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Abstract

South Africa's labor market exhibits a unique equilibrium with one of the highest unemployment rates in the world and yet a low level of informal employment. The unemployment rate has remained high and persistent over recent decades, in spite of the formal demise of the apartheid regime and subsequent transition to democracy in 1994. This paper uses a matching model of the labor market to argue that spatial considerations combined with low productivity of informal work may be responsible for such an outcome. Spatial dispersion inherited from the apartheid regime thins the labor market, creating exclusion and perpetuating spatial segregation. In most developing countries, the result would be higher employment in informal or own account employment. However, with low productivity in the informal sector, the high rate of exclusion shows itself in higher unemployment rates instead. Transportation costs and housing deregulation may become key factors in improving the working of the labor market in South Africa especially if it is not possible to raise informal productivity.

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1 Introduction

South Africa's unemployment rate stands out among emerging economies as does it low levels of informal employment. This high and persistent unemployment in South Africa has been a puzzle to researchers for a long time. Why doesn't unemployment decrease over time? Why does the labor market persist in this situation?

There are many possible explanations for this puzzle which we briefly review in section 2. In this paper, we want to present one specific argument (though we are quick to stress that this does not preclude the other explanations): the role of geographical dispersion combined with low informal sector productivity.

For historical reasons, South Africa has a spread out occupation of land. Apartheid policies created spatial structures in both urban and rural areas with low density. These policies separated people (especially Africans) from areas of economic opportunity. In addition, after apartheid, a key policy, after decades of exclusion, was to find a way for people to own their home, their plot, and their place. But such reparation, rather than in dense urban areas, was focused on home ownership. This, in turn, required an extensive sprawl. This sprawl, which in practice implies high costs of transportation, has become an essential factor in the workings of the South African labor market.

This paper argues that this segmentation has significant implications on the labor market, making it thinner and perpetuating segmentation and divergence in employment and wages. The main mechanism is that the geographical sprawl makes jobs less attractive to workers (because transport cost takes a large share of their income). Thus, to induce workers to participate, firms must offer higher wages that at least partially offset transport costs. This makes it less attractive for firms to post vacancies in non-dense areas where transport costs are higher. The resulting equilibrium is one of low employment rates and high unemployment, without an incentive for firms to move to the areas where workers are.

Extending the framework to include informal activities means that if transport costs are high enough, employment shifts from the formal sector to the informal one. However, the extent to which this happens depends not just on the size of transport costs but also on the productivity or viability of informal work. In other developing countries, informal work is more viable and therefore high transport costs result in those that are shut out of formal work turning to informal options. In the case of South Africa, low informal productivity might mean that high transport costs result in high unemployment. This is because at such low levels of informal productivity (itself perhaps a function of sprawl) searching for ow probability formal work is still the more rational choice.

The paper is organized as follows. Section 2 provides a brief review of the literature.

In section 3, we provide some empirical findings that relate transportation costs to labor outcomes in South Africa. We show how transport costs are a large wedge for labor markets in South Africa and a regressive one. This wedge creates segmentation across and within regions in South Africa.

Section 4 uses a basic search and matching model of the labor market that includes transportation costs to tell our story. We first build and simulate the model without informal home production to show the basic dynamics of how transport costs can act as a wedge in the labor market. Then we add in home production to show how such a model can explain the large informal sectors we see in many developing countries. Lastly, we show how in this version of the model, low informal sector productivity generates the type of equilibrium we think is occurring in South Africa.

In section 5, we use the model to discuss some policy initiatives. In particular we study 4 policies: a change in transport costs, transport subsidies, an improvement in matching technologies (job fairs and marketplaces), unemployment compensation, basic income grant and changes in union power. For all of these, we estimate the impact on the equilibrium employment, unemployment, wages, and the value of participating in the formal labor market.

We conclude that high transportation costs create real frictions in the labor market and that in the case of South Africa are made worse because of low productivity in the informal sector. To resolve its labor market issues, South Africa needs to reduce these frictions and not just subsidize their costs. Policies that increase population density near centers of economic activity or create cheaper forms of transport may bring down the barriers that today keep labor markets segmented and exclusion levels very high in specific areas.

2 Five stories for unemployment

We first briefly review five different stories for South Africa's high unemployment rate.

Our first story is that recorded unemployment may be the result of measurement issues. While the methodology for computing unemployment in South African labor force surveys is standard, two factors can have an impact on the number. First, subsistence farming is not considered as part of the labor force. About 1.5 millions workers are thus considered out of the labor force that would be in the labor force in comparable countries (see Shah 2022). As a comparison, including these workers into the labor force would increase the employment rate to 47% from 42% (and decrease the broad unemployment rate to 33% from 36%), making the landscape of South Africa's labor market slightly more comparable to that of other countries. The second reason for mis-measurement, may be the extent of social support in South Africa which may bias respondents in the informal market to answer that they are unemployed in order to avoid risking such social support. This would imply that what in South Africa counts as unemployed in other countries would be counted as employed informal workers. Still, even with generous assumptions around the size of these measurement issues, the data would still leave South Africa with an anomalously high level of unemployment (see Shah 2022).

A second interpretation focuses on the role of high levels of unionization and strict labor laws. According to this view, collective bargaining increases the real wage reducing formal employment. Magruder 2012 looks at spatial discontinuities in the enforcement of centralised bargaining agreements. Using a database of bargaining council agreements at the district level he finds big spatial discontinuities: having a centralised bargaining agreement in a particular industry in a specific town causes employment to be 8 to 15 per cent lower and wages to be 10 to 21 per cent higher than in the same industry in an uncovered neighbouring town. In addition there is some evidence that unionization may have reduced employment in certain sectors. Nattrass and Seekings 2019 describes in detail the case of textile workers in Port Elizabeth, where employment was precluded by high union wages. When workers organized in cooperatives, where, because they were all "owners" they could circumvent labor legislation, unions and courts managed to curtail the nascent activities. Bhorat, Kanbur, and Stanwix 2014, shows that minimum wage laws had a negative impact on employment for the agricultural sectors.

However, several reasons also suggest this is not a good interpretation of South Africa's high unemployment rate. While it is evident that unionization and labor laws have made employment more expensive, the formal employment rate of South Africa is pretty much in line with what is to be expected given it's income level (see Shah 2022). Shah 2022 also shows that despite evidence that nominal wages exhibit rigidity with respect to differences in productivity across areas of South Africa, non-employment rates and local real wages are not that different by productivity. In other words, employment outcomes do not seem to be very different in places where productivity is high versus where they are low despite wages being not that different in those places. This suggests that there is some flexibility in labor negotiations. [1]

Finally, a review of labor laws, does not allow the conclusion that South Africa over regulates the labor market, at least in comparison with other emerging economies. (See Shah 2022).

A third explanation has to do with the legacies of apartheid and long term inter-generational

[1]Boeri et al. 2019 shows that in Italy, unemployment results from labor queuing as real wages are higher in low productivity areas suggesting strong wage rigidity arising from national wide wage agreements. We don't find the same pattern in South Africa.

unemployment spells. Lochmann 2022 finds that labor markets that are closer to former homelands exhibit higher unemployment rates. One possible explanation is that areas closer to homelands were ”exposed” to the homelands, leaving a trace of exclusion that affects labor outcomes today. Magejo, Ntuli, and Mudiriza 2020 similarly finds that areas of former homelands continue to have higher rates of unemployment, though a large portion of this difference can be explained by differences in endowments and worker characteristics between regions.

A fourth explanation is lack of skills. Research by many have shown that unemployment rates differ in South Africa considerably by education level (Dias and Posel 2007 and Shah 2022). This is often used as evidence for there being a skills gap and this gap being a cause of high unemployment. Hofmeyr 2010 examines the link between social networks and ethnic occupational niches in manufacturing. Employing data from the 2001 census, at the district level, the author uses individuals' language groups as a proxy of social networks. The results show that English and Afrikaans individuals cluster in niches where monthly income and skill levels are relatively high.

Finally another common story is that the extent of social programs (e.g., the old-age pension or child support grant) combined with household income sharing has led to increases in the reservation wage, to the point that labor demand cannot produce sufficient jobs at that reservation wage leading to high unemployment. Studies have shown mixed results on the impacts of social grants on labor force participation. Some have shown that they can help entry into the labor force and promote migration (Ardington, Case, and Hosegood 2007). But a review of the evidence by Shah 2022 finds that social programs, at best, explain only a small part of the labor response for groups like women and elderly (see also Tondini 2019 and Abel 2013).

While we may discuss the quantitative power of each of these explanations, it is clear that all these stories are relevant. Here, however, we want to focus on the role of geographical dispersion and low density as an explanation of labor outcomes. In short we will produce a model with equilibrium unemployment, without resorting to subsidies that increase the reservation wage, where there are no skill differentials, where there are no unions nor cultural legacies. In short, we try to argue that these factors, while potentially important, are not strictly necessary to generate a labor market model that replicates the main features of the South African labor market.

It is obvious that the peculiar features of the south african labor market will need to be explained by a feature that is unique to south africa. Reservation wages or union strength can be particularly important, but they are present in other labor markets as well. Thus, unless we argue some special reason why these common causes generate such unusual outcome in

South Africa, we may need a more South African explanation. We think that the geographical dispersion with low density is a feature that is quite unique to the South African economy.

In short, we will show that a model with mobility costs and low informal productivity is sufficient to replicate the unique features of the South African labor markets. Once we do this we analyze the effect of transport costs, transport subsidies, income transfers and unions, within the context of a model with mobility costs.

3 The empirics of transportation and employment

3.1 Data

To establish some basic, stylized facts on transportation costs and employment, we use the second wave of the *National Income Dynamics Study* (NIDS) and the *National Household Travel Survey* (NHTS) 2020.

NHTS is a cross-sectional, nationally representative survey that asks detailed information about people's travel behavior. This data set gives extensive information about travel, times, distances, and modes of transport. However, the dataset does not contain as rich information on employment and wage outcomes. In addition, the data in its publicly available form does not allow for analysis below a province level.

NIDS is first nationally representative panel data set of individuals in South Africa. Till-date there have been 5 waves of the panel following 28,000 individuals in 7,300 households from 2008 (wave 1) to 2017 (wave 5).

The NIDS panel includes detailed information on household income, spending, employment outcomes, unemployment, and much more. The second round taken between 2010 and 2011 also contains detailed information on transportation times, distances, costs, and modes of transportation for peoples' primary occupation. In addition, we are able conduct analysis at the level of the 52 district councils in South Africa. It is this data that we use to examine some basic facts about transportation and its relationship with employment in South Africa.

The NIDS wave 2 data have three important variables related to transportation costs. First, it asks the employed the total direct cost they pay to get to their place of work. Second, it asks the distance that they must travel to get to work. Third, it asks the amount of time it takes for them to reach their place of work. Usually costs and time are correlated to distance, but the relationship could be ambiguous depending on the modes of transportation available to people. For example, extensive rail infrastructure in one area might mean that people are able to travel longer distances at a lower direct and time cost.

We must consider both the direct and time costs of transport. For example, in a place where the direct costs of transport are especially high (because of poor infrastructure), people are more likely to use modes of transport that have lower direct costs but higher time costs. We see this in data from the NHTS for 2020, where those that are poorer are more likely to walk to work, while those at the middle of the income distribution are more likely to take taxis, and those at the top end of the income distribution are more likely to use cars.

To consider both direct and time costs we calculate a measure of total transportation costs. First we take the direct costs listed in Rands and to this we add the product of time taken to work by the individual's hourly earnings. Hourly earnings are determined for each individual by dividing average weekly income (net of taxes) by the number of hours the person worked in a week. This method is equivalent to one used by Kerr 2017 for determining the implicit tax of transportation on earnings in South Africa, except that we use earnings net of taxes rather than gross earnings to better estimate time costs of travel.

