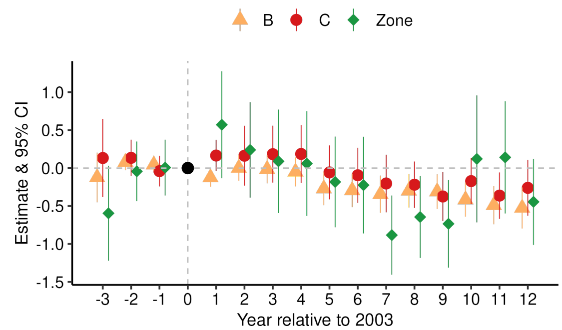
Shares of	Firms	Employment	Revenue
All			
Entrants	0.98	0.85	0.83
Exiters	0.74	0.47	0.49
A			
Entrants	0.96	0.88	0.90
Exiters	0.76	0.49	0.56
B			
Entrants	0.98	0.88	0.97
Exiters	0.82	0.62	0.74
C			
Entrants	0.98	0.85	0.84
Exiters	0.74	0.48	0.50

* *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.

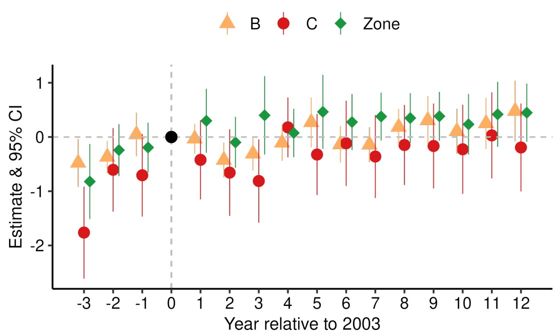
Figure A6: Event-Study of Agriculture and Service Sector Firm Entry and Employment



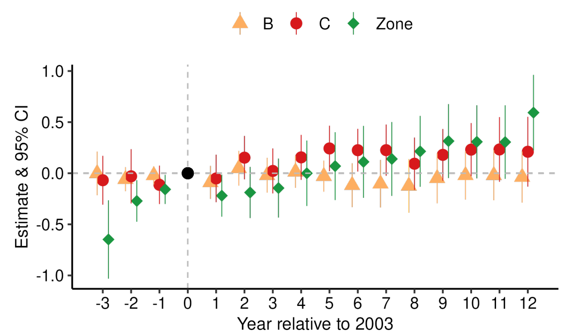
(a) Agriculture - Entry



(b) Agriculture - Labor



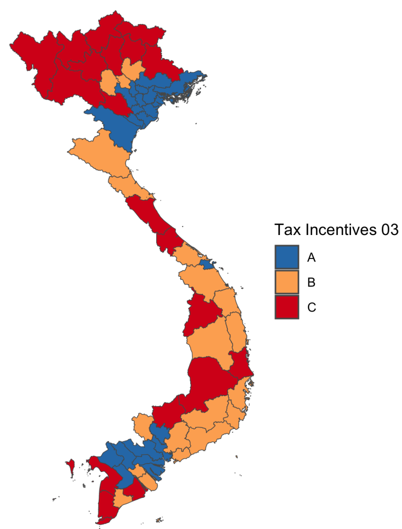
(c) Service - Entry



(d) Service - Labor

Source: Annual Establishment Surveys (2000-2015). *Notes:* Refer to notes in Figure 5 for details.

Figure A7: 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 A4: 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 4.2, 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 (**??**).

B.2 Firms with continuous stages

This subsection extends the entrepreneur discrete stages to a continuous one where I denote each stage as $s \in \{1,\ldots,S\}$. 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 $\psi^j_{i,t}$

$$\log \psi^j_{i,t} = -\frac{1}{\chi} f^j_{i,t} + \frac{\beta}{\chi} V^{j1}_{i,t+1} - \log \sum_{n=1}^{N} \exp\left(V^{j1}_{n,t+1} - f^j_{n,t}\right)^{1/\chi}.$$

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

$$\log \psi^j_{i,t} = \frac{\beta}{\chi} \log\left((1-\tau^1_{i,t+1})\frac{\pi^j_{i,t+1}}{P_{i,t+1}}\right) + \beta \log\left[\exp\left(V^{j2}_{i,t+2}\right)^{\frac{\beta}{\chi}} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}}\right] - \frac{1}{\chi} f^j_{i,t} + \Theta^{j1}_t. \tag{B.4}$$

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

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

Substituting this expression into (B.4) yields

$$\log\left(\psi^j_{i,t}(1-\varsigma^{j1}_{i,t+1})^{\beta}\right) = \frac{\beta}{\chi} \log\left((1-\tau^1_{i,t+1})\frac{\pi^j_{i,t+1}}{P_{i,t+1}}\right) - \frac{1}{\chi} f^j_{i,t} + \frac{\beta^2}{\chi} U_{i,t+1} + \Theta^{j1}_t. \tag{B.6}$$

