Two Essays on the Macroeconomic Analysis of Government Policies and Entrepreneurship

Zoë Kuehn

TESIS DOCTORAL UNIVERSIDAD CARLOS III / 2010

DIRECTOR DE LA TESIS

Profesor Nezih Guner

Universidad
Carlos III de Madrid
www.uc3m.es

Acknowledgments

This thesis turned out to be quite a long journey and while my own patience, endurance, pain, and joy accompanied me so did the feeling, emotions and reasonings of many others who directly or indirectly contributed to me finishing this thesis. I would like to take the opportunity to thank all those who have been and hopefully continue to be my travel mates and teachers on this and many other journeys.

In the first place I want to thank my advisor Nezih for his invaluable advice and support and for teaching me how to write a paper. Thank you for cutting me short on all the novel-like paragraphs that I am about to toss upon you in these acknowledgments.

Thank you Gregorio, for everything. Not even my novel style writing is enough to put in words all I would like to thank you for; continuous questioning, infinite patience, trust, love, energy, travels, and all the things you taught me; the list is endless. Thank you.

I am also grateful to those who did not get too desperate even though their daughter continued to be a student at the age of 30, Rüdiger and Gudrun; the one who still thinks his big sisters has super-powers or at least makes me feel like it , Bosse; and the one who would have loved to see me graduate but unfortunately passed away a year and a half before it could happen, Anneliese Lina.

And thank you those far away but close to the phone. Thank you Mareike for never getting tired even after 2 hours of hot-ear phone calls. Thank you Susanne for being there with calm advice and medical help.

were those who taught me about a great continent - Latin America - and its beauty; los ticos: Ivania y Alonso, the Mexican gang: Rodrigo, Manuel, Takeshi; the Colombian mafia: Rene and Carlos Andrés; la urugaya: Mariangela; el peruano: Luis. I learned a lot about a country called Spain. Thank you Tatiana, Ara, and Ileana for teaching me. And a place called Italy came closer to me living with Luca and Alessandro and sharing an office with Alessio. Thanks to all those who helped me to maintain 'Mens sana in corpore sano': Antonio, Luz, Yolanda, and Javier.

As my father, I hope to be a 'discipulo eterno' as well as an enteral traveler with as many great teachers and travel mates as I had on this journey. There were more than the ones mentioned here but if you accompanied me and I did forget to mention you, I hope that you feel included. If you allow me to, I dedicate this thesis to you.

Getafe, June 2nd 2010.

Summary

In this thesis, I study the macroeconomic link between government policies and entrepreneurship. In the first chapter, I look at the informal economy in high-income countries and show that taxes and the quality of governance can account for a large fraction of cross country differences in informality. In the second chapter, I ask why the East German economy, in contrast to other transition economies, suffers from a lack of entrepreneurial activity and low growth rates. In particular, I study how the integration of East Germany into an established economy - West Germany - adversely affected the allocation of entrepreneurial talent in East Germany.

The first chapter entitled "Tax Rates, Governance, and the Informal Economy in High -Income Countries" studies the mechanisms behind the informal economy in high-income countries. About 16.7% of output in high-income OECD countries was produced informally in 2001-02 (Schneider (2002)). Davis and Henrekson (2004) show that there exists a positive relation between tax rates and the informal economy for high-income OECD countries. While existing models of the informal economy mostly focus on developing countries where informality is linked to the use of labor-intensive and low productive technologies, this chapter studies the mechanisms behind the informal economy in high-income countries.

I build a model economy, following Lucas (1978), in which agents of different managerial abilities decide to become workers, managers of informal firms, or managers of formal firms. Managers of informal firms use the same technology as formal managers. However, in contrast to formal managers, managers of informal firms do not pay taxes but run the risk of getting caught, taxed, and fined. Simulations show that differences in tax rates can only account for approximately 33% of the observed variation in informal economy across

high-income countries. The quality of governance, the extent to which these tax rates are enforced, however, plays a more significant role. Differences in governance quality can account for about 43% of the variation. When combining differences in tax rates with differences in governance quality, the model accounts for approximately 56% of the cross-country variation in informal economy. Policy experiments show that if all countries attained Switzerland's governance quality, average informality would drop by around 15%. I estimate average costs of this policy to be equivalent to at most 26% of the average tax administration's budget and find gains in tax revenues to be around ten times larger than these costs.

This chapter contributes to the small literature on the informal economy in high-income countries by being the first one, to the best of my knowledge, in quantifying explicitly the separate and joint effects of two important driving forces on the informal economy, tax rates and the quality of governance.

The second chapter entitled "Migration, Wages, and Parental Background: Obstacles to Entrepreneurship and Growth in East Germany" addresses the question of how East Germany's integration into an established economy, West Germany, may have hindered a fruitful development of entrepreneurship and how this may have affected economic growth. For the last decade, the East German economy has been suffering from high unemployment and low economic growth. Policy makers often point to the lack of entrepreneurship as one of East Germany's main problems.

I build a model economy that places Lucas (1978)' span-of-control model into an overlapping-generations framework. Following Hassler and Rodríguez Mora (2000) managerial knowhow is defined as a combination of two factors, innate talent and entrepreneurial parental background, and growth depends on the innate talent of entrepreneurs only. In East Germany, the lack of entrepreneurial

parental background makes innate talent the decisive factor in occupational choice and more talented entrepreneurs should contribute to high growth rates. However, three key aspects of East Germany's integration into West Germany inhibit this mechanism: 1) the unrestricted mobility of East Germans to the West, 2) the policy of fixing East German wages as fractions of West German wages, and 3) the importance of parental background for entrepreneurship in West Germany. I first calibrate the basic model economy to West Germany before reunification pinning down the key parameters governing the role of parental background and the link between entrepreneurship and growth. The model is then extended to account for aspects of reunification allowing for migration between West and East Germany. I run counterfactual experiments eliminating any of the three key aspects of integration - Migration, Wages, and Parental Background - and find that they all pose obstacles to more entrepreneurs, less unemployment, and higher economic growth in East Germany.

This chapter contributes to the literature by being the first one, to the best of my knowledge, that explicitly models the link between a lack of entrepreneurship and low economic growth in East Germany. It applies the theory established by the literature on social mobility and economic growth to the context of economic transition. From the historical unique context of a generation without parental background in entrepreneurship arises the natural question of its implications for economic growth. This chapter tries to address this question and to provide some quantification of the implications for the case of East Germany.

Resumen

En esta tesis analizo los mecanismos que relacionan las políticas públicas con la creación de empresas por parte de emprendedores. En el primer capítulo estudio la economía informal en países desarrollados y demuestro que la carga impositiva y la calidad de la gestión pública pueden explicar una parte considerable de la variación en las tasas de informalidad entre países. En el segundo capítulo investigo las razones por las que la economía de Alemania del Este, a diferencia de otros países en transición, sufre de falta de emprendedores y bajas tasas de crecimiento económico. En concreto, muestro como la integración de Alemania del Este con una economía madura- Alemania Occidental- ha podido afectar de manera adversa la asignación de talento empresarial en Alemania del Este.

El primer capítulo llamado "Tasas impositivas, Gestión de Gobierno, y la Economía Informal en Países de Renta Alta" estudia los mecanismos detrás de la economía informal en países de renta alta. Alrededor del 16.7% de la producción de los países de renta alta de la OCDE se realizó de manera informal durante los años 2001 y 2002 (Schneider (2002)). Davis and Henrekson (2004) establecen una relación positiva entre tases impositivas y el tamaño de la economía informal para los países de renta alta. Los modelos clásicos de economía informal suelen estar enfocados a países en vías de desarrollo donde la informalidad está vinculada al uso de tecnologías de baja productividad e intensivas en el uso del factor trabajo mientras que este capítulo estudia los mecanismos detrás de la economía informal en países de renta alta.

Para analizar este problema, planteo un modelo similar al de Lucas (1978) en el cual agentes con distintas habilidades para dirigir empresas deciden ser traba-

jadores, emprendedores formales o emprendedores informales. Los emprendedores informales usan la misma tecnología que los emprendedores formales. Sin embargo, a diferencia de los emprendedores formales, los emprendedores informales no pagan impuestos sino que corren el riesgo de ser descubiertos y tener que pagar los impuestos más una multa. Las simulaciones del modelo demuestran que diferencias en las tasas impositivas pueden explicar aproximadamente un 33% de la variación observada en la tasa de economía informal entre países de renta alta. Por otro lado, la calidad de gestión del gobierno – definida como el nivel con el que se hacen cumplir las obligaciones tributarias – desempeña un rol más importante. En concreto, diferencias en la calidad de gestión de gobierno pueden explicar el 43% de la variación. Finalmente, un modelo con ambas características (diferencias en las tasas impositivas y en la gestión pública) puede explicar aproximadamente el 56% de la variación en las tasas de informalidad entre países. A la luz de estos resultados, realizo experimentos que muestran que si todos los países tuviesen la calidad de gestión de gobierno de Suiza, la informalidad se reduciría, en media, en un 15%. Los costes de gestionar tal medida equivaldrían a un 26% del presupuesto medio de Hacienda, mientras que las ganancias en términos de recaudación adicional de impuestos serían diez veces más altas que estos costes.

Este capítulo contribuye a la reducida literatura sobre economía informal en países desarrollados, siendo el primer artículo del que tengo constancia que cuantifica la influencia individual y conjunta de dos factores determinantes de la economía informal: las tasas impositivas y la calida de gestión de gobierno.

En el segundo capítulo llamado "Migración, salarios, y antecedentes familiares: obstáculos a los emprendedores y al crecimiento en Alemania del Este" me pregunto cómo la integración de Alemania del Este con una economía madura, Alemania Occidental, puede haber inhibido un desarrollo fructífero del espíritu emprendedor y cómo esto puede haber ralentizado su crecimiento económico. Alemania Oriental está sufriendo tasas de desempleo altas y tasas de crecimien-

to económico bajas desde hace más de una década y varios actores políticos han hecho hincapié en la falta de espíritu emprendedor en Alemania del Este como una de sus principales causas.