3.2 Transport costs in South Africa

Transport costs for the employed in South Africa are high. For 2010, on average, we estimate the ratio of direct transport costs to net wages to be 17%, and total costs including time to commute to be 57% of net wages. These are similar (though slightly higher) than numbers estimated for 2003 in South Africa by Kerr 2017.

Furthermore, these costs are highly regressive. In general, transport costs represent a fixed cost which is similar to all people in an area based on density and local transportation infrastructure and options. As a result, transport costs tend to be a larger portion of the incomes of those that are poorest.

Figure 1 shows the average ratio of direct and total (i.e., including time costs) by quintiles of household income per capita. The lowest quintile saw direct transport costs of more than 37% of their after-tax income. Considering time as well, transport represented almost 85% of their after-tax income. Direct costs for the other quintiles are less than 20%. However, even for these quintiles, time costs are high and so total transport costs are a large portion of people's after-tax income. This is like a large tax on wage work in South Africa.

Similar to Kerr 2017, we also find that the effective "tax" on labor from transport costs also differs by the primary mode of transport used by commuters. Figure 2 shows the direct and time costs of transport by the mode of transport used.

Interestingly, the affordability of transport modes differ depending on whether we look at just direct costs or also consider total costs. By direct cost alone, trains and employee provided transport is less than taxis and motor vehicles. Buses are still more expensive but are comparable to taxis. However, once we factor in time costs, buses, trains, and employee

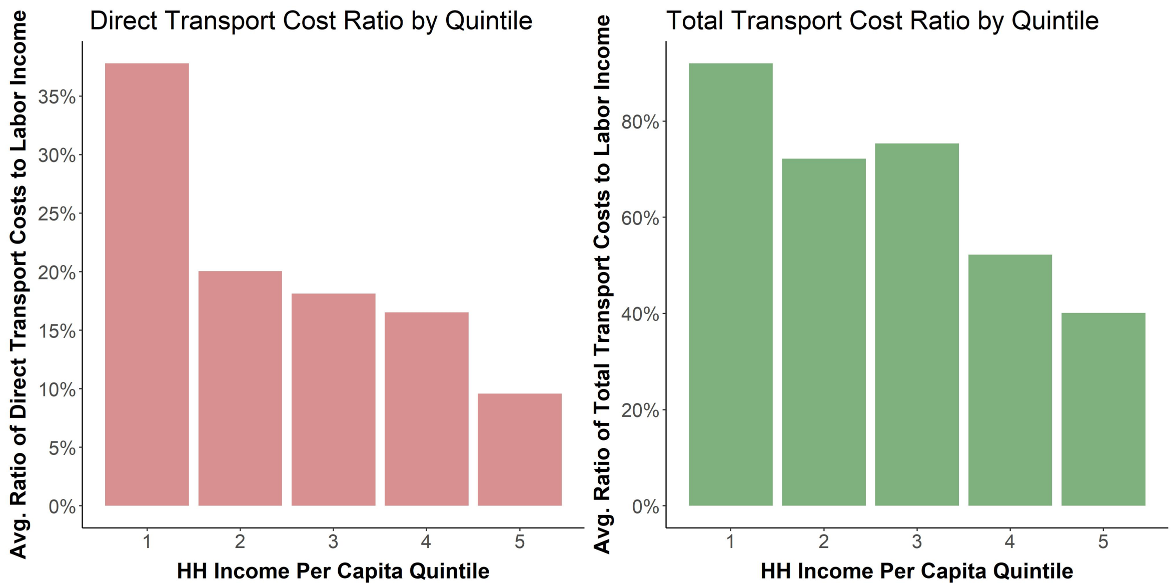

Figure 1: Direct and Total Transport Costs by HH Income Quintile

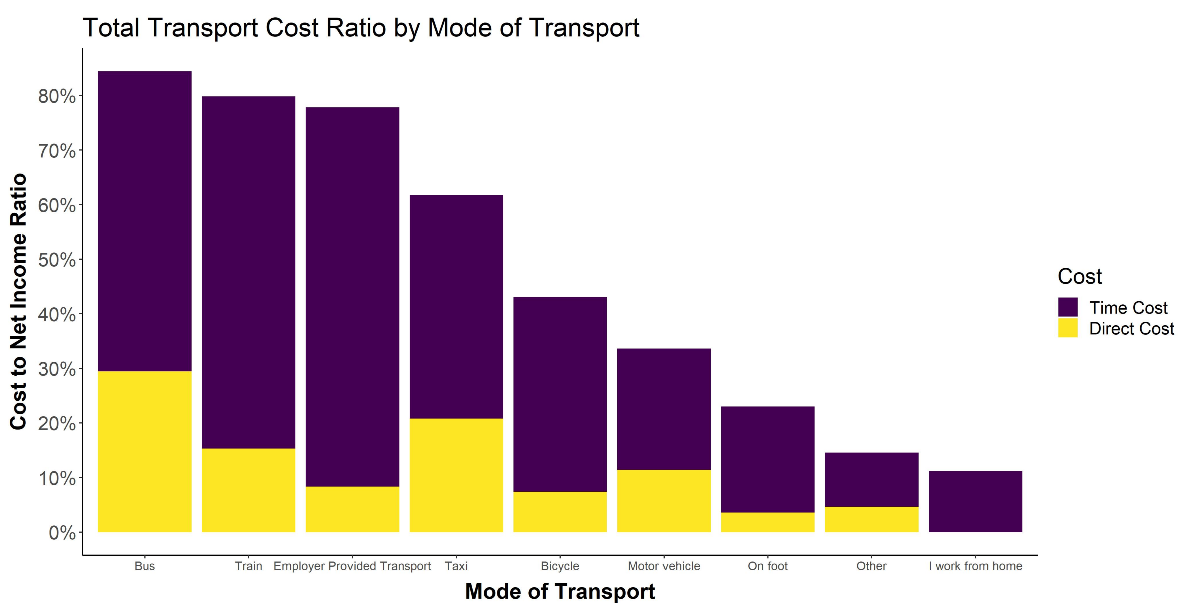

Figure 2: Direct and Indirect Transport Costs by Mode of Transport

provided transport have the highest rate of effective transport ”tax”.

It is no wonder that taxis, followed by motor vehicles, followed by walking are the most common modes of commuting. Bicycles have a low cost to income ratio, but are relatively under-utilized in South Africa (See Lochmann 2022, forthcoming).

3.3 Transport costs and labor market outcomes

One key fact about a labor market with transportation costs, is that wages will tend to increase with transport costs (though with an elasticity less than 1). This is because employers must at least partially compensate their employees for the increased costs of travel (See Manning 2003 and Zenou 2007). As we will see later in section 4, this is indeed a prediction of the model we develop here.

The table 1 shows a mincer regression of daily earnings net of taxes on individual characteristics (like gender and race), years of education, experience, sector, occupation, and measures of transport costs along with district fixed effects for the year 2010. We include three different measures of transport costs in turn in columns 1 through 3 and then together in column 4. These dimensions are distance to place of work, time of commute, and the direct costs of commuting. For all regressions we restrict analysis to individuals where these values are greater than zero, to avoid the left censoring that would otherwise occur (and which was mentioned above).

Individually, all three are positively correlated with with daily earnings, though only distance and direct costs are significantly correlated. When we include all three variables, distance and direct costs remain positively correlated with earnings. A 10% increase in distance would be associated with an approximately 1% increase in daily earnings, whereas a 10% increase in direct commuting costs would be associated with an approximately 1.8% increase in daily earnings. Once we consider all three of these costs together, the sign on time turns negative. This makes sense as once we control for distance and direct costs, the loss of time due to commuting would come at the expense of being able to work longer and earn more in a given day.

Aggregating to a district level, we can better observe the relationship between total transport costs and other labor market outcomes. However, first we must consider that the 52 districts in South Africa have varying levels of productivity and costs of living. In order to compare them properly it is important to take cost of living into account. This is especially important for transport costs which are non-tradeable services. Thus, part of difference in prices across regions will reflect differences in productivity in tradeable and faster growing sectors (i.e., the Baumol or Balassa effect) rather than differences in distance or transport

Table 1: Transport Costs and Wages

	Dependent variable:			
	Log Daily Earnings			
	(1)	(2)	(3)	(4)
Log Distance (km)	0.084***			0.099***
	(0.016)			(0.027)
Log Time (hours)		0.009		−0.060
		(0.028)		(0.042)
Log Cost (2012 Rand)			0.199***	0.187***
			(0.034)	(0.029)
Years Education	0.116***	0.107***	0.097***	0.100***
	(0.008)	(0.009)	(0.016)	(0.009)
Pot. Exp.	0.041***	0.043***	0.033***	0.027**
	(0.008)	(0.006)	(0.009)	(0.011)
Poten. Exp. Sq.	−0.0004***	−0.0004***	−0.0003*	−0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Female	−0.320***	−0.335***	−0.264***	−0.249***
	(0.048)	(0.041)	(0.044)	(0.045)
DC FE	YES	YES	YES	YES
Sector + OCC FE	YES	YES	YES	YES
Pop. Group FE	YES	YES	YES	YES
Observations	2,417	2,937	1,619	1,318
R^2	0.630	0.597	0.635	0.654
Adjusted R^2	0.618	0.586	0.617	0.632
Residual Std. Error	32.407	32.599	34.480	34.334
	df = 2339	df = 2859	df = 1541	df = 1238
Note:				*p<0.1; **p<0.05; ***p<0.01

technology.

To account for local prices, we create local cost of living indices based on rent per room given in the NIDS household survey (including implicit rents for those who own their homes). We use this to create a rental price index that we use to convert nominal variables into adjusted ones that take into account differences in local costs of living (See Moretti 2013, and Góes and Karpowicz 2017). Using this local price index, we deflate (or inflate) average, total transport costs to arrive at an adjusted average total transportation cost value that is more comparable across the 52 districts.

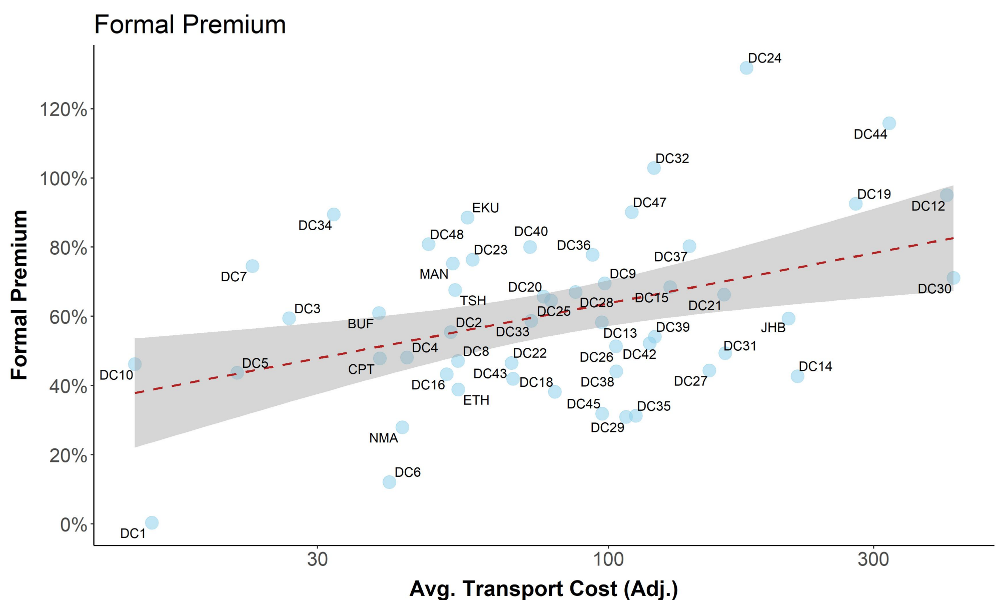

Figure 3: Formal Premia and Transport Costs

Figures 3 and 4 show the relationship between the formal premium (measured as the coefficient of a mincer regression for formal or informal work) by district and the average reservation wage of the unemployed with locally adjusted total transportation costs. There is a clear positive relationship between transportation costs and both the formal premium as well as the self-reported reservation wages of the unemployed. This is likely a direct consequence of the positive relationship between wages and transportation costs shown earlier and will also be shown to be a product of the model developed in section 4.