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)

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

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

$$\log \frac{\varsigma^{js-1}_{i,t}}{1-\varsigma^{js-1}_{i,t}} = \frac{\beta}{\chi} \log\left((1-\tau^s_{i,t+1})\frac{\pi^j_{i,t+1}}{P_{i,t+1}}\right) + \beta \log\left(\exp(V^{js+1}_{i,t+2})^{\beta/\chi} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}}\right) - \frac{\beta}{\chi} U_{i,t+1}.$$

Applying (B.5) yields

$$\log \frac{\varsigma^{js-1}_{i,t}}{1-\varsigma^{js-1}_{i,t}}(1-\varsigma^{js}_{i,t+1})^{\beta} = \frac{\beta}{\chi} \log\left((1-\tau^s_{i,t+1})\frac{\pi^j_{i,t+1}}{P_{i,t+1}}\right) - \frac{\beta}{\chi} U_{i,t+1} + \frac{\beta^2}{\chi} U_{i,t+1}.$$

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

Worker's 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

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

I can write the expected lifetime utility as

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

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

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

$$\widehat{W}_i = \sum_{t=1}^{\infty}\beta^t \log \frac{\widehat{c}_{i,t}}{(\widehat{\mu}_{ii,h})^{\nu}(\widehat{\psi}^{0}_{nn,h})^{\chi}}$$

C Dot Algebra

I collect all equilibrium equations and rewrite them in exponential notations. In particular, let $\widetilde{v}^{js}_{i,t} = \exp(V^{js}_{i,t})$, $\widetilde{f}^{j}_{i,t} = \exp(f^{j}_{i,t})$, $\widetilde{u}_{i,t} = \exp(U_{i,t})$, and $\widetilde{m}_{in,t} = \exp(m_{in,t})$. The following system of equations characterizes the baseline economy where $\dot{x}_{t+1} \equiv \frac{x_{t+1}}{x_t}$.

$$\dot{v}^{j\text{III}}_{i,t} = \dot{\mathcal{T}}^{\text{III}}_{i,t} \left(\frac{\dot{\pi}^{j}_{i,t}}{\dot{P}_{i,t}} \right) \left[\varsigma^{j\text{III}}_{i,t-1} \left(\dot{v}^{j\text{III}}_{i,t+1} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\text{III}}_{i,t-1}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.1}$$

$$\dot{v}^{j\text{II}}_{i,t} = \dot{\mathcal{T}}^{\text{II}}_{i,t} \left(\frac{\dot{\pi}^{j}_{i,t}}{\dot{P}_{i,t}} \right) \left[\varsigma^{j\text{II}}_{i,t-1} \left(\dot{v}^{j\text{III}}_{i,t+1} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\text{II}}_{i,t-1}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.2}$$

$$\dot{v}^{j\text{I}}_{i,t} = \dot{\mathcal{T}}^{\text{I}}_{i,t} \left(\frac{\dot{\pi}^{j}_{i,t}}{\dot{P}_{i,t}} \right) \left[\varsigma^{j\text{I}}_{i,t-1} \left(\dot{v}^{j\text{II}}_{i,t+1} \right)^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\text{I}}_{i,t-1}) \left(\dot{u}_{i,t+1} \right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.3}$$

$$\dot{v}^{jO}_{i,t} = \left[\sum_{n=1}^{N} \psi^{j}_{n,t-1} \left(\dot{v}^{j\text{I}}_{n,t+1} \right)^{\frac{\beta}{\chi}} \right]^{\chi} \tag{C.4}$$

$$\dot{u}_{i,t} = \frac{\dot{w}_{i,t}}{\dot{P}_{i,t}} \left(\sum_{n=1}^{N} \mu_{in,t-1} (\dot{u}_{n,t+1})^{\frac{\beta}{\nu}} \right)^{\nu} \tag{C.5}$$

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

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

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

$$\psi^{j}_{i,t} = \frac{\psi^{j}_{i,t-1} \left(\dot{v}^{j\text{I}}_{i,t+1} \right)^{\frac{\beta}{\chi}}}{\sum_{n=1}^{N} \psi^{j}_{n,t-1} \left(\dot{v}^{j\text{I}}_{n,t+1} \right)^{\frac{\beta}{\chi}}} \tag{C.9}$$

$$\dot{\Psi}^{j}_{t} = \frac{\Psi^{j}_{t-1} \left(\dot{v}^{jO}_{t+1} \right)^{\beta/\eta}}{\sum_{k} \Psi^{k}_{t-1} \left(\dot{v}^{jO}_{t+1} \right)^{\beta/\eta}} \tag{C.10}$$