Para responder a esta pregunta construyo un modelo à la Lucas (1978) en un contexto de generaciones superpuestas. Siguiendo Hassler and Rodríguez Mora (2000), el nivel de conocimiento de los emprendedores está compuesto de dos factores: talento innato y antecedentes familiares de emprendedores. El crecimiento económico en este modelo depende solamente del talento innato de los emprendedores. En Alemania del Este, la falta de antecedentes familiares de emprendedores implica que el talento innato es el factor decisivo en la decisión de la ocupación y más emprendedores talentosos deberían contribuir a tasas de crecimiento altas. Sin embargo hay tres aspectos clave de la integración con Alemania Occidental que inhiben este mecanismo: 1) La movilidad sin restricciones de alemanes del Este hacia del Oeste; 2) La política de fijar los salarios en Alemania del Este como fracción de los salarios en Alemania Occidental; 3) La importancia de antecedentes familiares en la decisión de convertirse en emprendedor en Alemania Occidental. Comienzo el análisis con la calibración del modelo básico para que represente a la economía de Alemania Occidental antes de la reunificación, fijando así los parámetros clave que determinan el rol de los antecedentes familiares y el vínculo entre el talento de los emprendedores y el crecimiento. En un segundo paso, amplío el modelo para incorporar aspectos de la reunificación, permitiendo la migración entre las dos Alemanias. Finalmente, y a fin de cuantificar cuáles son los mecanismos más importantes, elimino secuencialmente cada uno de los tres aspectos señalados: migración, salarios, y antecedentes familiares. Los resultados muestran que todos suponen obstáculos para que aparezcan más emprendedores, se reduzca el desempleo y se incremente el crecimiento en Alemania del Este.

Este capítulo contribuye a la literatura siendo el primero, del que tengo conocimiento, que explícitamente modela el vínculo entre la falta de emprendedores y

bajas tasas de crecimiento en Alemania Oriental. Aplica la teoría establecida de la literatura de movilidad social y crecimiento económico al contexto de la transición económica. Alemania del Este ofrece una perspectiva histórica única para estudiar el impacto del talento empresarial en el crecimiento económico al estar formada por trabajadores que carecen de emprendedores entre sus antecedentes familiares más próximos. Este capítulo trata de dar una respuesta a esta cuestión desde un punto de vista cuantitativo.

Contents

Chapter 1

Tax Rates, Governance, and the Informal Economy in High-Income Countries

1.1 Introduction

Informal economic activity was long thought to be a feature of developing countries. Formalization of business was supposed to go hand in hand with economic development. But despite worldwide economic growth, employment has increasingly become informal as stated by the United Nations (2006). Indeed, even among high-income countries a large part of economic activity is informal. Schneider (2002) defines the informal economy as all "unreported income from the production of legal goods and services [...] which would generally be taxable were they reported to the [...] authorities."(p.4).

Schneider (2002)'s estimates of the informal economy, reproduced in Figure 1.1.1, show that on average 16.7% of GDP in high-income OECD countries

Figure 1.1.1: Informal Economy 2001-02 as % of official GDP

Data: Schneider (2002)
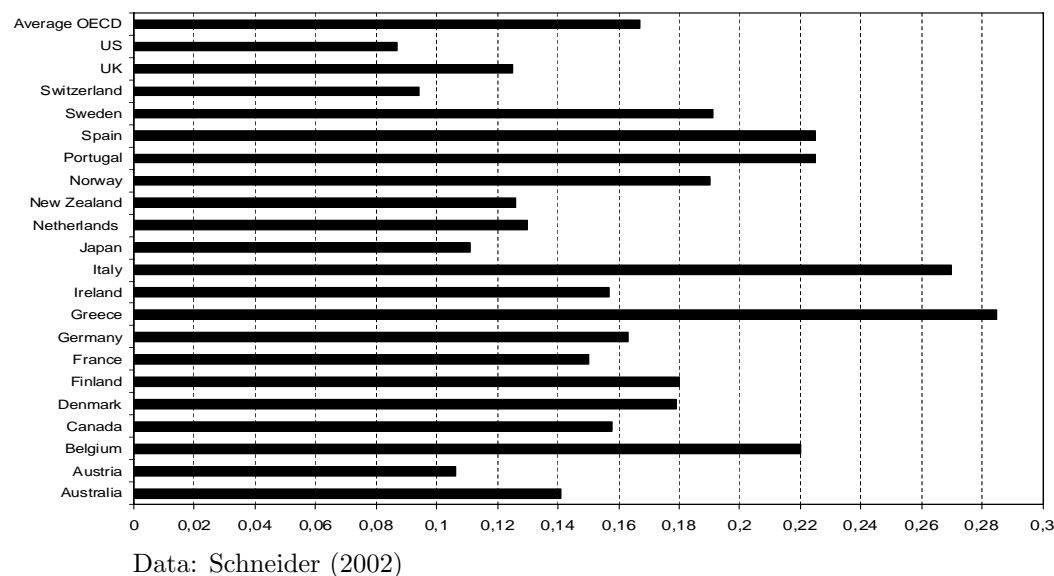
was produced informally in 2001-02.[1] In Greece the informal economy amount-
ed to 28.5% of GDP, whereas in the US an equivalent of 8.7% of GDP was
estimated to have been produced informally.[2] Put differently, the production
of goods and services worth $892 billion (about $3,090 per capita) went un-
taxed in the US, while in Greece production of goods and services worth $49
billion (about $4,380 per capita) escaped taxation.[3]

Given that there are sizable differences in the informal economy, even across

---

[1]In this chapter 'OECD' or 'high-income OECD countries' excludes the following OECD
countries whose GDP per capita in 2001-02 was lower than Greece's or whose population
amounted to less than 1 million inhabitants: Czech Republic, Hungary, Iceland, Korea,
Luxembourg, Mexico, Poland, Slovak Republic, and Turkey.

[2]Frey and Weck (1983) cite various alternative estimates for informality. More recent
estimates are hard to come by. One exception is Alañón Pardo and Gómez de Antonio
(2004) for Spain. According to them, the Spanish informal economy amounts to 20.9% of
GDP (2000), compared to 22.5% (2001-02) estimated by Schneider (2002).

[3]Schneider (2002) estimates the informal economy either by the currency demand ap-
proach that attributes any changes in 'excess' demand in currency to increases in informali-
ty or by the so-called DYMIMIC (dynamic multiple-indicators multiple-causes) model that
incorporates multiple causes of informality into the estimation (see Appendix A.1.1 for a
discussion on methods of estimating the informal economy).

high-income countries, the following two questions arise: What are the driving forces behind informal economic activity in high-income countries? To what extent can differences in these driving forces account for cross-country differences in the informal economy?

Figure 1.1.2: Tax Rates and the Informal Economy 95-96
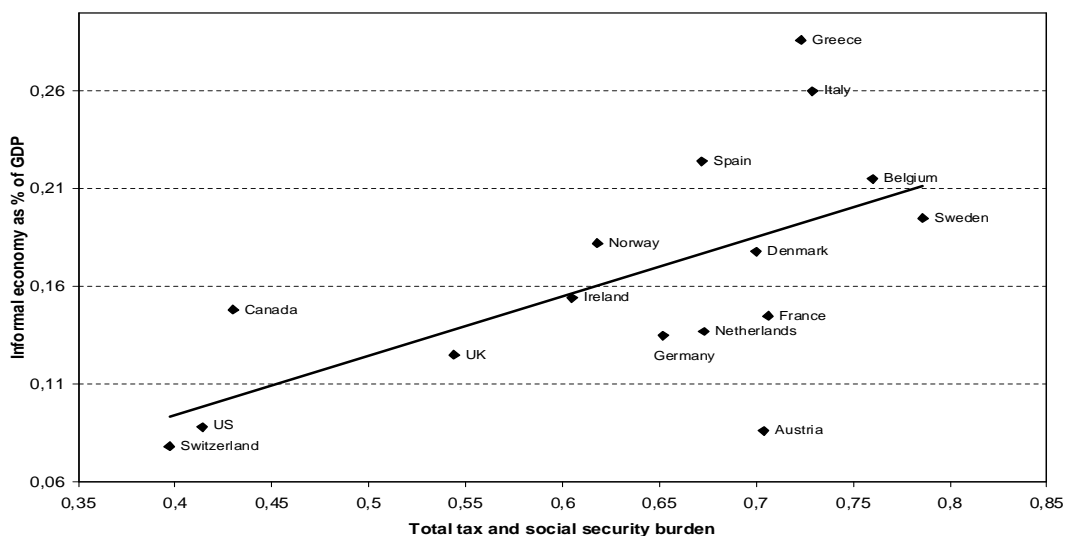
Data: Schneider (2002)

A recent paper by Davis and Henrekson (2004) provides one possible answer to the first question. Across 16 high-income OECD countries the authors find a positive and significant relation between tax rates and the informal economy. Figure 1.1.2, which relates tax rates on income and consumption and social security contributions to the size of the informal economy, is a replication of their result. Despite a positive relation between tax rates and the informal economy, for countries with equally high tax rates, informal economy estimates are strikingly different. In 1995-96, Austria and Italy had similar total tax rates on income and consumption and social security contributions of around 70% and 75%. But whereas Austria's informal economy was estimated to amount to 8.6% of GDP, the estimate for Italy was 26%. On the other hand, Austria and Switzerland were estimated to have a similar sized informal economy but

7

differed strikingly in their total tax rates on income and consumption. Apart
from tax rates additional forces seem to drive the informal economy in high-
income countries.