Given the high "tax" on labor that transport costs represent, we would expect to see a large impact of these transport costs on various employment outcomes. This is what we see in figure 5. As transportation costs increase, wage employment decreases, whereas own account employment (from a very low level), unemployment, and inactivity among the working age population all increase.

To see how large these relationships are, we run a regression of wage employment, own

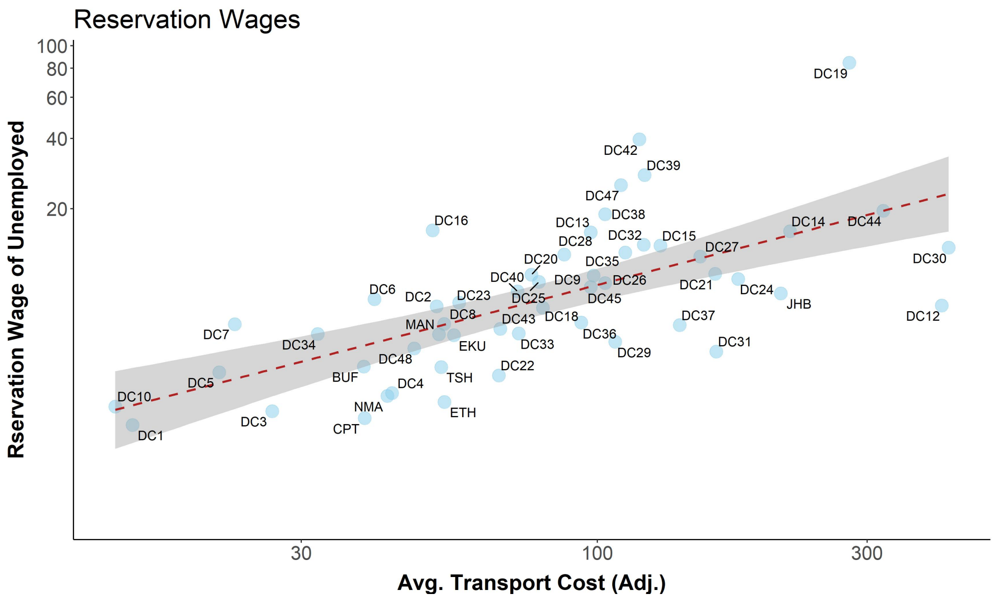

Figure 4: Reservation Wages of the Unemployed and Transport Costs

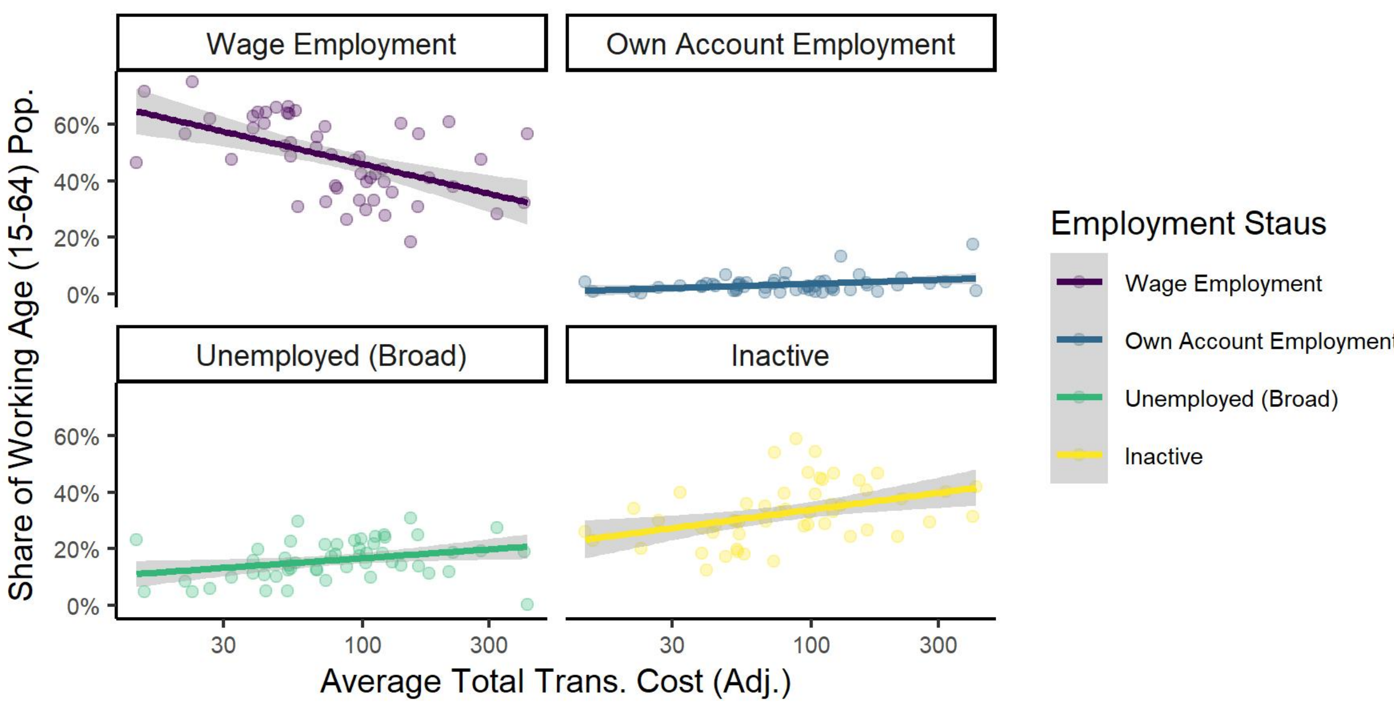

Figure 5: Employment Outcomes and Transpor Costs

account employment, unemployment, and inactivity (which all sum to 1 for every district) on locally adjusted, average, total transportation costs. Table 2 shows the result of this regression. For every 10% increase in transport costs, the wage employment rate falls by 2%. The own account employment rate and inactivity rate increase by 3.2% and 1.8% respectively, though the constant for own account employment is much lower. While we do see a positive relationship between unemployment (measured at the broad level) and transportation costs, the relationship is weak and not statistically significant. These basic facts about the relationship between transport costs and employment outcomes will be ones that we will try and replicate in the model we construct in section 4.

Table 2: Transport Costs and DC Employment Status

	Dependent variable:			
	Log Share of Working Age Pop.			
	Wage	Own Acc.	Unem. Broad	Inactive
	(1)	(2)	(3)	(4)
Log Tot. Trans. Cost (Adj.)	-0.206^{***}	0.323^{**}	0.089	0.182^{***}
	(0.050)	(0.157)	(0.132)	(0.057)
Constant	0.128	-5.192^{***}	-2.375^{***}	-1.969^{***}
	(0.221)	(0.696)	(0.586)	(0.252)
Observations	52	52	52	52
R^2	0.256	0.078	0.009	0.171
Adjusted R^2	0.241	0.060	−0.011	0.155
Residual Std. Error (df = 50)	0.271	0.853	0.717	0.308
F Statistic (df = 1; 50)	17.189^{***}	4.235^{**}	0.454	10.329^{***}
Note:				*p<0.1; **p<0.05; ***p<0.01

4 Geographical dispersion and unemployment

4.1 Related literature

After the demise of apartheid in 1994, geographical segmentation, continued, for a number of reasons. First, former homeland areas had already developed a large housing infrastructure that naturally anchors people. Second, properties in homelands are tax exempt, generating an incentive to stay there.

However, in spite of these factors that tend to stick people to their living quarters, a paradox remains. If people have been geographically separated from cities and jobs, and let's assume that for the mentioned reasons people cannot or will not move: wouldn't we see jobs moving to were people are? This paper tries to explain why this does not occur.

The role of geographical segmentation in South Africa's labor market has received significant attention. Kingdon and Knight 2004 found that location matters for black unemployment.

Naudé 2008 examines the role of distance from city center and shows that it plays a significant role as a predictor of black unemployment. Havemann and Kearney 2010 use 2001 census data to construct an urbanisation index at district level, controlling for individual-specific predictors of employment. They find a positive relationship between urbanisation and the probability of being employed. Finally, Krugell and Blaauw 2014 find that day labourers are more likely to find a job and earn higher wages in denser areas.

Why does location matter? It matters because it makes the market thinner of thicker. If location is spread out, there are higher costs to get to jobs. The higher costs imply that fewer workers will want to participate. The key issue is that if there are fewer workers willing to participate, then it is less attractive for firms to post vacancies. In short, if the market is too thin, jobs don't flow to were people are. In short the geographical dispersion imposed by apartheid perpetuates itself through a labor market equilibrium. In the next section we use a standard matching model to show this mechanism.

4.2 A matching model

In order to describe the employment situation in South Africa is is useful to think of the labor market as a matching problem in which sellers (job-seeking workers) and buyers (employee-seeking firms) have to search for each other in order to find a match. If jobs and workers are heterogeneous, the process of finding the right match will be costly and take time, and unemployment will be the result of that protracted process.[2]

Let us consider a simple version of the search model of unemployment. The economy consists of workers and jobs. The number of employed workers is E and that of unemployed workers is U. Workers can also work at home, so that $E + U + H = \bar{L}$ where $\bar{L}$ is the size of the labor force. On the firm side the number of vacant jobs is V and that of filled jobs is F. (We will assume that one worker can fill one and only one job, so that $F = E$, but it is still

[2]This is but one example of a general kind of problem of two-sided markets, which can be used to study all sorts of different issues, from regulation to poverty traps. The unemployment version was worth a Nobel prize in 2010 for Peter Diamond, Mortensen and Pissarides, and the analysis of two-sided markets is one of the main contributions of 2014 Nobel laureate Jean Tirole.

useful to keep the notation separate.) Job opportunities can be created or eliminated freely, but there is a fixed cost C_F (per unit of time) of maintaining a job and a cost C_V of posting a vacancy. An employed worker produces A units of output per unit of time ($A > C$), and earns a wage w, which is determined in equilibrium. Critical for our analysis of South Africa will be the transportation cost τ_w, which is the cost of travel to the job, which may be unusually high in South Africa as a result of geographical displacement. In addition we allow for a search cost t_u.

The key assumption is that the matching between vacant jobs and unemployed workers is not instantaneous. We capture the flow of new jobs being created with a matching function

$$M = M(U, V) = KU^{\beta}V^{\gamma}, \tag{1}$$

with $\beta, \gamma \in [0, 1]$. This can be interpreted as follows: the more unemployed workers looking for jobs, and the more vacant jobs available, the easier it will be to find a match. As such, it subsumes the searching decisions of firms and workers without considering them explicitly. Note that we can measure the extent of the thick market externalities: if $\beta+\gamma > 1$, doubling the number of unemployed workers and vacant jobs more than doubles the rate of matching; if $\beta+\gamma < 1$ the search process faces decreasing returns (crowding). As is standard in the literature and based on empirical observations elsewhere in the world, we will assume that $\beta + \gamma = 1$, so that there are constant returns to scale in the matching function (see Petrongolo and Pissarides 2001).