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

Evolution

$$(\dot{\underline{\phi}}_{i,t})^{\beta} = \left(\sum_n \mu_{in,t-1}(\dot{u}_{n,t+1})^{\frac{\beta}{\nu}}\right)^{\nu} \left(\sum_j \Psi^j_{t-1}\left(\sum_n \psi^j_{n,t}(\dot{v}^{j\mathrm{I}}_{n,t+2})^{\frac{\beta}{\chi}}\right)^{\frac{\beta}{\eta}\chi}\right)^{-\eta} \tag{C.12}$$

$$L_{i,t+1} = \sum_{n=1}^{N} \mu_{ni,t}(1-(1-\exp(-\underline{\phi}_{i,t}^{-\vartheta}))\iota)L_{n,t} + \sum_{j=1}^{J}\sum_{s\in\{\mathrm{I,II,III}\}} \left(1-\varsigma^{js}_{i,t}\right)E^{js}_{i,t} \tag{C.13}$$

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

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

$$E^{j\mathrm{I}}_{i,t+1} = \psi^j_{i,t}E^j_t \tag{C.16}$$

$$E^j_t = \sum_n \Psi^j_t\left(1-\exp(-\underline{\phi}_{i,t}^{-\vartheta})\right)\iota L_{i,t} \tag{C.17}$$

Temporary equilibrium

$$\dot{P}^j_{i,t+1} = \left(\sum_n \lambda^j_{ni,t}\dot{E}^j_{n,t+1}\left(\dot{p}^j_{ni,t+1}\right)^{1-\sigma}\right)^{1/(1-\sigma)} \tag{C.18}$$

$$\dot{K}_{i,t+1} = \beta(q_{i,t}/P_{i,t} + (1-\delta_i)); \tag{C.19}$$

$$\dot{P}_{i,t+1} = \prod_{j=1}^{J}(\dot{P}^j_{i,t+1})^{\alpha^j} \tag{C.20}$$

$$\dot{p}^j_{in,t+1} = \dot{x}^j_{i,t+1} = (\dot{w}_{i,t+1})^{\xi^j}(\dot{q}_{i,t+1})^{1-\xi^j} \tag{C.21}$$

$$\dot{\lambda}^j_{in,t+1} = \dot{E}^j_{i,t+1}\left(\frac{\dot{p}^j_{in,t+1}}{\dot{P}^j_{n,t+1}}\right)^{1-\sigma} \tag{C.22}$$

$$\pi^j_{i,t+1} = \frac{1}{\sigma}\sum_{n=1}^{N}(\dot{x}^j_{i,t+1})^{1-\sigma}(\dot{P}^j_{n,t+1})^{\sigma-1}\frac{\lambda^j_{in,t}}{E^j_{i,t}}\alpha^j\Pi_{n,t+1} \tag{C.23}$$

$$\Pi_{i,t+1} = \sum_{j=1}^{J}\dot{w}_{i,t+1}w_{i,t}\dot{L}^j_{i,t+1}L^j_{i,t} + \dot{q}_{i,t+1}\dot{K}^j_{i,t+1}q_{i,t}K^j_{i,t} + \dot{E}^j_{i,t+1}E^j_{i,t}\dot{\pi}^j_{i,t+1}\pi^j_{i,t} \tag{C.24}$$

$$\dot{w}_{i,t+1}\dot{L}^j_{i,t+1}w_{i,t}L^j_t = \xi^j\frac{\sigma-1}{\sigma}\sum_{n=1}^{N}\dot{\lambda}^j_{in,t+1}\lambda^j_{in,t}\dot{X}^j_{n,t+1}X^j_{n,t} \tag{C.25}$$

Worker's value in dot algebra: Let's start with the value of the household in changes (C.5). Recalling the value of a household that works in location i from (5), and taking the ratio $\dot{u}_{i,t+1} \equiv \frac{\widetilde{u}_{i,t+1}}{\widetilde{u}_{i,t}}$ yields

$$\dot{u}_{i,t+1} = \frac{\dot{w}_{i,t+1}}{\dot{P}_{i,t+1}}\left[\frac{\sum_{n=1}^{N}(\widetilde{u}_{n,t+2})^{\frac{\beta}{\nu}}(\widetilde{m}_{in,t+1})^{\frac{-1}{\nu}}}{\sum_{n=1}^{N}(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}}(\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}\right]^{\nu}$$

The second fraction on the right-hand side can be written as

$$\frac{\sum_n (\widetilde{u}_{n,t+2})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t+1})^{\frac{-1}{\nu}}}{\sum_n (\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}} = \sum_n \frac{(\widetilde{u}_{n,t+2})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t+1})^{\frac{-1}{\nu}}}{\sum_c (\widetilde{u}_{c,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t})^{\frac{-1}{\rho\nu}}} \frac{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}$$
$$= \sum_n \mu_{in,t} \left(\dot{u}_{n,t+2}\right)^{\frac{\beta}{\nu}}$$

where the last line assumes no future changes in migration costs. Thus, we have derived (C.5).