Lack of institutional quality and corruption are possible suspects. Their
importance for explaining differences in informal economy has been illustrated
by various empirical studies. Friedman et al. (2000), Chong and Gradstein
(2007), and Johnson et al. (1998) all find a positive relation between lack of
institutional quality, a large regulatory burden, corruption and the informal
economy. The link between institutional quality and the informal economy also
holds for high-income countries. The Global Competitiveness Survey carried
out by the World Economic Forum (2003) provides a measure of institutional
quality. It asks business executives for their opinions on various aspects of the
country they operate in, among others on government and institutions and in
particular about the competence of public sector personnel, quality of general
infrastructure, and time spent by senior management dealing with government
officials. I use a ranking of countries based on answers to these particular as-
pects of the Global Competitiveness Survey (GCI-Governance) as a measure
of institutional quality.[4] Figure 1.1.3 displays the negative relation across 21
high-income OECD countries between the GCI-Governance Index and esti-
mates of the informal economy.[5]

---

[4]The same part of the Global Competitiveness Survey referring to aspects of institu-
tional quality is used by the World Bank to construct its Government Effectiveness Index
(Kaufmann et al. (2006)). Throughout the chapter, I will refer to it as the GCI-Governance
Index.

[5]The negative relationship is robust to various alternative measures of institutional qual-
ity by the World Bank as the Control of Corruption Index, the Regulatory Quality Index
or the Rule of Law Index (Kaufmann et al. (2006)) as well as Transparency International
(2002)'s anti-corruption index. The negative relationship is also robust to the exclusion of
Greece and Portugal, the two poorest among the 21 high-income OECD countries. Percent-
ages of affirmative answers to "if cheating on taxes is justified" and "if almost all compatriots
cheat on taxes"(World Value Survey (2000)), are clearly positively related to estimates of
the informal economy.

Figure 1.1.3: GCI-Governance and the Informal Economy
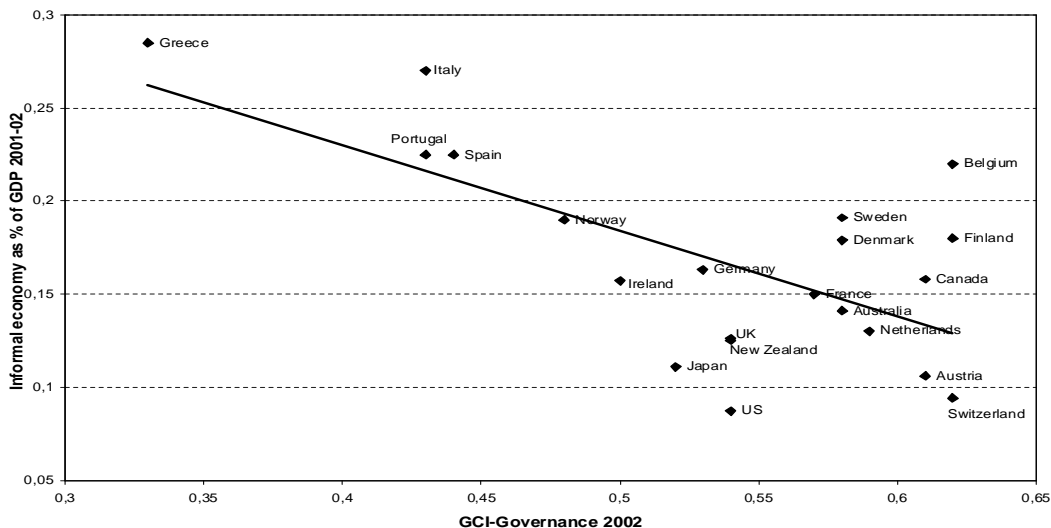
Data: Schneider (2002) and Kaufmann et al. (2006)

In contrast to the current chapter, the existing literature on the informal economy has almost exclusively looked at developing countries. Most models propose mechanisms that link informality to labor-intensive economic activities of low productivity. An informal firm in these models is defined up front as less productive and it faces higher input prices, mainly for capital. This chapter on the other hand tries to account for the informal economy in high-income countries and characterizes an informal firm as a common firm that evades taxes and faces a risk of getting caught. It stresses the positive link between tax rates and informality that can only be broken by high quality institutions.

The current chapter proposes a model that relates differences in the size of the informal economy and tax evasion to differences in tax rates and institutional quality. Institutional quality determines the extent to which tax rates are enforced. In the model economy, there is a representative household and a government. The household has a continuum of members who differ in their managerial ability, as in Lucas (1978). Given their abilities, household

members can become workers, set up an informal firm and evade taxes, or set up a formal firm and pay taxes. Firms producing informally face a probability of getting caught, taxed, and fined. Formal and informal managers have access to the same technology that uses labor, capital, and their managerial ability as inputs. Occupational choices in this economy are characterized by two thresholds for managerial ability. The first threshold defines who becomes a worker and who will be an informal manager. The second threshold divides informal and formal managers. These two thresholds determine the size of the informal economy, and they depend on tax rates and the probability that an informal firm gets caught evading taxes.

A calibrated version of the model quantifies the influence of tax rates and governance quality on informality. It shows that differences in tax rates alone can only account for approximately 33% of the observed variation in informal economy across high-income countries, while differences in governance quality, the extent to which these tax rates are enforced, can account for about 43% of the variation. When combining both, differences in tax rates and differences in governance quality, the model accounts for 56% of the variation in informality across high-income countries. I run a policy experiment with all countries attaining the best governance quality observed (Switzerland's) and show that in this case average informality drops by approximately 15%. Furthermore, I estimate average costs of this policy to be equivalent to at most 26% of the average tax administration's budget and find gains in tax revenues to be around ten times larger than these costs. Even by conservative costs estimates, countries gain both in terms of reduced informality and increased tax revenues when adopting this policy.

Among recent models of the informal economy, the ones that are closely related to this chapter are Amaral and Quintin (2006), Antunes and Cavalcanti (2006), Prado (2007), and Aruoba (2009).[6] Amaral and Quintin (2006) try to

---

[6]Another important strand of literature looks at the effects of the informal economy on

account for characteristics of the labor market in developing countries, where despite free entry to the formal sector informal workers tend to be less educated and are paid less than formal workers. In their model, the informal economy arises from imperfections in the capital market due to a lack of commitment to financial contracts. Antunes and Cavalcanti (2006) use a similar framework where employment tax, entry costs into the formal sector, and access to credit lead to a more capital-intensive production by formal firms. The authors examine the separate and joint influence of regulation costs and enforcement costs of financial contracts on the informal economy. Prado (2007) builds a model of monopolistic competition where firms can decide to operate formally by paying taxes and an entry cost, or to operate informally paying an enforcement cost. The author quantifies the influence of government policy, consisting of tax rates, entry costs to the formal sector, and levels of enforcements on the informal economy by backing out unobserved levels of enforcement for all OECD countries and Brazil. Recent work by Aruoba (2009) models informal and formal markets in the spirit of day and night markets. The author relates informality, inflation, taxes, measured output, and governance in a framework where tax policy and inflation rates are being set endogenously by a benevolent planner. I view his results as complementary to mine as they highlight the relation between inflation and informality.

However, none of these recent models addresses the two questions this chapter attempts to answer, "What are the driving forces behind informal economic activity in high-income countries?" and, "To what extent can differences in these driving forces account for cross-country differences in the informal economy?"[7] Providing answers to these questions is important for two reasons. To start with, there exists little empirical work on the environment of the informal

---

economic growth; see for example Loayza (1997) and Sarte (2000).

[7]Busato and Chiarini (2004) is one of the few works that looks specifically at the informal economy in a high-income country. However, the authors do not address the question of why the informal economy exists, instead they study the business cycle dynamics of the Italian economy assuming an exogenously less productive informal sector.

economy in developed countries. Williams and Windebank (1998) compare local studies of the informal economy in high-income countries and do not find any clear patterns on earnings, type of workers, or their motivations.[8] The sparse and vague findings thus stand in contrast to the clear picture of the informal economy in developing countries as an environment where low skilled individuals, unable to enter formal employment engage in low-productive activities.[9]

Secondly, whereas the costs of establishing a formal business seem to play an important role for developing countries, no robust relation between the "Ease-of-Starting-Business-Index" (Djankov et al. (2002)) and informality can be established for high-income countries.[10] Therefore, a focus on the fixed costs for establishing a formal business does not seem to be adequate for the study of the informal economy in high-income countries. Instead, an emphasis on the role of tax rates and quality of governance, as in this chapter, seems more appropriate for the proposed analysis, because across high-income countries tax rates are clearly positively related to the size of the informal economy. For a broader group of countries, however, there is no consensus about the relation between taxes and the informal economy.[11]

The remaining of this chapter is organized as follows. The next section presents the model in greater detail. I then describe my calibration strategy.

---

[8]For Germany, Schneider (2006) find that of those working informally 43% have a full employment in the formal economy compared to only 6.5% who are unemployed.

[9]The International Conference of Labour Statisticians characterizes the informal economy in developing countries as "consisting of units engaged in the production of goods and services with the primary objective of generating employment and income to the persons concerned." (Paragraph 5).

[10]The initially positive relationship loses any significance when excluding Greece and Portugal from the sample of 21 high-income OECD countries.

[11]For 49 countries Johnson et al. (1998) establish a positive relation between high taxes and informal economy, whereas Friedman et al. (2000) looking at 69 countries argue that higher taxes are related to better functioning public administrations and hence to less informal economy.

Section 1.4 presents the results. In Section 1.5 I perform a policy experiment, and Section 1.6 concludes.

1.2 The Model

The set-up follows Lucas (1978)'s span-of-control model. There is a single representative household and a government in this economy. The household is made up of a continuum of members with different managerial abilities.[12] According to their managerial abilities, household members either become workers or managers. Managers produce a homogenous good by using labor, capital, and their ability as inputs. Managers can operate a formal firm and pay taxes to the government, or they can choose to operate an informal firm and evade taxes. Tax evaders run the risk of getting caught, taxed, and fined by the government. The larger their firm, the greater is the risk they face. Given incomes of all household members, the household decides jointly about consumption and savings.

Household The household is composed of a continuum of members. Its total size is normalized to unity. The household lives forever and maximizes the infinite sum of discounted utilities given by

$$\sum_{t=0}^{\infty} \beta^t log(C_t), \tag{1.2.1}$$

where C_t denotes total household consumption at time t, and $\beta \in (0,1)$ is the discount factor.

---

[12] By assuming a single representative household I abstain completely from any effects of occupational choice on the distribution of income, but focus on the effects on firm set-ups instead.