We also assume an exogenous rate of job destruction, which we denote as b. This means that the number of employed workers evolves according to

$$\dot{E} = M(U, V) - bE. \tag{2}$$

We denote a as the rate at which unemployed workers find new jobs and α as the rate at which vacant jobs are filled. It follows from these definitions that we will have

$$a = \frac{M(U, V)}{U}, \tag{3}$$

$$\alpha = \frac{M(U, V)}{V}. \tag{4}$$

The above describes the aggregate dynamics of the labor market, but we still need to specify the value for the firm and for the worker associated with each of the possible states. Each worker and firm state (E, U, H, V and F) can be thought of as an asset that needs to satisfy the following arbitrage equation

$$rV_E = w - \tau_w - b(V_E - V_U), \tag{5}$$

$$rV_U = -\tau_u + a(V_E - V_U), \tag{6}$$

$$rV_H = q \tag{7}$$

$$rV_V = -C_V + \alpha(V_F - V_V) = 0, \tag{8}$$

$$rV_F = A - w - C_F - b(V_F - V_V), \tag{9}$$

$$rV_H \geq rV_U, \tag{10}$$

where r stands for the interest rate (which we assume to be equal to the individual discount rate). These equations are intuitive, so let's review them quickly. In (5) the instantaneous value of being employed is the instantaneous wage minus the transport cost. With probability b the worker can become unemployed in which case loses the utility $(V_E - V_U)$. In (6) the unemployed workers gets an instantaneous return $-\tau$ (the transportation cost associated to searching). With probability a he/she finds a job and gains $(V_E - V_U)$.[3] Equation (7) indicates that the worker has the option to stay at home and engage in local activities, such as setting a shop in his own house, These activities, obviously, do not require paying the transport cost.

On the firms side (8) indicates that posting a vacancy has a cost C_V and with probability α the post gets filled in which case there is a gain of $(V_F - V_V)$. If the vacancy is filled then the benefit for the firm is the workers productivity A minus the wage paid and the cost of sustaining the job C_F. With probability b the job disappears and the firm has a loss of $(V_F - V_V)$. As we will explain later, in the steady-state equilibrium with an assumption of free-entry, V_v (the value of posting a vacancy) will be zero.

Equation (7) says, intuitively that the value of searching for a job needs to be bigger than the value of home production. Initially, however, we will solve the model assuming that the value of home production is exceedingly low to a point of making it irrelevant for decisions. We will lift this assumption and make the constraint binding in the following section.

4.3 Nash bargaining

In order to solve the model, we assume that workers and firms have equal bargaining power when setting the wage, so that they end up with the same equilibrium rents:[4]

[3]Both a and b as well as α below are all hazard rates that can go to infinity, and therefore not constrained to be in the range $[0, 1]$, however, we will refer to them as probabilities for ease of intuition.

[4]This result is not arbitrarily imposed, but an application of the axiomatic approach to bargaining of Nash Jr (1950).

$$V_E - V_U = V_F - V_V. \tag{11}$$

Let us start by computing the rents that will accrue to employed workers and employing firms, as a function of the wage, using (5)-(9):

$$r(V_E - V_U) = w - \tau_w + \tau_u - b(V_E - V_U) - a(V_E - V_U) \Rightarrow V_E - V_U = \frac{w - \tau_w + \tau_u}{a + b + r}, \tag{12}$$

$$r(V_F - V_V) = A - w - C_F - b(V_F - V_V) + C_V - \alpha(V_F - V_V) \Rightarrow V_F - V_V = \frac{A - w - C_F + C_V}{\alpha + b + r}. \tag{13}$$

The assumption of Nash bargaining (11) implies that the equilibrium wage must satisfy

$$\frac{w - \tau_w + \tau_u}{a + b + r} = \frac{A - w - C_F + C_V}{\alpha + b + r}, \tag{14}$$

which solves as,

$$w = \frac{(a + b + r)(A - C_F + C_V) + (\tau_w - \tau_u)(\alpha + b + r)}{a + \alpha + 2b + 2r}. \tag{15}$$

The intuition is simple: a and α capture how easy it is for a worker to find a job, and for a firm to find a worker; their relative size determines which party gets the bigger share of output. Notice the different effect of the transportation cost to going to work and to searching for a job: the first increases the wage, because the firm needs to compensate, even if partially the cost of working. But the cost of searching actually decreases the wage, because the higher the searching cost the more eager the worker will be to accept an offer. The costs, in turn, play an indirect role through the coefficients a and α as we will see below.

The equilibrium will be pinned down by a free-entry condition: firms will create job opportunities whenever they generate positive value. In equilibrium, the value of a vacant job will be driven down to zero. But how much is a vacant job worth to a firm? Using (8), (13), and (36) yields

$$rV_V = -C_V + \alpha \frac{A - w - C_F + C_V}{\alpha + b + r} = -C_V + \alpha \frac{A - C_F + C_V - \frac{(a+b+r)(A - C_F + C_V) + (\tau_w - \tau_u)(\alpha + b + r)}{a + \alpha + 2b + 2r}}{\alpha + b + r}.$$

Now recall (3) and (4). We can turn these into functions of E, by focusing the analysis on steady states where E is constant. For this to be the case (2) implies that $M(U, V) = bE$, the numbers of jobs filled has to equal the number of jobs lost. It follows that

$$a = \frac{bE}{U} = \frac{bE}{\bar{L} - E}. \tag{16}$$

To find out what α is, we still need to express V in terms of E, which we do by using the matching function (1):

$$KU^{\beta}V^{\gamma} = bE \Rightarrow V = \left(\frac{bE}{KU^{\beta}}\right)^{\frac{1}{\gamma}} = \left(\frac{bE}{K(\bar{L} - E)^{\beta}}\right)^{\frac{1}{\gamma}}. \tag{17}$$

As a result, we obtain

$$\alpha = \frac{bE}{V} = \frac{bE}{\left(\frac{bE}{K(\bar{L}-E)^{\beta}}\right)^{\frac{1}{\gamma}}} = K^{\frac{1}{\gamma}}(bE)^{\frac{\gamma-1}{\gamma}}(\bar{L} - E)^{\frac{\beta}{\gamma}}. \tag{18}$$

Conditions (16) and (18) can be interpreted as follows: a is an increasing function of E because the more people are employed, the smaller will be the number of people competing for the new job vacancies and the easier it for an unemployed worker to find a job. Similarly, α is decreasing in E because the same logic will make it harder for a firm to fill a vacancy.

The final solution of the model imposes the free-entry condition, using (8), to implicitly obtain equilibrium employment:

$$rV_V(E) = -C_V + \frac{\alpha(E)}{a(E) + \alpha(E) + 2b + 2r}(A - C_F + C_V - \tau_w + \tau_u) = 0. \tag{19}$$

What does the function $V_V(E)$ look like? It is negatively sloped, because

$$V_V'(E) = \frac{A - C_F + C_V - \tau_w + \tau_u}{r} \frac{\alpha'(E)\left[a(E) + 2b + 2r\right] - a'(E)\alpha(E)}{\left(a(E) + \alpha(E) + 2b + 2r\right)^2} < 0. \tag{20}$$

Intuitively, more employment makes it harder and more expensive to fill vacant jobs, reducing their value to the firm. When E is zero, filling a job is very easy, and the firm gets all the surplus $A - C_V$; when E is equal to $\bar{L}$ (full employment), it is essentially impossible, and the value of the vacancy is $-C_V$. This is shown in Figure (6).

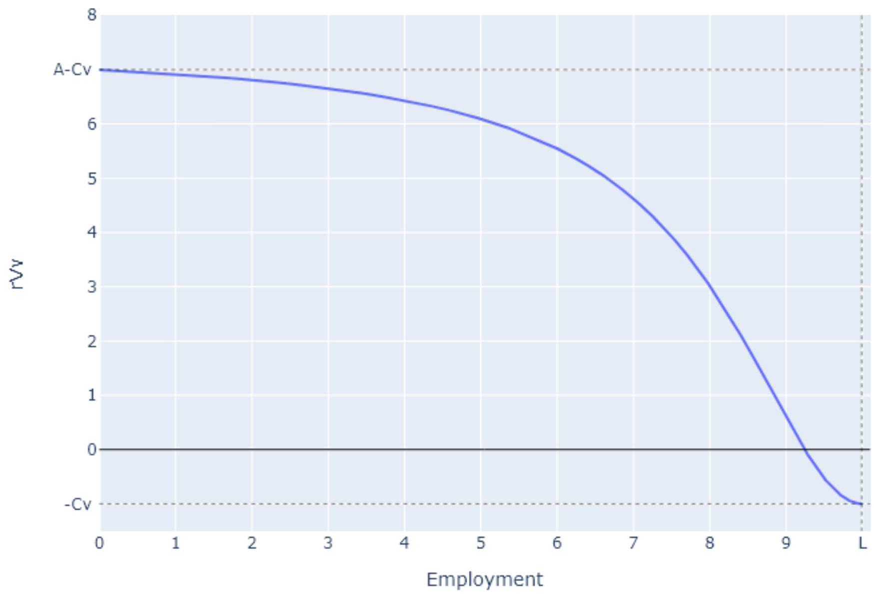

Figure 6: Equilibrium employment in the search model

To gain intuition into the workings of the model we show in Figure 2, the value of rV_V, rV_u, w as a function of employment. In this simulation we assume that the labor force equals 10. We assume here that all exogenous cost parameters t_w, t_w C_F and C_V are equal to zero. We assume that $\kappa = 1$, $\beta = \gamma = .5$ and $b = .2$. As can be seen from the graphs, the wage increases with employment, which in turn increases the value of being unemployed rV_u. The outcome is natural, as employment increases the required wage to provide a similar value gain to the worker increases (as the outside option of being unemployed becomes more valuable because it is easier to find a job). On the other hand, the value of a vacancy rV_V falls with employment as workers increase their leverage in wage negotiations.

Notice that in this configuration the value of posting a vacancy is always positive. This implies that in the frictionless market there will be full employment. In particular, if there are no costs of placing a vacancy or finding work, then there will be full employment.

Figure (8) shows the value of rV_V once we allow different positive values of C_V (assuming t_W, t_u and C_F are still zero). The equilibrium level of employment E is found when the value of a vacancy becomes zero. Thus the model generates unemployment in equilibrium and the unemployment is higher the higher the costs of keeping vacancies open.

What is the effect of changes in the exogenous parameters on the equilibrium level of employment? We start with a specification that assumes $t_w = 3$, $t_u = 1$, $C_F = 1$ and $C_V = 1$ with $A = 10$ in addition to the values for b, β, γ, and κ shown above.

From that set of parameters we now move individually each cost parameter. For each