Next, recalling the share of workers that move between i and n (**??**)

$$\mu_{in,t} = \frac{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}{\sum_{c=1}^{N} (\widetilde{u}_{c,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t})^{\frac{-1}{\nu}}}$$

Multiplying both the numerator and denominator by $(\widetilde{u}_{n,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t-1})^{\frac{-1}{\nu}} \sum_{c=1}^{N} (\widetilde{u}_{c,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t-1})^{\frac{-1}{\nu}}$ yields

$$\mu_{in,t} = \frac{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}{\sum_{c=1}^{N} \frac{(\widetilde{u}_{c,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t})^{\frac{-1}{\nu}}}{\sum_{c=1}^{N} (\widetilde{u}_{c,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t-1})^{\frac{-1}{\nu}}}} \frac{(\widetilde{u}_{n,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t-1})^{\frac{-1}{\nu}}}{(\widetilde{u}_{n,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t-1})^{\frac{-1}{\nu}}} \frac{1}{\sum_{c=1}^{N} (\widetilde{u}_{c,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t-1})^{\frac{-1}{\nu}}}$$

Thus,

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

which is (C.11).

Firm's Location Choice The value of being an old entrepreneur (15) in time changes is given by

$$\dot{v}_{i,t+1}^{j\mathrm{III}} = \dot{T}_{i,t+1}^{\mathrm{III}} \frac{\dot{\pi}_{i,t+1}^{j}}{\dot{P}_{i,t+1}} \left(\frac{(\widetilde{v}_{i,t+1}^{j\mathrm{III}})^{\frac{\beta}{\chi}} + (\widetilde{u}_{i,t+1})^{\frac{\beta}{\chi}}}{(\widetilde{v}_{i,t}^{j\mathrm{III}})^{\frac{\beta}{\chi}} + (\widetilde{u}_{i,t})^{\frac{\beta}{\chi}}} \right)^{\chi}.$$

where $\mathcal{T}_{i,t}^{a}$ denotes the net profit rate $(1 - \tau_{i,t}^{a})$. Equivalently,

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

Similarly, the value of a firm s-years old (16), where $s \in \{\mathrm{I}, \mathrm{II}, \mathrm{III}\}$, in time difference is given by (C.2) and (C.3)

Since talent is fixed over time, the value of an informal entrepreneur (**??**) in time differences is constant across talent type ϕ and is given by

$$\dot{v}^{jO}_{t+1} = \left[\frac{\sum_n (\widetilde{f}^{j}_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}}{\sum_n (\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}\right]^{\chi} = \left[\frac{\sum_n (\widetilde{f}^{j}_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} \frac{(\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}{(\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}}{\sum_n (\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}\right]^{\chi}$$

$$= \left[\frac{\sum_n \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} (\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}{\sum_n (\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}\right]^{\chi} = \left[\sum_n \psi^{j}_{n,t} \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}\right]^{\chi}$$

where the last equation follows from (6), thus, I get (C.4).

Recall the fraction of I entrepreneurs that stays in ij (17)

$$\varsigma^{j\mathrm{I}}_{i,t+1} = \frac{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}} = \frac{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \frac{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}}{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \frac{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}} = \frac{\left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}}$$

Dividing the numerator and denominator by $(\widetilde{v}^{js+1}_{i,t+1})^{\frac{\beta}{\chi}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}$ yields

$$\varsigma^{ij}_{a,t+1} = \frac{\varsigma^{ij}_{a,t} \left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\varsigma^{ij}_{a,t} \left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{ij}_{a,t})\widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}},$$

which is (C.8).

Similarly, the fraction of informal entrepreneurs that enter i (6) is given by

$$\psi^{j}_{i,t+1} = \frac{(\widetilde{f}^{j}_{i,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\sum_n (\widetilde{f}^{j}_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}} = \frac{(\widetilde{f}^{j}_{i,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}} \frac{(\widetilde{f}^{j}_{i,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{(\widetilde{f}^{j}_{i,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}}{\sum_n (\widetilde{f}^{j}_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} \frac{(\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}{(\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}}$$

$$= \frac{\left(\dot{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}} (\widetilde{f}^{j}_{i,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\sum_n \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} (\widetilde{f}^{j}_{n,t})^{\frac{-1}{\chi}} (\widetilde{v}^{j\mathrm{I}}_{n,t+1})^{\frac{\beta}{\chi}}}$$

Thus,

$$\psi^{j}_{i,t+1} = \frac{\psi^{j}_{i,t} \left(\dot{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\sum_{n=1}^{N} \psi^{j}_{n,t} \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}},$$

which is (C.9).