Endowments   Each household member has one unit of productive time that he supplies inelastically. Household members differ in their managerial abilities (z). For each individual this ability is time invariant. It is distributed in $Z = [0, \bar{z}]$ with cdf $F(z)$ and density $f(z)$. The household assigns occupations to its members depending on their abilities. They can become workers, set up an informal firm, or operate as formal entrepreneurs.

Production   Both formal and informal managers have access to the same technology. They hire workers, rent capital, and produce a single output, which is used for consumption and investment, according to

$$Y_t = F(z, n_t, k_t) = z^{1-\gamma}(k_t^{\nu} n_t^{1-\nu})^{\gamma}, \qquad (1.2.2)$$

where $\gamma \in (0, 1)$ is the span-of-control parameter and $\nu\gamma \in (0, 1)$ is the capital share of production.

Formal managers   Formal managers pay a proportional tax (τ) on profits. They choose the optimal amount of labor and capital in order to maximize their profits net of taxes. Given a wage rate (w_t) and a rental rate for capital (R_t), their problem is

$$\max_{\{n_t, k_t\}} \pi_t^f = (1-\tau)\pi_t = (1-\tau)[z^{1-\gamma}(k_t^{\nu} n_t^{1-\nu})^{\gamma} - w_t n_t - R_t k_t].$$

Combining the two first order conditions of this maximization problem, the optimal capital-labor ratio for formal managers is given by,

$$\frac{k_t}{n_t} = \frac{\nu}{1-\nu}\frac{w_t}{R_t}, \qquad (1.2.3)$$

which is independent of the tax rate (τ). This implies that optimal profits of formal managers are given by

$$
\pi_t^f(z, w_t, R_t) = (1-\tau)(1-\gamma)^{\frac{1}{1-\gamma}} z \left(\frac{\gamma(1-\nu)}{w_t} \right)^{\frac{\gamma}{1-\gamma}} \left(\frac{\nu}{1-\nu} \frac{w_t}{R_t} \right)^{\frac{\nu\gamma}{1-\gamma}} . \quad (1.2.4)
$$

Higher wages (w_t) and interest rates (R_t) reduce formal managers' profits, as do higher tax rates (τ) and a larger span-of-control parameter (γ). Higher managerial talent (z), on the other hand, increases profits of the formal manager.

Informal managers Informal managers do not pay taxes. They run, however, the risk of getting caught by the government. If they are caught, they are taxed just as their formal counterparts. In addition they have to pay a fine M. If their profits are too low to cover the fine, the government seizes their total available profits.

Let $p(z)$ denote the probability of getting caught for a manager of talent z. I assume that this probability increases with firm size.[13] Hence, $p(z)$ is given by

$$
p(z) = \frac{1}{(1+e^{-\sqrt{z}})^{1/\theta}} \quad with \quad \theta > 0 . \quad (1.2.5)
$$

Figure 1.2.1 shows the function $p(z)$, bounded above at one. For a given z, $p(z)$ is increasing in θ, i.e. a higher θ is associated to a higher probability of getting caught.[14]

---

[13]This approach is similar to Fortin et al. (1997) who assume costs of evading taxes and regulations to increase with firm size. Note that there is a one-to-one mapping between labor demand and managerial talent z, since $n(z, R_t, w_t) = z \Upsilon R^{\frac{-\nu\gamma}{1-\gamma}} w^{\frac{\nu\gamma-1}{1-\gamma}}$ where Υ is a constant; a similar relationship holds for the demand of capital. Making detection depend on n or k directly would distort input choices, which is not the primary interest of the current chapter.

[14]Note that Figure 1.2.1 is drawn for very small values of θ that arise in the calibration of the model to data (see Section 1.3), hence $p(0) \simeq 0$.
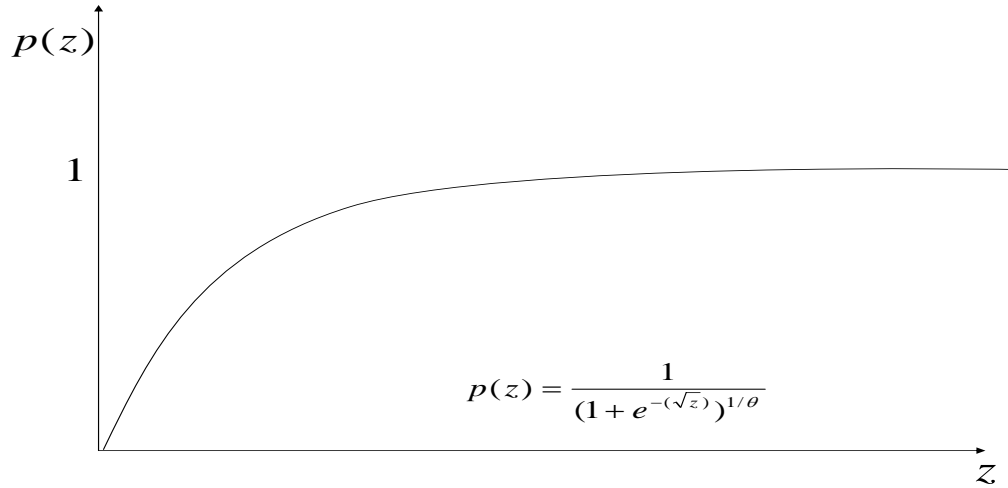
Figure 1.2.1: The probability of getting caught as a function of z

Then informal managers face the following profit maximization problem

$$\max_{\{n_t, k_t\}} \pi_t^i = (1 - p(z))\pi_t + p(z)\max\{0, (1-\tau)\pi_t - M\}.$$

Given that taxes are paid on profits and prices for inputs are the same for informal and formal managers, input choices are not distorted and informal managers' optimal decision rules for labor and capital inputs are identical to the ones for formal managers.[15] Therefore, the optimal capital-labor ratio for informal managers is also given by equation (1.2.3).[16]

Informal managers' *expected* optimal profits are given by:

$$\pi_t^i(z, w_t, R_t) = \begin{cases} \frac{(1-p(z))}{(1-\tau)}\pi_t^f(z, w_t, R_t) & for \quad M \geq \pi_t^f(z, w_t, R_t) \\ \frac{(1-p(z)\tau)}{(1-\tau)}\pi_t^f(z, w_t, R_t) - p(z)M & for \quad M < \pi_t^f(z, w_t, R_t). \end{cases}$$

$$(1.2.6)$$

---

[15] As long as workers or capital owners do not know which firms pay taxes and which do not, they cannot charge higher wages or higher rental rates of capital to informal firms.

[16] In contrast to Guner et al. (2008) and Restuccia and Rogerson (2008) who consider how policies distort input decisions, this chapter looks at firm specific decisions, to pay or to evade taxes, given a common tax policy.

16

Informal managers whose profits net of taxes are smaller than the fine for evading taxes, lose all their profits if caught. They expect to make profits only if they successfully evade taxes. In this case, their expected profits are equal to the ones of formal managers before taxes. More talented informal managers know that their profits net of taxes will suffice to pay the fine if caught. They thus expect their profits to be a convex combination of before tax profits and profits net of taxes minus the fine.

Given the functional forms of $\pi_t^f(z, w_t, R_t)$ and $\pi_t^i(z, w_t, R_t)$, there exist two unique thresholds $z_t^\star$ and $\hat{z}_t$. Household members with managerial ability below $z_t^\star$ will become workers. The income level of all workers is identical and equal to the wage rate (w_t). Those with abilities z such that $z_t^\star < z < \hat{z}_t$ will become informal managers. Finally, members of the household with $z > \hat{z}_t$ set up formal businesses. Figure 1.2.2 captures this idea.
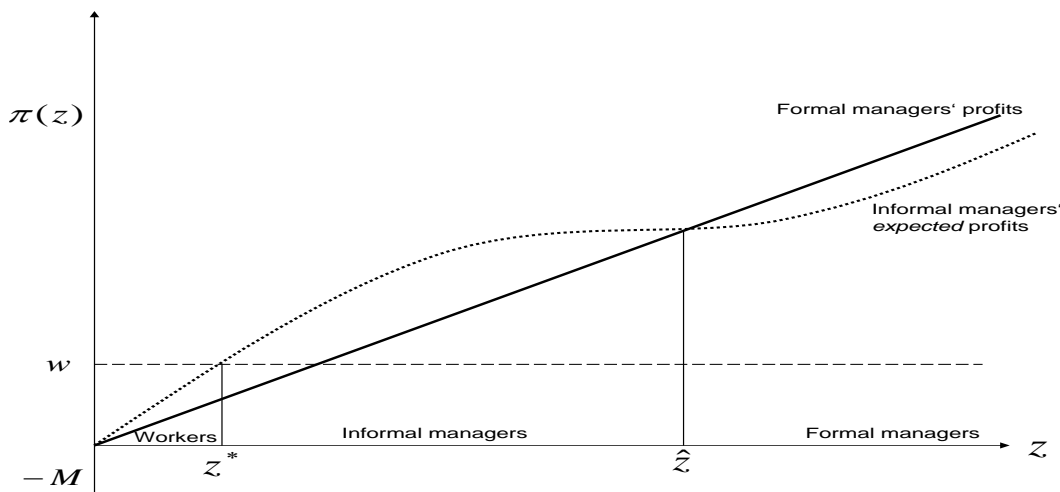
Figure 1.2.2: Thresholds for occupational choices

Informal managers' expected profits are a convex combination of before tax profits and taxed profits minus the fine. Managers of talent $z < \hat{z}$ face a low probability of getting caught. That is why they expect to make more profits as informal managers than as formal managers. As z increases, the probability of

getting caught also increases and the two profit functions cross. Subsequently, as $p(z) \to 1$, informal managers' profits become a linear function of taxed profits minus the fine.