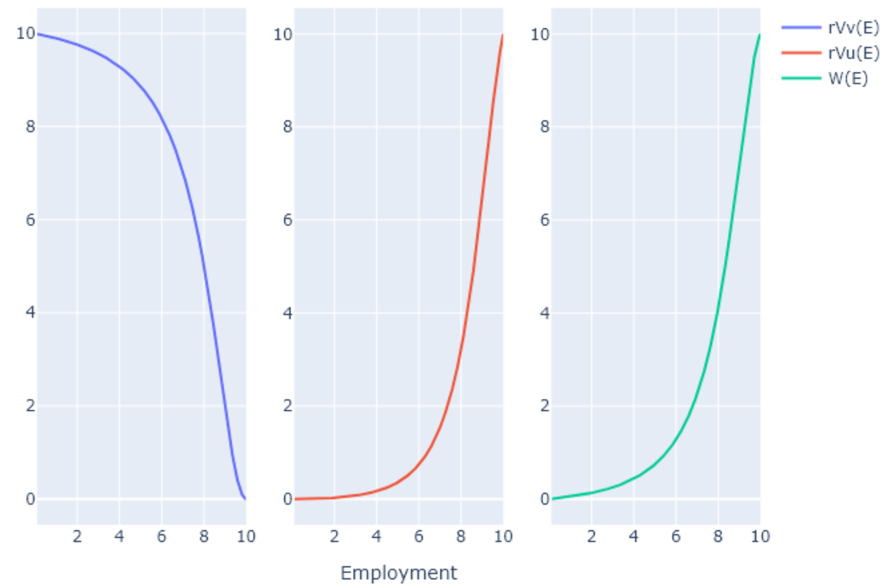

Figure 7: Value Functions response to Employment

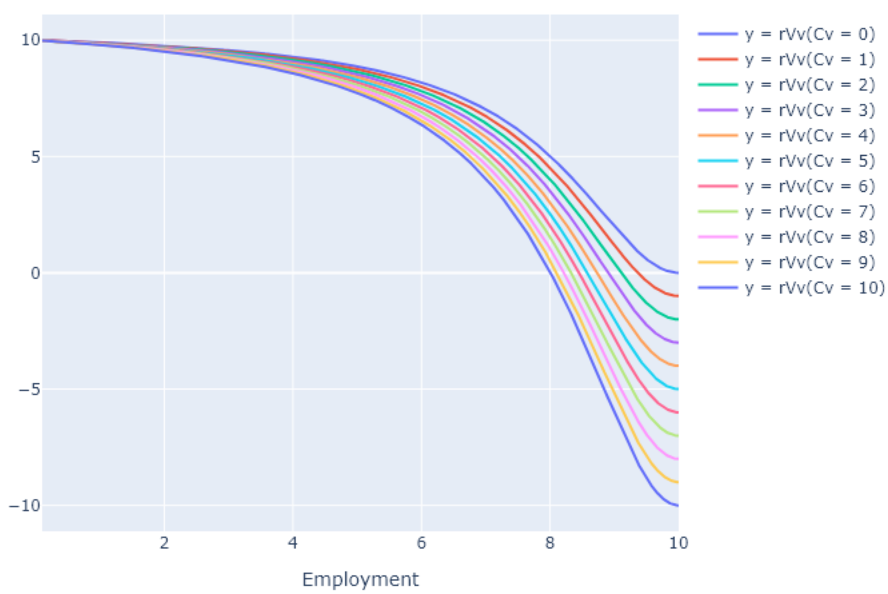

Figure 8: Equilibrium Employment

one, we estimate the value of employment for which $rV_V = 0$ and the corresponding wage. Figures (9) to (12) show employment, wage, the wage net of transportation costs, and the value of unemployment for different values of the parameters.

The model shows certain regularities. The first is that any increase in costs (of searching,

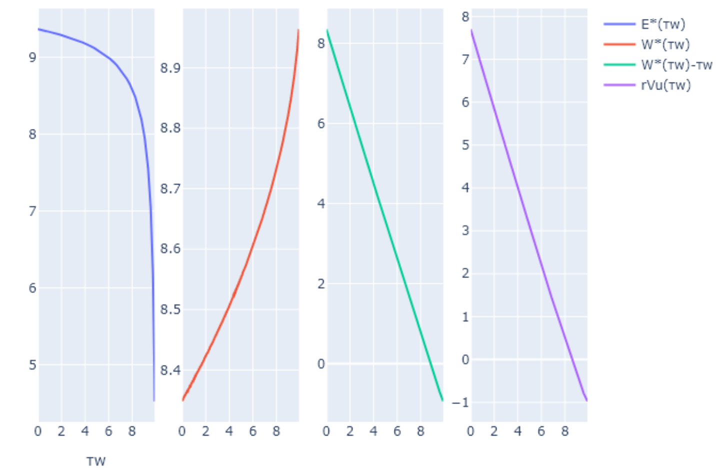

Figure 9: A change in t_w

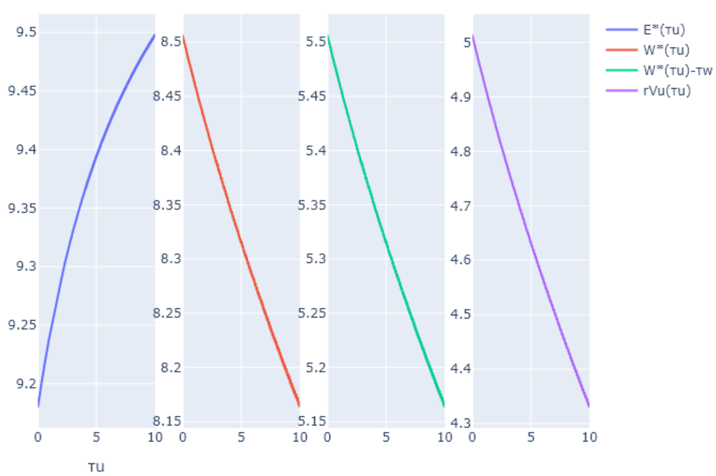

Figure 10: A change in t_u

traveling or posting and keeping jobs) reduce the net wage of workers and the value of searching for a job. The gross wage falls in all cases except when we move the cost of traveling to the job which needs to be partially compensated by the firms. In this case, the wage increases with the transport cost even when the wage, net of the transportation cost, falls.

Key for our discussion is the level of employment/unemployment in the model. An increase in all cost parameters reduce employment and therefore increase unemployment. The only exception is the cost of search by workers. An increase in the cost of search decreases the bargaining power of the worker allowing for a lower wage leading to higher

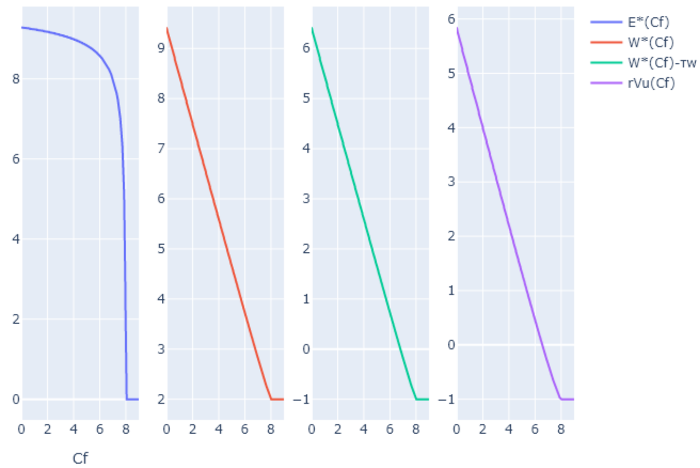

Figure 11: A change in C_f

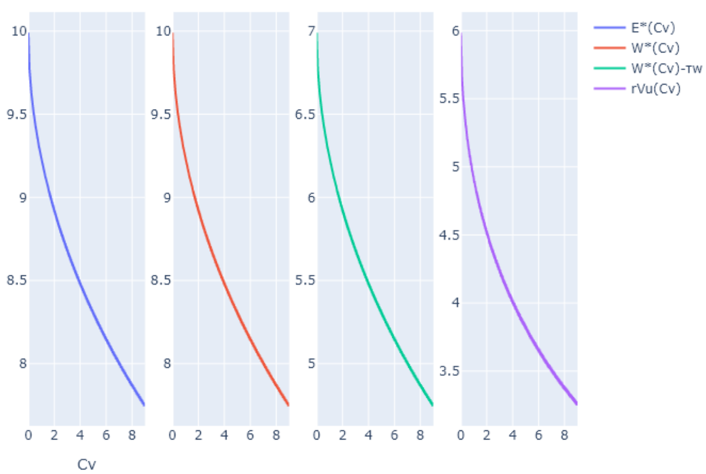

Figure 12: A change in C_v

employment.

In this basic version of the model (where all workers must search and there is no home production), transport costs create a wedge that results in involuntary unemployment at the prevailing wage, while also reducing the net wage of those employed. Figures (13) and (14) below show how aggregate employment variables first, and then the formal employment and unemployment population ratios. When transport costs are high enough, employment levels will fall drastically, leaving most if not all people as unemployed searchers.

However, as can be seen in (9) these simulations show that the value of searching becomes negative once the cost parameters become sufficiently high. But these scenarios are not

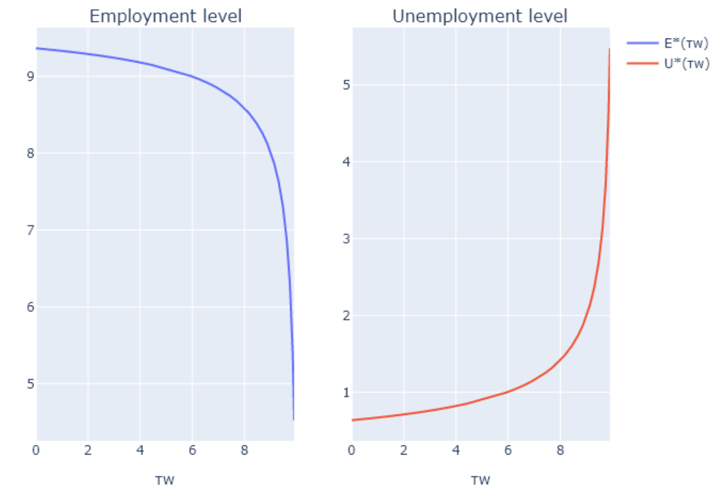

Figure 13: Transport Costs and Employment Levels

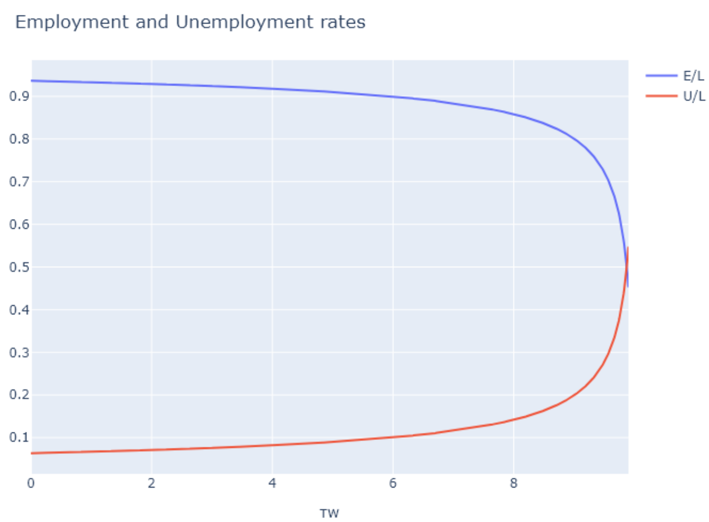

Figure 14: Transport Costs and Employment Rates

feasible, as people would not search if they provide negative utility, in fact they will not do so if the value of searching for a job is lower than the value of producing at home. Thus, while reasonable as a description of the working of the model, a more realistic description has to take into consideration this constraint. This consideration is especially important to consider in a developing country context where informal and own account work especially in the household sector can be a large part of the workforce. We do this in the following section.

4.4 The move into home production

The above showed the equilibrium in the labor market ignoring the home production constraint, let's look closer to the decision of agents to look for a job or not when an outside option is available. In order to discuss this, replace (12) in (7) to get

$$rV_u = -\tau + a\frac{w - \tau_w + \tau_U}{a+b+r}. \tag{21}$$

Using the solution for w from (36), we can write this as

$$rV_u = -\tau_u + a\frac{\left[\frac{(a+b+r)(A-C_V+C_F)+(\tau_w-\tau_u)(\alpha+b+r)}{\alpha+a+2b+2r}\right] - \tau_w + \tau_u}{(a+b+r)}. \tag{22}$$

This equation has a very intuitive interpretation. Job search costs reduce the value of being unemployed while higher wages increase it. In order to interpret the last term lets consider two extreme cases, one in which the market is at full employment and another where there is no worker employed. In the first case a approaches infinite and the last term boils down to $A - C_V + C_F - \tau_u$. On the other hand, if employment is zero, a is zero and the second term is zero and the value of being unemployed is just $-\tau_u$. The reason for this is that in full employment the worker gets all the bargaining power and reaps the full value of the working relationship, the opposite occurs if there is no employment. In short, the rV_u equation then looks as in Figure (15).

Notice that the upper limit is $A+C_V+C_F-\tau_u$ as workers are all employed. Even though the worker obtains the full value of the labor relationship it still has to pay for the transport cost. The lower bound places the worker at the same position as if it was unemployed. At the equilibrium employment rate E^* (defined by the point where $rV_V = 0$), the value of unemployment is rV_U^*.