The sectoral choice of households that choose to be entrepreneurs (**??**)

$$\dot{\Psi}_t^j = \frac{\Psi_{t-1}^j \left(\dot{v}_{t+1}^{jO}\right)^{\beta/\eta}}{\sum_k \Psi_{t-1}^k \left(\dot{v}_{t+1}^{jO}\right)^{\beta/\eta}}.$$

Occupation choice in changes The talent cut-off from (**??**) can be written as

$$\begin{aligned}\beta \log(\underline{\phi}_{i,t}) = \nu \log \left[\sum_{n \in \mathcal{R}} \exp\left(\beta U_{n,t+1} - m_{in,t}\right)^{1/\nu}\right] \\ - \eta \log \left[\sum_{j=1}^{J} \left[\sum_{n=1}^{N} \exp\left(\beta V_{n,t+2}^{j\mathrm{I}} - f_{n,t+1}^j\right)^{1/\chi}\right]^{\frac{\beta}{\eta}\chi}\right].\end{aligned}$$

Taking the dot ratio

$$(\dot{\underline{\phi}}_{i,t})^\beta = \left(\frac{\sum_n \widetilde{u}_{n,t+1}^{\frac{\beta}{\nu}} \widetilde{m}_{in,t}^{\frac{-1}{\nu}}}{\sum_n \widetilde{u}_{n,t}^{\frac{\beta}{\nu}} \widetilde{m}_{in,t-1}^{\frac{-1}{\nu}}}\right)^\nu \left(\frac{\sum_j \left(\sum_n \left(\widetilde{v}_{n,t+2}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t+1}^j\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\sum_j \left(\sum_n \left(\widetilde{v}_{n,t+1}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^j\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}\right)^{-\eta}$$

Consider

$$\begin{aligned}\sum_j \frac{\left(\sum_n \left(\widetilde{v}_{n,t+2}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t+1}^j\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\sum_k \left(\sum_n \left(\widetilde{v}_{n,t+1}^{kY}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^k\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}} &= \sum_j \frac{\left(\sum_n \left(\widetilde{v}_{n,t+1}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^j\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\sum_k \left(\sum_n \left(\widetilde{v}_{n,t+1}^{kY}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^k\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}} \frac{\left(\sum_n \left(\widetilde{v}_{n,t+2}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t+1}^j\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\left(\sum_n \left(\widetilde{v}_{n,t+1}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^j\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}} \\ &= \sum_j \Psi_{t-1}^j \left(\sum_n \psi_{n,t}^j (\dot{v}_{n,t+2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}\right)^{\frac{\beta}{\eta}\chi}\end{aligned}$$

Recall (**??**)

$$\Psi_t^j = \frac{(\widetilde{v}_{t+1}^{jO})^{\beta/\eta}}{\sum_k (\widetilde{v}_{t+1}^{kI})^{\beta/\eta}} = \frac{\left(\sum_n (\widetilde{v}_{n,t+2}^{j\mathrm{I}})^{\beta/\chi} (\widetilde{f}_{n,t+1}^j)^{-1/\chi}\right)^{\chi\beta/\eta}}{\sum_k (\widetilde{v}_{t+1}^{kI})^{\beta/\eta}}$$

Thus, the cut-off in time changes is given by

$$(\dot{\underline{\phi}}_{i,t})^\beta = \left(\sum_n \mu_{in,t-1} (\dot{u}_{n,t+1})^{\frac{\beta}{\nu}}\right)^\nu \left(\sum_j \Psi_{t-1}^j \left(\sum_n \psi_{n,t}^j (\dot{v}_{n,t+2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}\right)^{\frac{\beta}{\eta}\chi}\right)^{-\eta}$$

C.1 Temporary equilibrium equations in changes

The sectoral price index from (3) in changes is given by

$$\dot{P}^j_{i,t+1} = \frac{\left(\sum_n E^j_{n,t+1}(p^j_{ni,t+1})^{1-\sigma}\right)^{1/(1-\sigma)}}{P^j_{i,t}} = \frac{1}{P^j_{i,t}}\left(\sum_n \dot{E}^j_{n,t+1}E^j_{n,t}\left(\dot{p}^j_{ni,t+1}p^j_{ni,t}\right)^{1-\sigma}\right)^{1/(1-\sigma)}$$

Since $\lambda^j_{ni,t} = E^j_{n,t}(p^j_{ni,t}/P^j_{i,t})^{1-\sigma}$, I have

$$\dot{P}^j_{i,t+1} = \left(\sum_n \lambda^j_{ni,t}\dot{E}^j_{n,t+1}\left(\dot{p}^j_{ni,t+1}\right)^{1-\sigma}\right)^{1/(1-\sigma)}$$

I copy the pricing equation (13) for reference

$$p^j_{ni,t} = \frac{\sigma}{\sigma-1}\frac{d^j_{ni}x^j_{n,t}}{A^j_{n,t}} = \frac{\sigma}{\sigma-1}\frac{(\text{distance}_{ni})^{\kappa^j}B^j(w_{n,t})^{\xi}(q_{n,t})^{1-\xi^j}}{A^j_{n,t}}$$

where each component is either estimated in Section 5 or recovered from data.