The Household's problem   The household chooses sequences of consumption and savings, and the optimal occupation for each household member. Formally the household chooses $\{C_t, K_{t+1}, I^w_{z<z^\star}, I^i_{z^\star<z<\hat{z}}, I^f_{\hat{z}<z<\overline{z}}\}$ in order to maximize (1.2.1) subject to

$$
\begin{aligned}
C_t + K_{t+1} = \ & R_t K_t + (1 - \delta)K_t + I^w_{z<z^\star} w_t F(z_t) + \\
& + I^i_{z^\star<z<\hat{z}} \int_0^{\overline{z}} \pi^i_t(z, w, R) f(z) dz + \\
& + I^f_{\hat{z}<z<\overline{z}} \int_0^{\overline{z}} \pi^f_t(z, w, R) f(z) dz,
\end{aligned}
$$

and

$$
K_0 > 0.
$$

The solution to the household's problem is characterized by the following three first order conditions

$$
\frac{1}{C_t} = \beta(1 + R_{t+1} - \delta)\frac{1}{C_{t+1}}, \tag{1.2.7}
$$

$$
w_t = \pi^i_t(z^\star_t, w_t, R_t), \tag{1.2.8}
$$

and

$$
p(\hat{z}_t)M = (1 - p(\hat{z}_t))\tau \pi_t(\hat{z}_t, w_t, R_t). \tag{1.2.9}
$$

Condition (1.2.7) is the standard Euler equation for optimal capital accumulation. Condition (1.2.8) is similar to Lucas (1978)' condition for the 'marginal' manager. A household member with managerial ability $z^\star_t$ is indifferent between working or setting up an informal firm. His wage has to equal the profits he expects to make as an informal manager.

The additional condition (1.2.9) determines the second threshold for the occupational choice. Household members who have not become workers, i.e those with managerial abilities $z > z^\star$, face a second choice. They compare their income as formal managers to their expected income as informal managers. Whenever $\pi_t^f(z, w_t, R_t) \geq \pi_t^i(z, w_t, R_t)$ they go formal. Condition (1.2.9) compares costs and benefits of being an informal manager. A household member with managerial ability $\hat{z}$ is indifferent between keeping his firm informal or going formal. His costs equal his benefits of informality, where his costs are the fine weighted by the probability of getting caught and his benefits are the tax burden weighted by the probability of not getting caught.

Government The government collects taxes on profits from formal firms and from those informal firms that are caught. In addition it collects the fines from these same informal firms. In case these firms are not able to pay the fine the government seizes their profits. Government revenues are used for pure government consumption only. Each period the government has to fulfill the following constraint

$$G_t = \int_{\hat{z}_t}^{\overline{z}} \tau \pi_t(z, ;) f(z) dz + \int_{z_t^\star}^{\hat{z}_t} p(z) \tau \pi_t(z, ;) f(z) dz +$$

$$+ \int_{z_t^\star}^{\hat{z}_t} p(z) \min((1 - \tau)\pi_t(z, ;), M) f(z) dz. \qquad (1.2.10)$$

Equilibrium In equilibrium all three markets, i.e. for goods, capital, and labor, must clear. Denote by $n(z, w_t, R_t)$ and $k(z, w_t, R_t)$ demands for labor and capital services by a manager of ability z.[17] Then for the labor market to clear we require

$$N_t = \int_{z_{t\star}}^{\hat{z}_t} n(z, w_t, R_t) f(z) dz + \int_{\hat{z}_t}^{\overline{z}} n(z, w_t, R_t) f(z) dz. \qquad (1.2.11)$$

---

[17]Recall that factor demands for informal and formal managers do not differ.

Aggregate labor supply $N_t = F(z_t^\star)$ has to equal the sum of the labor demands of informal and formal managers. For the capital market to clear we need

$$K_t = \int_{z_t^\star}^{\hat{z}_t} k(z, w_t, R_t) f(z) dz + \int_{\hat{z}_t}^{\overline{z}} k(z, w_t, R_t) f(z) dz. \qquad (1.2.12)$$

With $y(z, w_t, R_t)$ being the supply of goods by any manager of ability z, for market clearing in the goods market we require

$$\int_{z_t^\star}^{\hat{z}_t} y(z, w_t, R_t) f(z) dz + \int_{\hat{z}_t}^{\overline{z}} y(z, w_t, R_t) f(z) dz = C_t + K_{t+1} - K_t + \delta K_t + G_t.$$
$$(1.2.13)$$

We can now define a competitive equilibrium for the model economy. Given a government policy $\{\tau, M, p(z)\}$ and a sequence of prices for labor and capital $\{w_t, R_t\}_0^\infty$, a competitive equilibrium is a collection of sequences $\{C_t, K_{t+1}, G_t, z_t^\star, \hat{z}_t, I_{z<z^\star}^w, I_{z^\star<z<\hat{z}}^i, I_{\hat{z}<z<\overline{z}}^f\}_0^\infty$ such that:

1. $\{C_t, K_{t+1}, I_{z<z^\star}^w, I_{z^\star<z<\hat{z}}^i, I_{\hat{z}<z<\overline{z}}^f\}_0^\infty$ solves the household's problem;

2. all three markets, for goods, capital, and labor clear for all t, i.e. equations (1.2.11)- (1.2.13) hold;

3. the government budget constraint is fulfilled, i.e. equation (1.2.10) holds.

Absent any exogenous growth, there will be a steady state with all variables remaining constant.

Two factors, tax rates and the quality of institutions, are clearly related to the size of the informal economy across high-income countries (see Figures 1.1.2 and 1.1.3). These factors also play a key role in the model. The purpose of this chapter is to assess the quantitative importance of these driving forces behind the informal economy across high-income countries. In particular I would like to answer questions like: "How much of the variation in informality across high-income countries is due to different tax rates?" "Can different

tax rates and differences in governance quality fully account for differences in the informal economy across high-income countries?" The following sections undertake the quantitative analysis needed in order to address these questions.

1.3 Calibration Strategy

Some parameters of the model are fixed a priori based on available evidence. I calibrate the model's remaining parameters by matching certain key statistics to French data. France is chosen as a representative country because its average firm size, informal economy, and employment and establishment shares of firms with less than ten employees are closest to the mean values of these four variables across all 21 high-income countries.[18]

The tax rate (τ) in the model is fixed, based on available data. Entrepreneurs' profits are subject to income tax and only incorporated companies are subject to corporate taxes. Hence as an estimate of the profit tax in the model, I use what the OECD (2003) calls 'tax wedge'. Data for this measure is available for all 21 countries and includes income tax, employee and employer social security contributions less cash benefits, applicable to a single individual without children and earnings equal to that of the average production worker. To be able to compare my estimates to Schneider (2002)'s estimates of the informal economy for 2001-02, I take an average over the annual rates for both years. For the countries considered, between $40-60\%$ of all tax revenues stem from income taxes and social security contributions. Tax data used in Figure 1.1.2 is for 1996 and taken from Schneider (2002) and combines 'tax wedge' and value-added tax. Since the positive relationship between tax rates

---

[18]For average firm size, the size of the informal economy, and employment and establishment shares for firms with less than 10 employees, I compute the squared differences between the mean values across all 21 countries and the values for each country. Then I sum the squared differences across the four variables for each country. The calculated sum of squared differences is lowest for France.

and informal economy is robust over time as well as to the exclusion of value-added tax, in the current exercise I chose to use more recent data for 2001-02 and to leave aside value-added tax rates.[19] For the annual depreciation rate of capital (δ) I pick the standard value of 0.1, as in Prescott (1986).

Next, I choose the technology parameters, the span-of-control-parameter (γ) and the share of capital (ν) and I pick the fine for tax evasion (M), the parameter for the probability function of getting caught (θ), and the discount factor (β). I also specify the distribution of managerial ability $F(z)$. I assume that $F(z)$ is log-normally distributed with mean (μ) and standard deviation (σ).[20] These seven parameters are determined by matching seven targets; i.e. average firm size, employment and establishment shares of small firms, capital-output ratio, capital share, the surcharge on tax evaded, and the size of the informal economy for France. Table 2.4.9 displays calibration targets, next to target values and the resulting statistics in the model.

According to the European Commission (2003) average firm size in France was 8 workers per firm, excluding public enterprises and establishments in agriculture, fishing, forestry and hunting. I set the span-of-control parameter in the production function (γ) to 0.748 to match this statistic. Employment and establishment shares of firms are closely linked to the distribution of managerial ability. In France, 37.1% of all workers are employed by firms that have 0 to 9 employees (micro firms). These firms make up 93% of all establishments

---

[19]The positive relationship between tax rates and the informal economy across high-income countries is also robust to alternative measures of tax burden by Nickell and Nunziata (2001). Given its collection mechanism, avoiding payments of value-added tax requires networks of informal firms as in de Paula and Scheinkman (2007); with those avoiding taxes only buying from and selling to others avoiding taxes. Other major taxes are corporate taxes. However, across high-income countries there is no linear statistical relation between corporate tax rates and the informal economy.

[20]Assuming that these parameters are homogenous across countries is a strong stand and attributes all differences in informal economy to differences in policy. It is the adequate stand point here as I want to answer the question, of how much different policy (tax rates and institutions) can account for differences in informal economy.

Table 1.3.1: Calibration Targets and Model Values for France

	Target	Model
Average firm size	8.0	8.0
Employment share of micro firms (0-9 employees)	37.1%	37.1%
Establishment share of small firms (0-9 employees)	93%	79%
Capital-output ratio	2.3	2.3
Capital share	0.319	0.319
Surcharge on tax evaded	80%	80%
Informal economy	15.0%	15.0%

(European Commission (2003)). In order to match employment and establishment shares of micro firms in France I choose the mean log-managerial ability (μ) to be 0 and set the standard deviation of log-managerial ability (σ) to 2.129.[21]

The discount factor (β) is set to 0.9628 to match a capital-output ratio for France of 2.3 (Maddison (1995)). In the model, $\gamma\nu$ is the share of capital income. Given γ, the parameter ν is set to 0.4265, to be able to generate a capital share adjusted for labor shares for self-employed income of 0.319 (Gollin (2002)).[22] I set θ to 0.00706 to match the estimate by Schneider (2002) that 15% of GDP was produced informally in France in 2001-02. Next, I determine the fine for tax evasion (M). According to standard procedures of tax administrations, if firms are found to evade taxes deliberately, they have to pay their tax debt and are fined in addition. Fines across the 21 countries considered range from surcharge on taxes evaded, to surcharge on undeclared income, to fixed fines, or even imprisonment.[23] The most commonly

---

[21]This simple functional form for the distribution of managerial talent has the shortcoming that one has difficulties matching employment shares and establishment shares simultaneously. This can be achieved assuming an extra tail for very talented managers as in Guner et al. (2008). However, as the focus of this chapter is on small informal firms rather than on large firms, I stick to a simple log-normal distribution for managerial talent.