This value of rV_u^*, however, can be larger or smaller than q the value of home production. If is is higher then everybody would be in the formal labor market and there would be no home production (even with unemployment). We shod this case in Figure (15), by assuming that $V_u^* < q$.

At this employment level, searching for a job delivers a lower return than home production. What is the implication of this? Naturally, that some people drop out of the formal labor market opting for home production. As people opt out, the curve rV_U moves up (as there are less workers the bargaining position of each remaining worker improves), and the curve rV_V moves down (for the same reason, the increased relative position of the workers implies a less convenient match for the firm).

The process of exit from the labor force continues until the rV_u equation touches q at at a

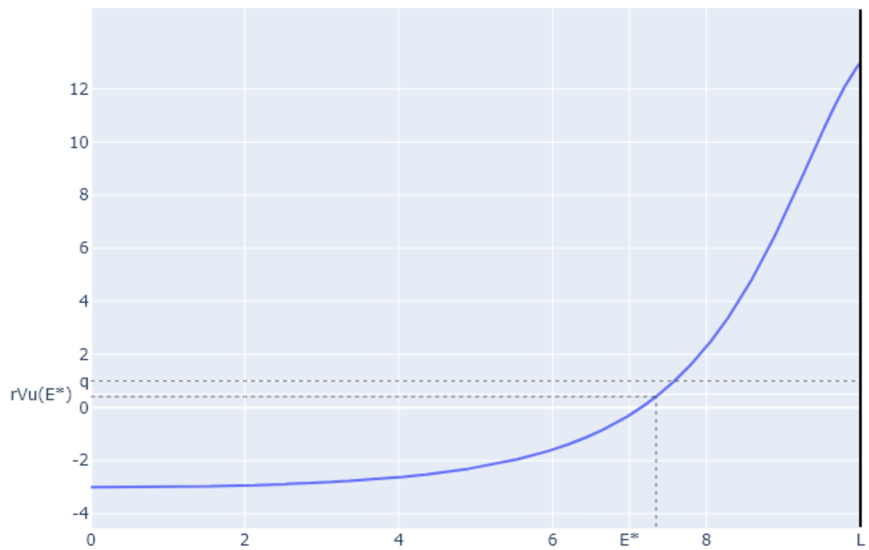

Figure 15: The value of unemployment and q

new equilibrium level. As workers exit the labor market, the bargaining power of remaining workers increase, increasing the surplus for the workers and reducing it for the firms. A new equilibrium is found with lower employment and a lower number of workers in the formal labor market.

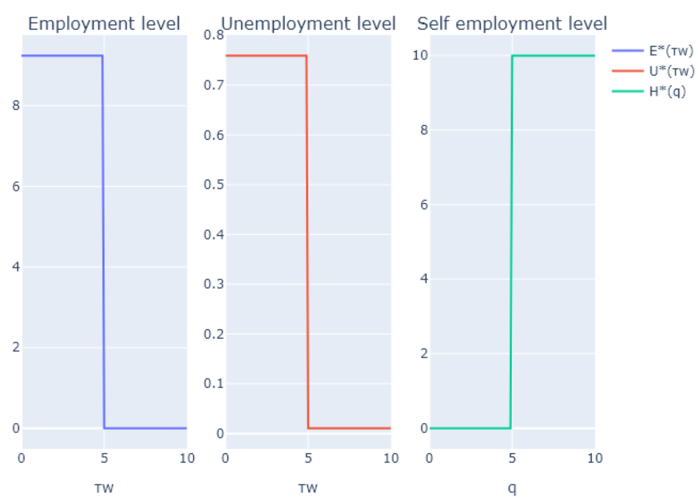

Figure 16: Impact of q on Employment Levels

Figures (16) and (17) summarize these dynamics by showing how the equilibrium level and rates of employment, unemployment, and self-employment would change with changes

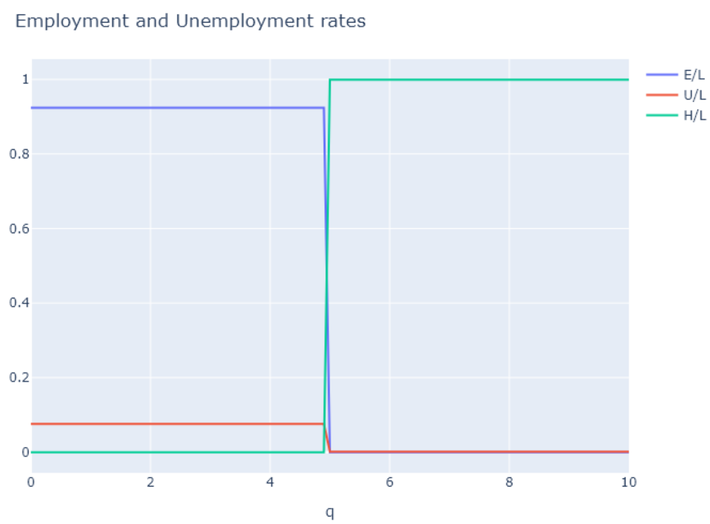

Figure 17: Impact of q on Employment Rates

in the productivity of home production for the case of CRS matching function. At first, changes in q have no impact because rV_u is still higher and therefore it makes more sense to search in the formal labor market. However, at the point where $V_u^* < q$, we can see a dramatic shift in the equilibrium. At that point, the formal labor market would disappear and most everyone would engage in informal work. As a result, economies at either side of this critical point would have dramatically different labor markets despite differences in underlying parameters not being that large.

An increasing return technology will provide dynamics that are similar to those of the CRS technology. But the same will not be true when the matching function exhibits decreasing returns to scale as shown in (18) and (19). Notice that in this case, there is also a reduction of formal employment as transport costs increase, but the change is smooth, decreasing slowly. So this configuration can replicate the characteristics of South Africa's labor market (which shows a small but coexistent informal sector) even assuming full homogeneity of the labor force.

Is a decreasing returns to scale matching technology realistic? Consider, for example a market with skills (or race) segmentation with leontieff production function across skill levels. In such case doubling the amount of workers and jobs vacancies may not lead to any new jobs if some of the skills in the menu are not forthcoming. In short the matching function is of the form

$$M = M(U, V, S) = KU^{\beta}V^{\gamma}S^{\delta}, \tag{23}$$

While it is plausible that the complexity of the South African market may be well represented by such a function, we will continue working in what follows with the more standard matching function technology. At any rate we think that thinking on the nature of the matching function is an interesting future line of research.

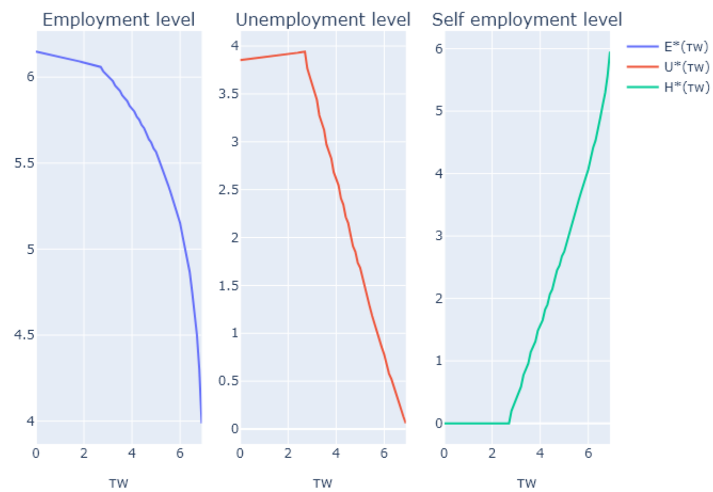

Figure 18: Employment, Unemployment and Self production level for changes in Transport Costs with DRS

Figure 19: Employment, Unemployment and Self production rates for changes in Transport Costs with DRS

4.5 The interaction of transport costs and q

In a world with the possibility for home production, frictions like transport costs become especially important. This is because they can now push an economy to either side of the critical point from having an economy with lots of formal work or a large informal sector.

This is shown in figures (20) and (21) below that show how employment levels and rates would change with transport costs when home production is an option. Here is where we can see the combined dynamics of transport costs and home production. At low levels of transport costs, $V_u^* > q$ we have a larger formal sector and unemployed searchers. But once transport costs are high enough, $V_u^* < q$ and we are instead in a world with informality and no people that we would consider as "unemployed" using traditional labor surveys.

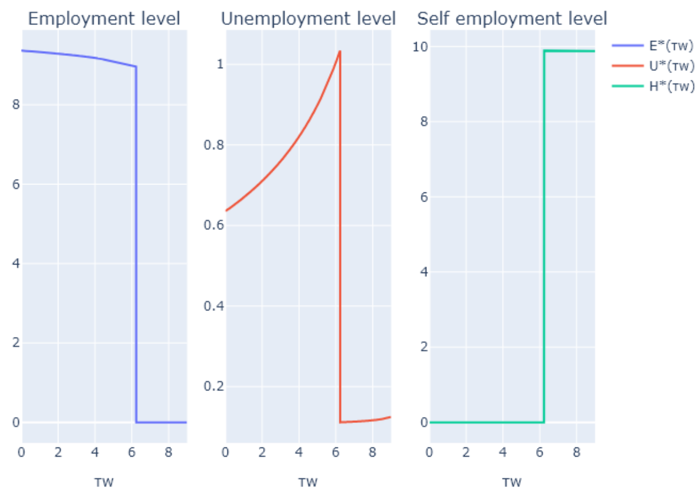

Figure 20: Transport Costs and Employment Levels with Home Production

Figure 21: Transport Costs and Employment Rates with Home Production

The world of high transport costs and large informality is a common one across the developing world. In fact, high transport costs due to poor infrastructure and segregated housing (e.g., slums on the outskirts of cities) could be thought of as one reason that informality exists as a fact of life in so many developing countries.

The way that transport costs create informality in this framework is important to consider. It is not just that workers find it difficult to get to jobs. This is certainly the case and is akin to a tax on labor. But it also raises the reservation wage of workers so that employers will post fewer vacancies where transport costs are high because they also need to compensate workers (at least partially) for higher transport costs. This will result in less formal employment available and in the common but extreme case much more informal employment.

The story above on transport costs and informality can help us to understand the case of many developing countries (e.g., Mexico) where there is a large informal sector and little observed open unemployment. However, it sits at odds with the situation in South Africa where the informal sector is small and unemployment is higher. As the next section will show, South Africa also has large transport costs suggesting that it should have even higher, not lower informality.

However, the model suggests a way to observe South Africa's situation. Crucially, the size of q can determine at which level of T_w the formal market thins out and informality reigns. A low q would mean that the level of T_w where the formal market completely thins out would need to be higher.

This is shown in figures (22) and (23) below. In these two figures, we show the same simulation as in figures (20) and (21) but we lower the value of q. As a result, the simulation shows an economy where unemployment continues to rise with transport costs and the formal labor market does not completely thin out at even relatively high levels of T_w.

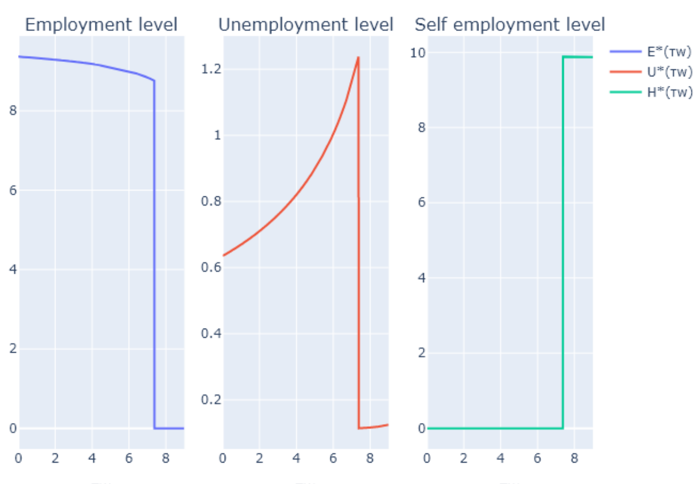

Figure 22: Transport Costs and Employment Levels with Home Production

Figure 23: Transport Costs and Employment Rates with Home Production

Thus, given two developing countries (which we can think of as A or formal productivity not being too high) with similarly high transportation costs, a high or low q could determine whether the economy is one of high unemployment or high informality. At $T_w = 7$, the economy with high q represented by figures (20) and (21) would have high informality and little unemployment (e.g., Mexico). But the economy with low q represented by figures (22) and (23) would have high unemployment and little informality (e.g., South Africa). We see precisely this difference between Mexico and South Africa in employment data with some evidence that the informal premium in South Africa is much lower (Shah 2022).