Recall (12)

$$\dot{q}_{i,t+1} = \frac{\dot{w}_{i,t+1}}{\dot{K}_{i,t+1}}\frac{\sum_j \frac{1-\xi^j}{\xi^j}L^j_{i,t+1}}{\sum_j \frac{1-\xi^j}{\xi^j}L^j_{i,t}},$$

so I can solve for the new user's cost $q_{i,t+1}$. Thus, the price of intermediate goods (13) in changes is given by

$$\dot{p}^j_{in,t+1} = \dot{x}^j_{i,t+1} = (\dot{w}_{i,t+1})^{\xi^j}(\dot{q}_{i,t+1})^{1-\xi^j}$$

The last equality follows the assumption that TFP stays constant from time t and the cost of the input bundle (11) in changes.

The change in aggregate bilateral expenditure shares (24)

$$\dot{\lambda}^j_{in,t+1} = \dot{E}^j_{i,t+1}\left(\frac{\dot{p}^j_{in,t+1}}{\dot{P}^j_{n,t+1}}\right)^{1-\sigma}$$

The revenue function from selling to nj in changes is given by

$$\dot{\pi}^j_{in,t+1} = (\dot{x}^j_{i,t+1})^{1-\sigma}\dot{X}^j_{n,t+1}(\dot{P}^j_{n,t+1})^{\sigma-1}$$

The total profit (14) from selling everywhere in the next period becomes

$$\pi^j_{i,t+1} = \frac{1}{\sigma}\sum_{n=1}^{N}\pi^j_{in,t}\dot{\pi}^j_{in,t+1}$$

Using $\pi^j_{in,t} = \lambda^j_{in,t}\frac{X^j_{n,t}}{E^j_{i,t}} = \left(\frac{p^j_{in,t}}{P^j_{n,t}}\right)^{1-\sigma} X^j_{n,t}$ yields

$$\pi^j_{i,t+1} = \frac{1}{\sigma}\sum_{n=1}^{N} \dot{\pi}^j_{in,t+1}\frac{\lambda^j_{in,t}}{E^j_{i,t}}X^j_{n,t}$$

Total income (25) in changes is given by

$$\Pi_{i,t+1} = \sum_{j=1}^{J} \dot{w}_{i,t+1}w_{i,t}\dot{L}^j_{i,t+1}L^j_{i,t} + \dot{q}_{i,t+1}\dot{K}_{i,t+1}q^j_{i,t}K^j_{i,t} + \dot{E}^j_{i,t+1}E^j_{i,t+1}\pi^j_{i,t+1}$$

Substituting the expression of profits yields

$$\Pi_{i,t+1} = \sum_{j=1}^{J} \dot{w}_{i,t+1}w_{i,t}\dot{L}^j_{i,t+1}L^j_{i,t} + \dot{q}_{i,t+1}\dot{K}_{i,t+1}q^j_{i,t}K^j_{i,t} + \dot{E}^j_{i,t+1}E^j_{i,t+1}\frac{1}{\sigma}\sum_{n}\left(\frac{x^j_{i,t+1}}{P^j_{n,t+1}}\right)^{1-\sigma}\alpha^j\Pi_{i,t+1}$$

Thus, expenditure shares (26) in changes is given by

$$\dot{X}^j_{i,t+1} = \dot{\Pi}_{i,t+1}$$

The labor market clearing condition in changes (27)

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

C.2 Algorithm for dot algebra

1. The program starts at $t = 3$ corresponding to 2015. Guess a set of paths of values for old entrepreneurs and workers

$$\mathbf{V}^0 \equiv \left\{\dot{v}^{j\mathrm{III}}_{i,t+1}; \dot{u}_{i,t+1}\right\}_{t=4}^{T}$$

where the superscript 0 indicates a guess. All paths converge to 1 for a sufficiently large T.

2. Build the sequences of flows for $t = 3, \ldots, T$: The guess $\mathbf{V}^0$ yields real profits $\frac{\dot{\pi}^j_{i,t}}{\dot{P}_{i,t}}$ using (C.1) and flows $\varsigma^{j\mathrm{II}}_{i,t}$ using (C.7). Then, (C.2) gives $\dot{v}^{j\mathrm{II}}_{i,t}$ which gives $\varsigma^{j\mathrm{I}}_{i,t}$ based on (C.8). Thus, (C.3) gives $\dot{v}^{j\mathrm{I}}_{i,t}$ resulting in the entry shares $\psi^j_{i,t}$ based on (C.9).

3. Build the migration shares $\mu_{in,t}$ from (C.11), and the talent cutoffs $\dot{\underline{\phi}}^j_{i,t}$ using (C.12).

4. Compute the measures of workers $L_{i,t+1}$ using , the measure of III entrepreneurs $E^{j\text{III}}_{i,t+1}$ from (18) the measure of II and the measure of I entrepreneurs from (20).