[22]The adjustment for self-employed income makes labor shares relatively constant across countries.

[23]See OECD's Centre for Tax Policy Administration (2006) for a detailed description on tax administration procedures in OECD countries, including fines imposed for deliberate

imposed fine among the countries considered is a surcharge on taxes evaded.[24]
In France, penalties for deliberate tax evasion range from 10-80% of tax evaded.
I fix the fine for deliberate tax evasion (M) to a value of 1.005 to match
an average surcharge on tax payable of 80%.[25] Table 2.4.8 summarizes all
parameter values.

Table 1.3.2: Parameter Values

Depreciation rate (δ)	0.1
Span-of-Control (γ)	0.748
Mean log-managerial ability (μ)	0
Dispersion in log-managerial ability (σ)	2.129
Discount factor (β)	0.9628
Importance of capital (ν)	0.4265
Parameter for probability of getting caught (θ)	0.00706
Fine for evading taxes (M)	1.005

1.4 Results

Tax Rates and the Informal Economy Given parameter values of Ta-
ble 2.4.8, the model can be simulated with different tax rates to generate
cross-country differences in informal economy. Figure 1.4.1 displays the re-
lation between informal economy estimates by Schneider (2002) and those
produced by the model when only differences in tax rates are taken into ac-
count (Model 1). If all other parameter values are the same for all countries, in
particular if informal managers in all other countries face the same probability
of getting caught evading taxes as informal managers in France, the informal

---

tax evasion.

[24]In this model imposing a surcharge on tax evaded instead of a fixed fine would make
tax evasion independent of the tax rate and a function of the surcharge rate only.

[25] Let s be the surcharge on tax payable, $\tau\pi^*$. Then fixing M, tax rate, and average
before-tax profits of informal managers for the Benchmark country, one obtains the value
for $s = \frac{M}{\tau\pi^*}$.

economy in most countries is lower than in the data. Thus, mean informality in this specification of the model is more than three percentage points lower than in the data (see column 2 of Table 1.4.1). For Netherlands, Germany, UK, and Japan estimates of informality by Model 1 are close to the data. This result suggests that for these four countries tax rates differences with respect to France can account for relative differences in informality.

Figure 1.4.1: Informal Economy Estimates in Model with Differences in Tax Rates Only vs. Data
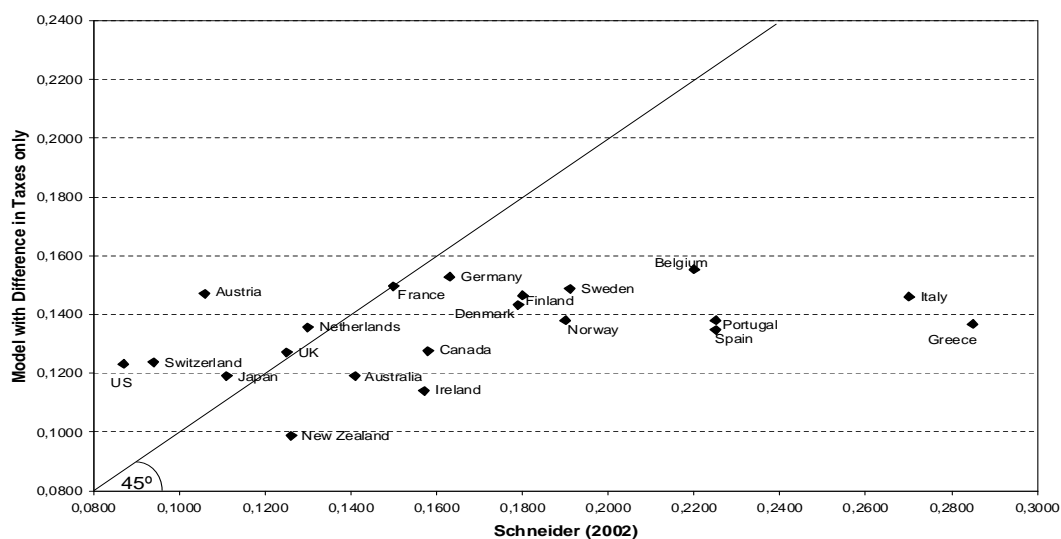
Data: Schneider (2002)

For Austria, Switzerland, and the US informality is overestimated, while for the remaining thirteen countries Model 1 underestimates the informal economy. Hence for most countries, differences in tax rates alone cannot account for differences in informality. In particular, a model with tax rates as the only source of heterogeneity among countries can only account for about one third of the variation in informality across high-income countries. The coefficient of variation for results on informality produced by Model 1 is equal to 33% of the coefficient of variation for Schneider (2002)'s estimates of informality. Hence, in order to better account for the variation in informal economy across countries, differences in governance quality, the extent to which these tax rates are enforced, have to be taken into account.

25

Table 1.4.1: Informal Economy: Data and all Model Specifications*

Country	Data Schneider (2002)	Model 1 Taxes Only	Model 2 Gov. Only	Model 3 Taxes + Gov.
Greece	0.285	0.137	0.226	0.214
Italy	0.270	0.146	0.189	0.186
Portugal	0.225	0.135	0.189	0.175
Spain	0.225	0.138	0.186	0.175
Belgium	0.220	0.155	0.138	0.144
Sweden	0.191	0.149	0.148	0.146
Norway	0.190	0.138	0.175	0.163
Finland	0.180	0.146	0.138	0.134
Denmark	0.179	0.143	0.148	0.141
Germany	0.163	0.153	0.161	0.164
Canada	0.158	0.128	0.140	0.117
Ireland	0.157	0.114	0.168	0.133
France	0.150	0.150	0.150	0.150
Australia	0.141	0.119	0.148	0.116
Netherlands	0.130	0.136	0.144	0.130
New Zealand	0.126	0.099	0.158	0.107
UK	0.125	0.127	0.158	0.136
Japan	0.111	0.119	0.163	0.133
Austria	0.106	0.147	0.140	0.137
Switzerland	0.094	0.124	0.138	0.112
US	0.087	0.123	0.158	0.131
Mean Informality	0.167	0.135	0.160	0.145
Coefficient of Variation	1.46	0.49	0.63	0.82
Mean squared error		0.0034	0.0018	0.0017
Rank correlation coefficient (Spearman)		0.48	0.41	0.77

*Countries appear in decreasing order of informal economy.

Governance and the Informal Economy   Governance quality means good institutions and a high quality government that indicate that a country is coherently enforcing its policies and that tax evaders are caught with a high probability. Corruption on the other hand poses an obstacle to the enforcement of policies. Within the model, the parameter θ, governing the probability of getting caught producing informally can be interpreted as a measure of the quality of governance.

I take the calibrated value for θ and search for a simple mapping from the French value for the GCI-Governance Index (GCI^{Fr}), into the calibrated value for θ. In particular, I set $\theta = aGCI^{Fr}$, where a is a constant.[26] Then I apply the same linear mapping to the GCI-Governance Indices for all other countries to obtain a transformed index of governance quality θ^i, suitable for the model. Given the simple linear transformation, these values are given by

$$\theta^i = aGCI^i.$$

Figure 1.4.2 shows the relation between informal economy estimates by Schneider (2002) and those produced by the model specification that keeps tax rates fixed at the French level and only varies θ^i across countries (Model 2). Column 3 of Table 1.4.1 reports the values for the informal economy produced by Model 2.

Mean informality under this specification is closest to the data. Most countries' informal economy estimates by Model 2 are on average closer to the data than those produced by Model 1, reducing the mean squared error by 47%. The model's coefficient of variation indicates that 43% of the variation in informality across high-income countries is accounted for by a model in which differences in governance quality are the only source of heterogeneity

---

[26] With GCI^{Fr} equal to 0.57 for 2002 and the calibrated value for θ being 0.00706, the constant a is equal to 0.0124.

among countries. Across high-income countries, differences in the quality of governance, the extent to which tax rates are enforced, seem to play a more important role for explaining the variation in informality than differences in tax rates. However, the model's ranking of countries according to their informality compared to the data is worse when compared to Model 1, lowering the rank correlation coefficient. And for the UK, Netherlands, US, Japan, and Switzerland estimates of the informal economy produced by Model 2 are farther from the data than those produced by Model 1. This suggests that to account for some countries' informality, relative differences in tax rates with respect to France seem to be more important than relative differences in governance quality.