This framework could in principle generate other observations we see for the labor market in South Africa. For example, in this version of the model we assume that all workers are the same. However, in real life there is clearly large segmentation of workers by skill, demographics, and other characteristics. In South Africa we observe lower unemployment rates for the more educated. This is sometimes argued as evidence for a skills gap. But in our framework we could observe a similar pattern with transport costs. Recall that transport costs are regressive. If more educated individuals are more productive (i.e., have a higher A) then our framework would predict that their wages would be higher and transport costs would be less binding for them (i.e., the transport "tax" is lower). This would mean that despite higher transport costs in South Africa, the more educated workers would have higher employment and lower unemployment rates and would be less likely to engage in informal work.

The model with CRS in the matching technology predicts a threshold point when the model moves from formal employment to informal employment. Of course in the real work formal and informal work coexist. One way to reconcile this is to think of this model as applying simultaneously to labor markets different geographies with different transport costs, or to labor markets with different skill levels, as explained above. In such cases the real world will show segments of the labor market that are in the high unemployment segment and other in the informality equilibrium. In the aggregate we will observe a relationship indicating that higher transportation costs lead to higher unemployment, while observing both formal and some informal employment.

5 Policy discussion

In this section we will discuss 5 "policy experiments" where we model the experiment through the lens of our model to see how the equilibrium shifts. These experiments are a change in transport cost vs a change in transport subsidies, an improvement in matching technologies (job fairs and marketplaces), unemployment compensation, a change in union power, and the implementation of a Basic Income program.

5.1 Transport costs vs Transport Subsidies

Let us start with the change in the transportation cost for which we can use our graph (9) above. The graph shows that lowering t_w increases employment and formal labor market participation. While it decreases the wage, this decrease is smaller than the the change in the transport cost so that a lower t_w implies a higher take home wage. All these results are consistent with our empirical findings in section 3.

These results are not surprising and provide a justification for changes in housing and urban development that may reduce transportation needs. But we stress here that undoing apartheid has important implications that go beyond the compensation for transportation: they change the equilibrium in the labor market. A more integrated society may generate benefits in terms of more formal employment, lower unemployment and higher wages. This is the main conclusion of our paper.

In addition to housing policies, investments in transportation infrastructure will still have to be weighted against the cost savings, but should consider in the evaluation that labor market equilibrium will change, providing positive externalities. In this context, the fact that there are only three trains a day covering the distance between Soweto and Johannesburg seems difficult to understand. Policies like transit oriented development of the Rea Vaya bus line to connect places like Soweto and Johannesburg CBD might be especially impactful but only if they actually reduce transport costs and times.

To analyze transport subsidies we need to slightly change the equations of our model to

$$rV_E = w - (\tau_w - t_s) - b(V_E - V_U) - s_E, \tag{24}$$

$$rV_U = -\tau_u + a(V_E - V_U) - s_U, \tag{25}$$

$$rV_H = q \tag{26}$$

$$rV_V = -C_V + \alpha(V_F - V_V), \tag{27}$$

$$rV_F = A - w - C_F - b(V_F - V_V) - s_F, \tag{28}$$

$$rV_H \geq rV_U. \tag{29}$$

The worker receives a transport subsidy which reduces his/her transportation cost. However, what we need to change is the fact that this cost has to be paid. In the specification above, it can be paid by firms (s_F), by the employed (s_E) or by the unemployed (s_U).[5]

In one extreme, consider the case that it is all paid by employed formal workers. This means $t_s = s_E$ while $s_F = s_U = 0$. It is easy to see that the policy has no effect on any variables. This extreme case is an interesting example to show the difference between *reducing* transport costs and *subsidizing* transport costs. The former provides a net gain, while the second just redistributes the burden of a real cost.

Figures (24) and (25) show these results graphically when the subsidy is fully paid by firms ($s_F = t_s$ and $s_E = s_u = 0$.)

Notice that in this case the result replicates the previous one. The reason for this is that when the subsidy is paid fully by the firm, because there is an equivalent amount of workers as jobs, the firm pays the transport subsidy one to one. In the market equilibrium this adjusts the wage by an equivalent amount. So the labor market equilibrium undoes the transport policy making it irrelevant.

The result will be less strong if the transport subsidy is paid by someone else than workers or firms (for example the unemployed) but the exercise helps to show that transport subsidies are much less effective as a a policy than actually reducing transport costs.

5.2 An improvement in matching technology

A change in our parameter κ would represent an improvement of the matching of workers: the development of job fairs, the creation of marketplaces matching workers with job postings, etc..

The results of a change in κ are shown in Figure (26) and (27).

[5] Of course other combinations are possible. If paid by all formal workers it suffices to make $s_E = s_U$.

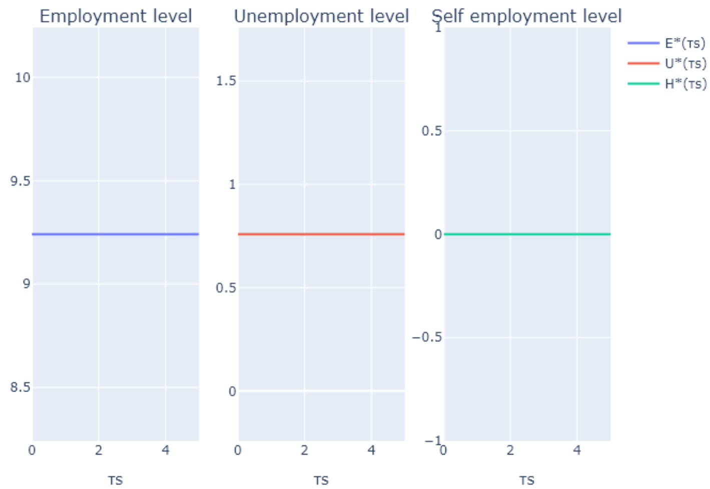

Figure 24: Transport Subsidies and Employment Levels with Home Production

Figure 25: Transport Subsidies and Employment Rates with Home Production

The increase in κ implies an increase in wages, employment, formalization and a reduction in unemployment.

At low levels of efficiency, as it increases employment it increases the labor force much more, so the number of people looking for a job increase at a rate that keeps the wage initially constant. Eventually as labor force participation increases enough and the value of a job in the formal market increases (the result of matches becoming easier) home production eventually becomes unattractive and there is full formalization. Further improvements in matching reduce unemployment, while wages and employment continue to increase.

From a theoretical point of view these policies are identified as helpful. Their challenge is implementation. Today, however, digital labor searching platforms can do much better than

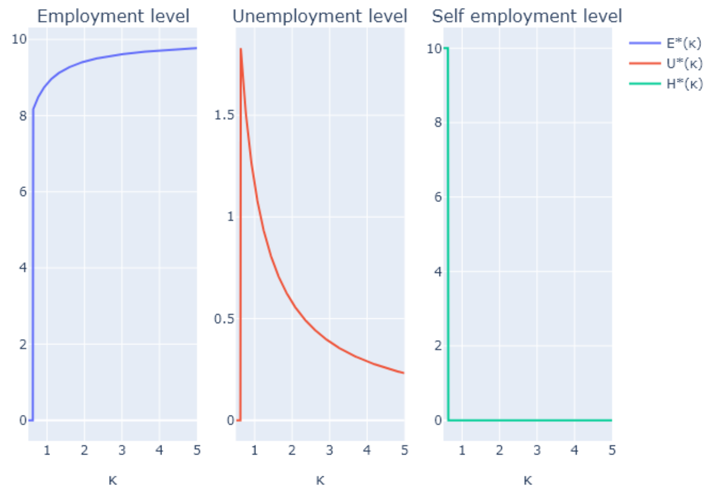

Figure 26: Improvement in Matching Technology and Employment Levels with Home Production

Figure 27: Improvement in Matching Technology and Employment Rates with Home Production

job fairs in the past. The value of developing such digital market places is well understood within the context of these models.

5.3 Unemployment compensation and job search subsidies

We capture the policy of an unemployment subsidy or search cost subsidy with our parameter t_u. In particular a negative t_u can be seen as an unemployment subsidy. A subsidy to job search works exactly the same way. This is a similar result to that found by Zenou 2000.

Figure 28: Unemployment Compensation and Employment Levels with Home Production

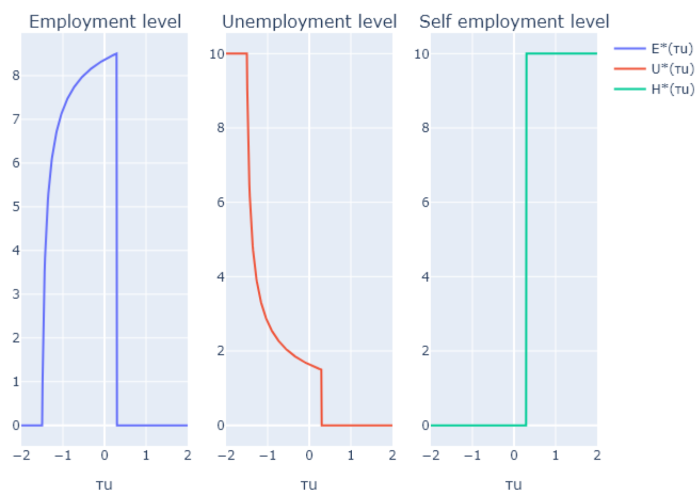

Figure 29: Unemployment Compensation and Employment Levels with Home Production

The results are shown in (28) and (29). The workings of the unemployment subsidy should be read as moving left to the left of zero. The effect of an unemployment benefit is well known in the literature: it decreases employment and increases unemployment due to increasing reservation wages. In our specification here, the market remains formalized (the unemployment benefit increases formalization, though not necessarily employment).

Be aware that when we decrease t_u without internalizing the fiscal cost, we are minimizing its effects, if firms were to pay the cost of the subsidy the effect on formal employment would be even larger and the effect on wages reduced. We return to these interactions in the more interesting case of a universal income grant below.

5.4 Basic Income Grant

What would be the labor market effects of a universal grant, such as a proposed Basic Income Grant (BIG) that has been discussed in South Africa? In order to answer this question the value functions would need to be changed to

$$rV_E = w - (\tau_w - t_s) - b(V_E - V_U) + B, \tag{30}$$

$$rV_U = -\tau_u + a(V_E - V_U) + B, \tag{31}$$

$$rV_H = q + B \tag{32}$$

$$rV_V = -C_V + \alpha(V_F - V_V), \tag{33}$$

$$rV_F = A - w - C_F - b(V_F - V_V) - \frac{B}{\frac{E}{L}}, \tag{34}$$

$$rV_H \geq rV_U. \tag{35}$$

The change in the specification incorporates a transfer received by all workers and paid by firms. It is this last feature that will provide a feedback into the labor market. BIG operates as a tax on firms, and the fewer the amount of jobs, the higher the burden of BIG for each active labor market match. For example, if $\frac{E}{L} = 0.5$, that is, only 50% of the labor force is working, then each working job has to support 2 basic income transfers. Thus in the (33) the basic income grant is multiplied by $\frac{L}{E}$. With these changes the solution for the wage is

$$w = \frac{(a + b + r)(A - C_F + C_V - \frac{BL}{E}) + (\tau_w - \tau_u)(\alpha + b + r)}{a + \alpha + 2b + 2r}. \tag{36}$$

As employment falls, there is an additional cost on the firm: an increasing tax burden as fewer firms have to sustain the payment of a universal grant. This operates as a unstable factor in the labor market.