5. Solve for temporary equilibrium for each $t \geq 4$

   (a) Guess wages $\dot{w}_{i,t+1}$

   (b) Compute $\dot{K}^j_{i,t+1}$ and using (C.19)

   (c) Compute $\dot{x}^j_{i,t}$ using (C.21)

   (d) Compute $\dot{P}^j_{i,t+1}$ using (C.18), $\dot{\lambda}^j_{i,t+1}$ using (C.22)

   (e) Compute $\Pi_{i,t+1}$ using (C.24).

   (f) Compute new pre-tax profits using (C.23).

   (g) Solve for new wages using market clearing condition (C.25).

   (h) Update wages until convergence.

6. Update $\mathbf{V}$ using (C.1) and (C.5) until convergence.

D Dynamic Hat Algebra

I use the usual hat notation $\widehat{x} = \frac{x'}{x}$ where x' represents a variable in a counterfactual economy and x represents the same variable in the baseline economy. I can derive the following conditions similar to the algebra in 1.

Value functions

$$\widehat{v}^{jIII}_{i,t} = \frac{(1-{\tau'}^{III}_{i,t})}{(1-\tau^{rom3}_{i,t})}\frac{\widehat{\pi}^{j}_{i,t}}{\widehat{P}_{i,t}}\left[\varsigma^{jIII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}+(1-\varsigma^{jIII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}\right]^{\chi} \tag{D.1}$$

$$\widehat{v}^{jII}_{i,t} = \frac{(1-{\tau'}^{II}_{i,t})}{(1-\tau^{II}_{i,t})}\frac{\widehat{\pi}^{j}_{i,t}}{\widehat{P}_{i,t}}\left[\varsigma^{jII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}+(1-\varsigma^{jII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}\right]^{\chi} \tag{D.2}$$

$$\widehat{v}^{jI}_{i,t} = \frac{(1-{\tau'}_{i,t}I)}{(1-\tau_{i,t}I)}\frac{\widehat{\pi}^{j}_{i,t}}{\widehat{P}_{i,t}}\left[\varsigma^{jI}_{i,t}\left(\widehat{v}^{jII}_{i,t+1}\right)^{\frac{\beta}{\chi}}+(1-\varsigma^{jI}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}\right]^{\chi} \tag{D.3}$$

$$\widehat{v}^{j\text{O}}_{i,t} = \left[\sum_{n=1}^{N}\psi^{j}_{n,t}(\widehat{v}^{jI}_{n,t+1})^{\frac{\beta}{\chi}}\right]^{\chi} \tag{D.4}$$

$$\widehat{u}_{i,t} = \frac{\widehat{w}_{i,t}}{\widehat{P}_{i,t}}\left[\sum_{n=1}^{N}\mu_{in,t}\widehat{m}^{\frac{-1}{\nu}}_{in,t}\widehat{u}^{\frac{\beta}{\nu}}_{n,t+1}\right]^{\nu} \tag{D.5}$$

$$\widehat{\varsigma}^{jIII}_{i,t} = \frac{\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{jIII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}+(1-\varsigma^{jIII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}} \tag{D.6}$$

$$\widehat{\varsigma}^{jII}_{i,t} = \frac{\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{jII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}+(1-\varsigma^{jII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}} \tag{D.7}$$

$$\widehat{\varsigma}^{jI}_{i,t} = \frac{\left(\widehat{v}^{jII}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{jI}_{i,t}\left(\widehat{v}^{jII}_{i,t+1}\right)^{\frac{\beta}{\chi}}+(1-\varsigma^{jI}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}} \tag{D.8}$$

$$\widehat{\psi}^{j}_{i,t} = \frac{\widehat{f}^{j}_{i,t+1}\left(\widehat{v}^{jI}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\sum_{n=1}^{N}\widehat{f}^{j}_{n,t+1}\left(\widehat{v}^{jI}_{n,t+1}\right)^{\frac{\beta}{\chi}}\psi^{j}_{n,t}} \tag{D.9}$$

$$\widehat{\Psi}^{j}_{t} = \frac{\left(\widehat{v}^{j\text{O}}_{t+1}\right)^{\beta/\eta_S}}{\sum_k \Psi^{k}_{t}\left(\widehat{v}_{t+1}\right)^{\beta/\eta_S}} \tag{D.10}$$