Figure 1.4.2: Informal Economy Estimates in Model with Differences in Governance Quality Only vs. Data

Data: Schneider (2002)
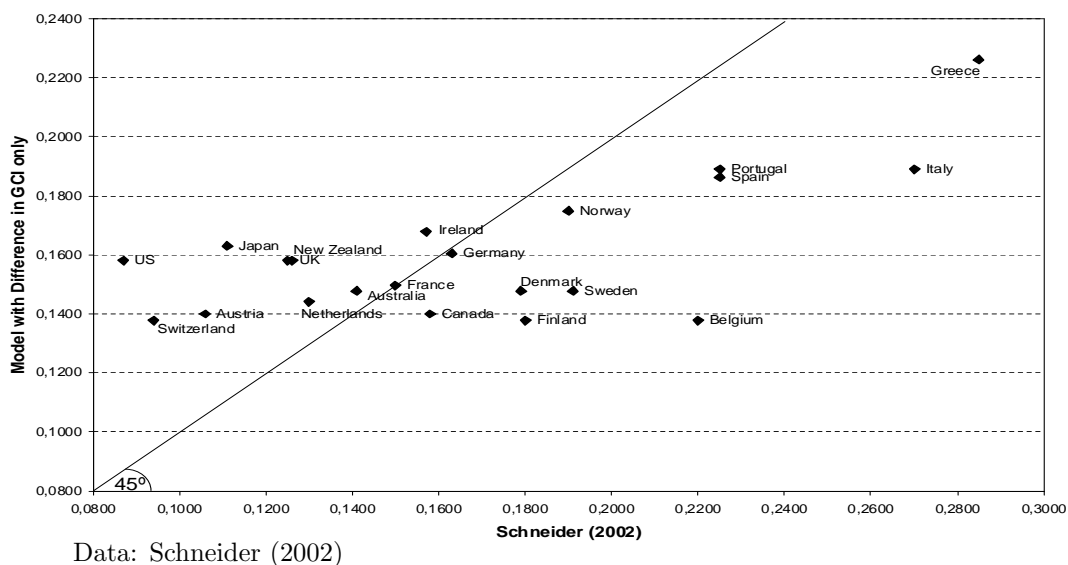
Tax Rates, Governance, and the Informal Economy   When combining both, differences in tax rates and differences in governance quality (Model 3) the model's explanatory power is further increased (see Figure 1.4.3). Column 4 of Table 1.4.1 shows that the third specification of the model can account

Figure 1.4.3: Informal Economy Estimates in Model with Differences in Tax Rates and Governance Quality vs. Data
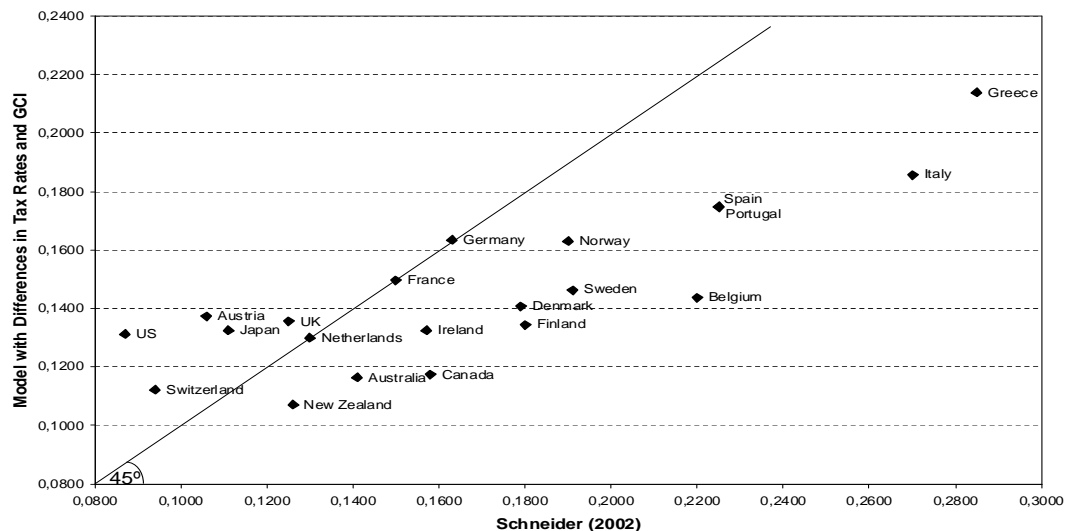
Data: Schneider (2002)

for 56% of the variation in informality across high-income countries. In addition, the rank correlation coefficient improves significantly indicating that the model is able to produce a ranking of countries according to their informality similar to the one in the data. However, mean informality produced by Model 3 is lower and thus farther from the data than mean informality estimated by Model 2. Furthermore, Model 2 estimates the informal economy for more countries closest to data than Model 3. While Model 2 is thus able to produce more individually accurate estimates of informality, Model 3 gives the best overall picture of the informal economy in high-income countries. Model 3, the model with differences in tax rates and differences in governance quality has the lowest mean squared error, 50% lower than Model 1 and 5% lower than Model 2. Agents facing high tax rates have a strong incentive to evade taxes. However, they will also take into account their country's enforcement of tax policy. If a country closely monitors its tax payers and controls their compliance with tax laws regularly, agents will prefer to pay their taxes upfront instead of later and together with a fine. Strictly enforcing its tax policy a country can counteract the positive effect of high tax rates on informality.

29

Figure 1.4.4: Relation with Informal Economy: Tax Rates and Governance
Quality in Model and Data
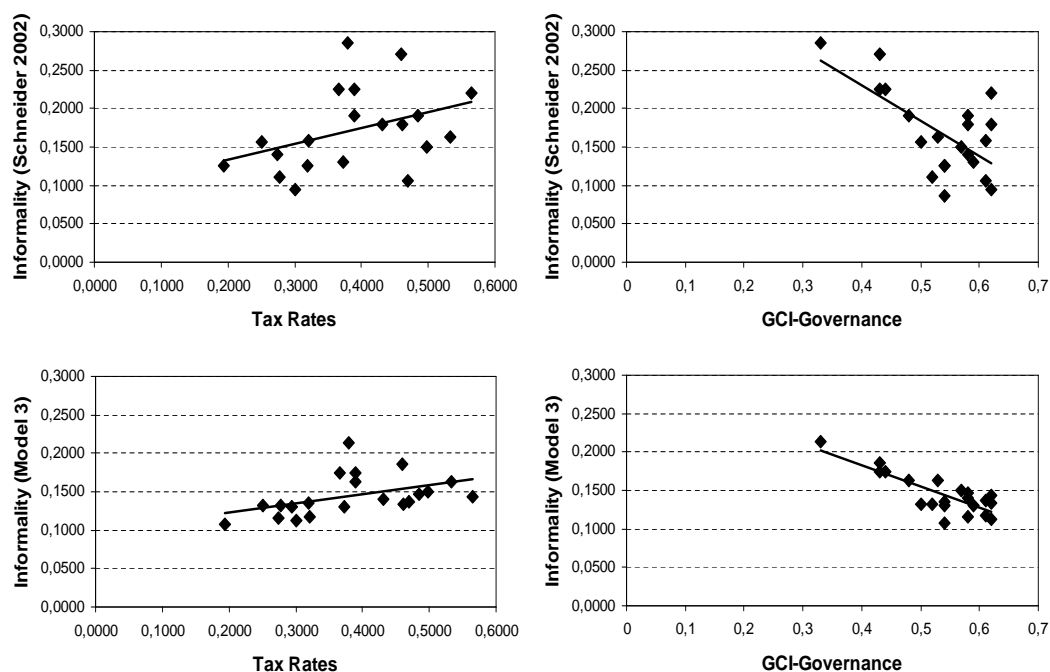
In addition, the model with differences in tax rates and governance quality
preserves the positive relationship between tax rates and the informal economy,
as well as the negative relation between informal economy and governance
quality (see Figure 1.4.4). The model's results are robust to the selection of
the Benchmark country as well as to the choice of the measure of governance
quality.[27]

---

[27]In Appendix A.1.2 I provide an alternative calibration of the model to a different
Benchmark country, Sweden. Statistics for results of the model's three specifications under
this alternative calibration are reported and discussed. In addition, statistics for results of
the original calibration that uses alternative measures of governance quality (Rule of Law
Index, Regulatory Quality Index, etc.) are presented.

1.5   Policy Experiment - Reducing Informality

What is the most effective way to reduce informality? The answer to this question might be of concern to policy makers in many high-income countries, since informality raises concerns about fair and equal treatment of taxpayers and also limits the possibilities of tax collection.[28] But exactly by how much does informality lower the ability of governments to collect taxes? Figure 1.5.1 shows tax revenues as a function of tax rates for the Benchmark country ('French enforcement') and a fictitious country where agents do not have the option to produce informally ('Perfect enforcement'). In the presence
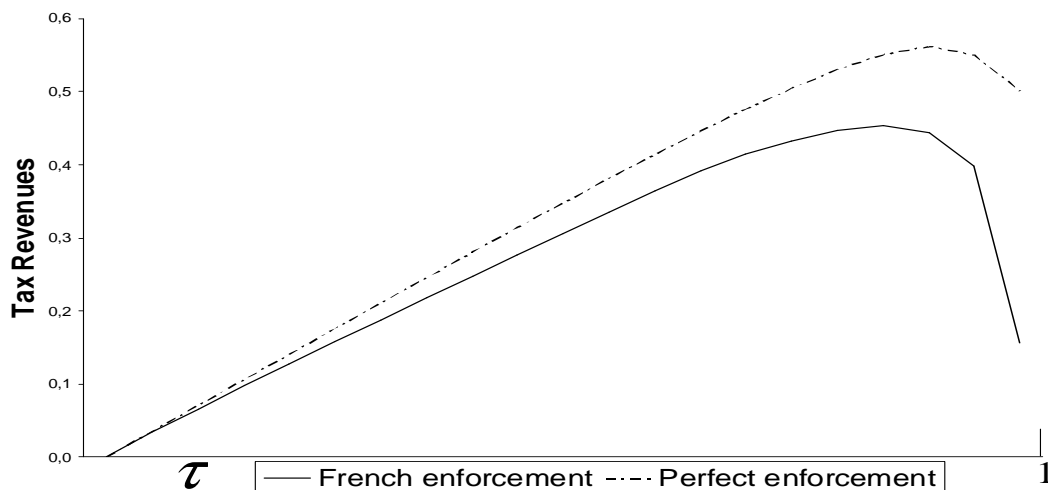
Figure 1.5.1: Effects of Informality on Tax Revenues

of informality, the higher the initial tax rate, the more difficult it is for policy makers to increase their tax revenues by a certain amount. If taxes were 35% in both countries and governments wanted to increase tax revenue by 20 units, the economy with imperfect enforcement would have to increase tax rates by more than 25 percentage points from 35% to more than 70%, while the required increase for a perfect enforcement economy is less than 20 percentage

---

[28]A third reason why policy makers might want to formalize economic activity is linked to external observability. Financial market ratings of national debt are closely linked to a country's performance of its 'formal' GDP and its tax base. A large informal sector reduces both and might thus make issuing debt more expensive.

points.