Our first intuition on the workings of BIG are provided by graphs (30) through (32). Figure (30) shows the instability that we are talking about.

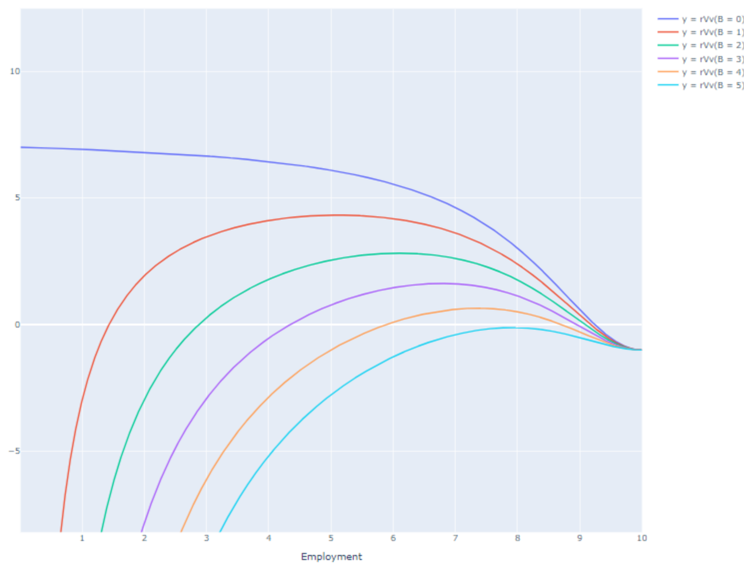

Figure 30: Value of posting a vacancy for different B

The value of posting a vacancy becomes very expensive if employment becomes too low, because those few jobs have to pay for the transfer to all other workers. In fact, the equilibrium moves relatively little as BIG increases, but eventualy the value of vacancies becomes zero at all employment levels and the formal job market dissapears (in figure (30) this happens when $B = 5$).

Notice that as BIG increases the reservations wages decrease in figure (32) in spite of the increase in the value of being unemployed shown in figure (31).

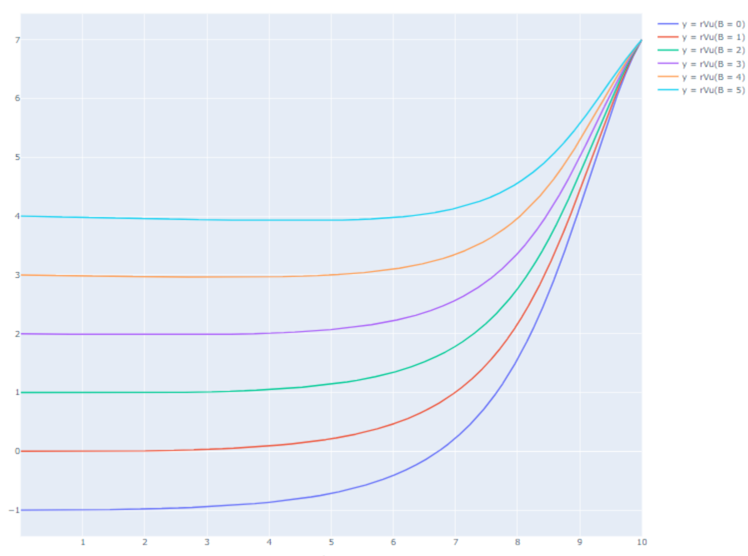

Figure 31: Value of searching for different B

Figure 32: Employment, Unemployment and Home production rates for BIG

Notice that its effect is to reduce the equilibrium wage and even the net take home wage. The reason for this is that BIG operates as a tax on formal employment. So each individual formal worker is worse off with BIG. However, the share on income accruing to labor (defined by the equation below) increases with BIG.

$$\frac{BIG \times Population + w \times E}{A \times E} \tag{37}$$

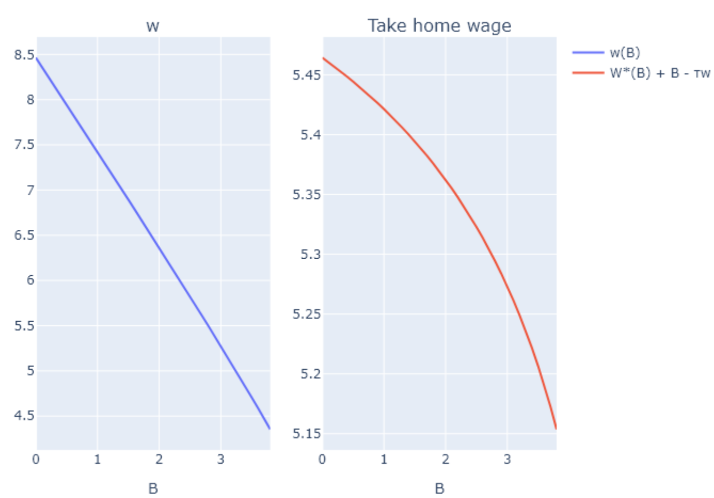

Figure 33: Wages for BIG

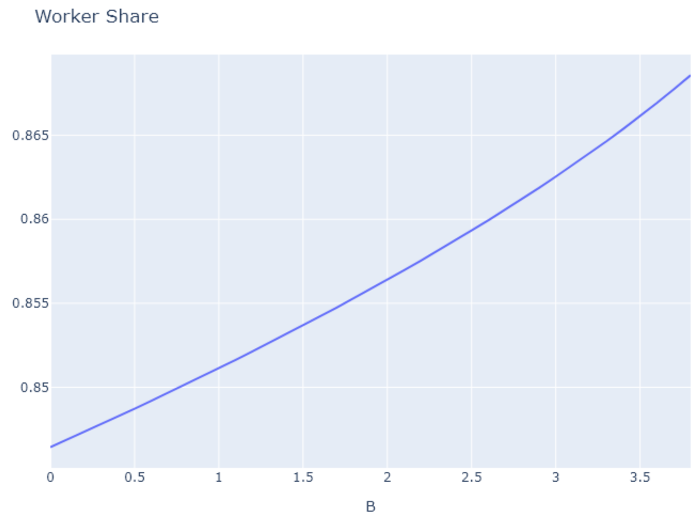

Figure 34: Worker's share

5.5 Changes in Union Power

To capture changes in union power we can modify our bargaining equation, so that

$$V_E - V_U = \phi(V_F - V_V). \tag{38}$$

A $\phi > 1$ implies that union power increases relative to the benchmark case. The opposite occurs if $\phi < 1$. Working out the wage, we find that now it is

$$w = \frac{\phi(a+b+r)(A - C_F + C_V) + (\tau_w - \tau_u)(\alpha + b + r)}{\phi a + \alpha + (1+\phi)b + (1+\phi)r}. \tag{39}$$

Incorporating this change we can compute the comparative statics to the changes in union power as shown in figures (35) through (37).

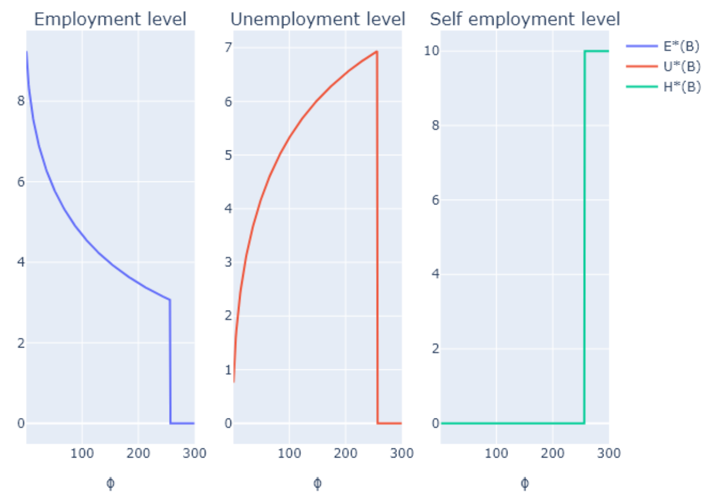

Figure 35: Employment, Unemployment and Home production level for Union Power

Figure 36: Employment, Unemployment and Home production rate for Union Power

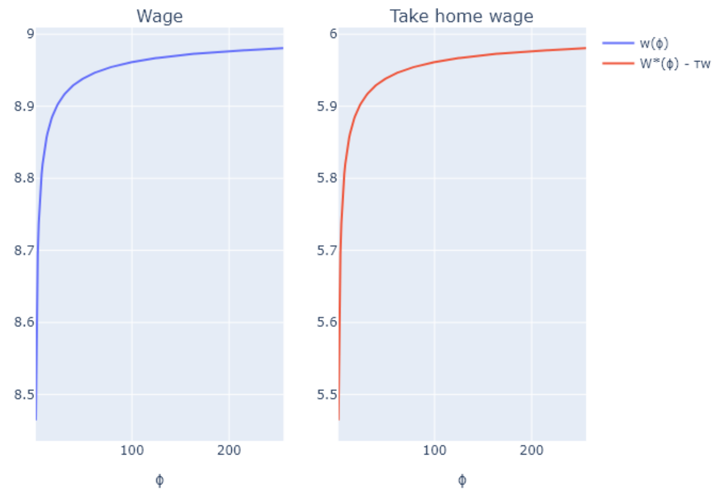

Figure 37: Wage for Union Power

Notice that in general an increase in union power increases the wage (37), decreases employment and increases unemployment, a result consistent with the insider-outsider story of unemployment (figures (35) and (36)).

6 Conclusions

This paper attempted to embed the high observed transportation costs in South Africa into a simple search and matching model of the south african labor market. The goal was to see whether such a framework would be able to replicate some of the key facts of the abnormal labor market in South Africa where we see high, in a cross country comparative, persistent unemployment, low informality, and average levels of formal employment. The hope was that in doing so, we could better understand the mechanisms of the labor market equilibrium in South Africa and what policy options are best placed to improve it.

In constructing such a model that most closely recreates the stylized facts of South Africa, we find that transportation costs have significant impacts on labor market outcomes. These have both distributional and efficiency consequences. Transport costs are like a regressive tax that can thin the labor market so much that we are stuck in an equilibrium of high wages but few jobs and job vacancies. In most countries, this would create a large informal sector, but in South Africa low informal sector productivity might mean that we see higher than expected open unemployment even when the market for jobs is very thin. Reasons for such lower informal productivity themselves might be due to spatial issues and the over-regulation of informal activities that are a legacy of Apartheid era policies (Shah 2022).

Transportation costs in South Africa are high. This is likely due to the deliberate policies that separated areas of settlement for Africans from the key areas of economic opportunities. To subsidize these high costs or to compensate those that are most likely excluded as a result might be important from a distributional point of view. However, our analysis shows that especially in South Africa's case this is not nearly as effective as policies that actually reduce the real costs of transport between where people live and where they work. Other policies simply shift the cost to someone else rather than truly solving them.

Policies that actually reduce transport costs must reduce not just direct costs but also people's time costs of commuting as well, as these are the largest part of the cost of transport. As shown in section 3, many forms of public transport like buses and trains have large transport costs because of the additional time costs involved, making other forms of transport like private (but still relatively expensive) taxis more attractive. Alternatives would mean a mix of transit oriented development that focused on modes of transport that have lower costs (bus and rail routes that were more efficient), infrastructure that can better support cheaper transport modes (bike lanes, roads that do not favor cars over two-wheelers), and housing policy that expands the supply of affordable housing closer to where people work.

It is these sets of policies that would reduce real costs of transport and help South Africa truly integrate populations and provide pathways for inclusive growth.

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