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

Law of motions

$$(\widehat{\underline{\phi}}_{i,t})^{\beta} = \left[\sum_{n=1}^{N} \widehat{m}_{in,t}^{\frac{-1}{\nu}} \mu_{in,t} (\widehat{u}_{n,t+1})^{\beta/\nu}\right]^{\nu} \left[\sum_{j=1}^{J} \Psi_t^j \left(\sum_n \psi_{n,t+1}^j \left(\widehat{v}_{n,t+2}^{jI}\right)^{\frac{\beta}{\chi}}\right)^{\frac{\frac{\beta}{\eta_S}}{\chi}\chi}\right]^{-\eta_S}$$

$$L'_{i,t+1} = \sum_{n=1}^{N} \widehat{\mu}_{ni,t} \mu_{ni,t} \left(1 - \left(1 - \exp\left(-\widehat{\underline{\phi}}_{i,t} \underline{\phi}_{i,t}\right)^{-\vartheta}\right) \iota\right) \widehat{L}_{n,t} L_{n,t} + \sum_{s \in \{I,II,III\}} \sum_{j=1}^{J} (1 - \widehat{\varsigma}_{i,t}^{js} \varsigma_{i,t}^{js}) \widehat{E}_{i,t}^{js} E_{i,t}^{js}$$

$$E'^{jIII}_{i,t+1} = \widehat{\varsigma}_{i,t}^{jIII} \varsigma_{i,t}^{jIII} \widehat{E}_{i,t}^{jIII} E_{i,t}^{jIII} + \widehat{\varsigma}_{i,t}^{jII} \varsigma_{i,t}^{jII} \widehat{E}_{i,t}^{jII} E_{i,t}^{jII}$$

$$E'^{jII}_{i,t+1} = \widehat{\varsigma}_{i,t}^{jI} \varsigma_{i,t}^{jI} \widehat{E}_{i,t}^{jI} E_{i,t}^{jI}$$

$$E'^{jI}_{i,t+1} = \widehat{\psi}_{i,t}^j \psi_{i,t}^j \sum_{n=1}^{N} \widehat{\Psi}_t^j \Psi_t^j \left(1 - \exp\left(-\widehat{\underline{\phi}}_{i,t} \underline{\phi}_{i,t}\right)^{-\vartheta}\right) \iota \widehat{L}_{i,t} L_{i,t}$$

$$K'_{i,t+1} = \beta \left(\frac{\sum_j \frac{1-\xi^j}{\xi^j} \widehat{w}_{i,t} \widehat{L}_{i,t}^j w_{i,t} L_{i,t}^j}{\widehat{K}_{i,t} K_{i,t} \widehat{P}_{i,t} P_{i,t}} + (1-\delta)\right) \widehat{K}_{i,t} K_{i,t}$$

Temporary equilibrium

$$\widehat{P}_{i,t}^j = \left(\sum_n \lambda_{ni,t}^j \widehat{E}_{n,t}^j (\widehat{p}_{ni,t}^j)^{1-\sigma}\right)^{1/(1-\sigma)} \tag{D.12}$$

$$\widehat{p}_{ni,t}^j = \widehat{x}_{n,t}^j = (\widehat{w}_{n,t})^{\xi^j} (\widehat{q}_{n,t})^{1-\xi^j} \tag{D.13}$$

$$\widehat{q}_{i,t} = \widehat{w}_{i,t} \frac{\widehat{L}_{i,t}}{\widehat{K}_{i,t}} \tag{D.14}$$

$$\widehat{\lambda}_{in,t}^j = \widehat{E}_{i,t}^j (\widehat{x}_{i,t}^j)^{1-\sigma} (\widehat{P}_{n,t}^j)^{\sigma-1} \tag{D.15}$$

$$\pi'^j_{i,t} = \frac{1}{\sigma} \sum_{n=1}^{N} \frac{\lambda_{in,t}^j}{E_{i,t}^j} \left(\frac{\widehat{p}_{in,t}^j}{\widehat{P}_{n,t}^j}\right)^{1-\sigma} \alpha^j I'_{n,t} \tag{D.16}$$

$$I'_{i,t} = \widehat{w}_{i,t} w_{i,t} \widehat{L}_{i,t} L_{i,t} + \widehat{q}_{i,t} q_{i,t} \widehat{K}_{i,t} K_{i,t} + \sum_{j=1}^{J} \widehat{E}_{i,t}^j E_{i,t}^j \widehat{\pi}_{i,t}^j \pi_{i,t}^j \tag{D.17}$$

$$\widehat{w}_{i,t} \widehat{L}_{i,t}^j w_{i,t} L_{i,t}^j = \xi^j \frac{\sigma - 1}{\sigma} \sum_{n=1}^{N} \lambda_{in,t}^j \widehat{\lambda}_{in,t}^j X'^j_{n,t} \tag{D.18}$$

E Estimation appendix

E.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 6.

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:

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

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

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

Column (1) of Table A5 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 (E.2) is by considering two cases of i.

Case 1: $i \in A^*$. Assumption (E.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 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

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

Table A5: 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.

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 A5 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 (E.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 (E.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 3b. 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 A5 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 6. In fact, the comparison between two means is akin to running a regression of the type (E.3) and using the flows RR as the control instead of A^*R. Column (3) of Table A5 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 6 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

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

E.2 Distance elasticity

Figure A8: 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.

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