In the current model, if a country wants to reduce its informal economic activity, it can opt for three strategies: increasing fines, reducing tax rates, or increasing enforcement. Figure 1.5.2 shows the effectiveness of these three strategies. Reducing informality by increasing the fine for evading taxes is a costless policy measure but has strong limitations (see Graph (1) of Figure 1.5.1). For the case of France, increasing the fine by 50% or more (to $M \geq 1.5$) reduces informality by just one percentage point. Equally, lowering the fine by 90% (to $M = 0.1$), leads to a mere increase in informal economy by around four percentage points. Hence, informality is rather inelastic with respect to fines. This should not be surprising since those firms evading taxes are small firms with low profits that cannot be fined more than their one period profits. Informal firms' one period profits thus put an upper limit to the fine. Increasing fines infinitely high in order to achieve some reduction in informality would seem like a straight forward policy recommendation. However, the recommendation while useful in the context of this model has to be taken with care when put to practice. A future reduction in the total number of firms might be an unintended consequence of this policy, because charging all informal firms their total period's profits may affect their ability to start up a formal firm in the following period.

Graph (2) of Figure 1.5.2 shows the effectiveness of lowering tax rates in order to reduce informality. The elasticity of the informal economy with respect to tax rates is quite low. Given French enforcement standards, lowering tax rates from an initial 50% by 20 percentage points to 30% leads to a mere reduction in informality by just three percentage points, from, 15% to 12%. The low elasticity of informality with respect to tax rates is again due to the behavior of small firms. Given any positive tax rates, firms that are fined their one period profits in case they are caught will always avoid paying taxes. A reduction in tax rates does not affect their expected profits and thus neither
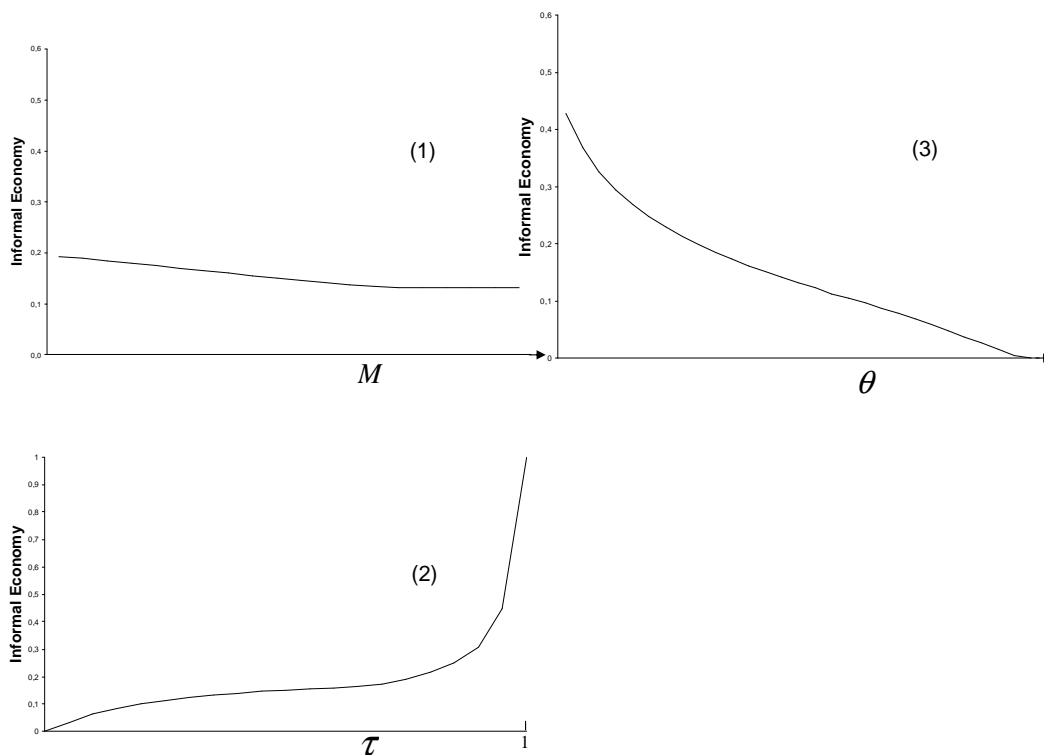
Figure 1.5.2: Ways to Reduce Informality

their decision to go formal. In case these firms contribute to a great extent to the informal economy the effect of a change in tax rates on the informal economy will be low. On the other hand, reducing tax rates will always be costly in terms of forgone tax revenues. Lowering tax rates from 50% to 30%, given French enforcement standards, leads to a fall in tax revenues by 39%.

Finally, countries can reduce informality by improving their governance quality and increasing the enforcement of their tax laws (Graph (3) of Figure 1.5.2).[29] Increasing enforcement seems to be the most effective way to reduce informality. The elasticity of informality with respect to enforcement is higher than elasticities of informality with respect to fines or tax rates. Given

---

[29]The United Nations (2006) recommend that "serious considerations should be given to developing the institutional capacities necessary for gradually formalizing informal economies."(pg.13)

French tax rates and a value for θ of 0.007, increasing enforcement by 30%
leads to a reduction in informality by 26% from 15% to 11%. As enforcement
increases, expected profits of all informal firms shrink, independent of their
ability to pay the fine. In contrast to the other two policies for reducing infor-
mality, increasing the enforcement of tax laws thus affects the decisions of all
firms, making it the most effective policy among the three.

Switzerland is the country with the best enforcement technology or best
governance quality according to the Global Competitiveness Index, the Rule
of Law Index, and the GCI-Governance Index. Table 1.5.1 shows how countries
adapting Switzerland's standards of enforcement can reduce their informality
by between 42% in Greece and 2% in Canada or Austria.[30] On average infor-
mality is reduced by around 15%. However, increasing enforcement does not
only reduces informality it also leads to higher tax revenues. Increases in tax
revenues range from 8% in Greece to 0.2% in Canada.

1.5.1 Costs of Reducing Informality

Results in Table 1.5.1 show that countries can lower the size of their infor-
mal economy and achieve higher tax revenues by adopting Switzerland's en-
forcement standards. Increasing enforcement, however, is costly. In order to
evaluate the policy of increasing enforcement standards to Swiss levels and
to be able to compare it to the alternative policy of lowering tax rates, we
need to estimate the costs of enforcement. The OECD's Centre for Tax Policy
Administration (2006) provides information on costs of revenue collection as a
fraction of tax revenues, the fraction of wage costs in revenue collection costs,
and the proportion of staff assigned to 'audit, investigation and other verifica-
tion functions' and 'enforced debt collection and related functions'. This data

---

[30]Finland, Switzerland, and Belgium all have the same enforcement strength and thus do
not experience any changes.

Table 1.5.1: Changes in results when increasing enforcement to Swiss standards*

	Reduction in Informal Economy	Increase in Tax Revenues	Increase in Enforcement
Greece	41.9%	8.0%	87.9 %
Portugal	29.9%	4.7 %	44.2%
Spain	28.0%	4.4 %	40.9 %
Italy	27.9%	4.5%	44.2 %
Ireland	23.4%	2.8%	24.0%
Norway	22.9%	3.3%	29.2%
Japan	19.0%	2.3 %	19.2%
New Zealand	18.7%	1.9%	14.8%
US	15.5 %	1.9 %	14.8 %
UK	15.3 %	1.9%	14.8%
Germany	13.7%	2.0%	17.0%
Australia	8.4%	0.9 %	6.9%
France	7.9%	1.0%	8.8%
Denmark	6.9%	0.9 %	6.9 %
Sweden	6.5%	0.8 %	6.9%
Netherlands	4.8%	0.6%	5.1 %
Canada	1.6%	0.2%	1.6%
Austria	1.6%	0.2%	1.6%

*Countries are ordered by decreasing increase in enforcement required.

shows large variation across countries. While in the UK about 16% of staff is assigned to enforcement related functions, in Japan 83% of tax administration staff is assigned to these functions. Whereas in New Zealand 58% of tax administration costs are salaries, in Greece 86% of total costs are labor costs. Costs of collecting taxes range from 0.42% of tax revenues in Italy to 1.8% in Germany.[31]

In order to calculate enforcement costs for country i, let C_i be the costs of collecting taxes as fraction of tax revenues, c_{wi} the fraction of wage costs, and S_i the proportion of staff assigned to enforcement related tasks. Then define

---

[31]For the complete data see Table A.1.3.1 in Appendix A.1.3

$C^e_i = C_i c_{wi} S_i$ as total enforcement costs. I thus assume that enforcement costs consists of the total wage bill associated with enforcements tasks while all other remaining costs are assumed to be independent of enforcement. Let $(1 + \Delta\theta_i)$ and $(1 + \Delta T_i)$ be increases in enforcement and tax revenues associated to adopting Swiss standards in country i respectively, as reported in Table 1.5.1. I simply assume that

$$C^{e'}_i / C^e_i = \frac{(1 + \Delta\theta_i)}{(1 + \Delta T_i)},$$

i.e. enforcements costs increase by the percentage increase in required enforcement per extra unit of taxes.

Given the cost function above, increases in total costs; i.e. increased enforcement costs plus constant administrative costs can be estimated. Table 1.5.2 provides estimates for the increase in tax collection costs for 13 countries for which data are available.[32] Countries that need to increase their enforcement more to reach Swiss standards tend to face a higher increase in costs $(\Delta C'_i)$. However, given the heterogeneity in enforcement costs this link is not perfect. Denmark and Sweden both need to increase their enforcement by 6.9% to reach Swiss standards. However, while this implies an increase in tax collection costs of 1.7% in Denmark, Sweden faces a 2.3% increase in its tax collection costs. This difference is due to the fact that in Sweden a larger fraction of tax administration staff is assigned to enforcement tasks. On average, countries need to expand their tax administration's budget by approximately 4% in order to carry out the policy of adopting Switzerland's standards of enforcement.

However, this estimate may be downward biased if additional units of enforcement are more expensive than previous ones. Taking this into account, I calculate an alternative estimate assuming that in all countries additional units of enforcement are as expensive as in the country with the highest

---

[32]Data on Canada as well as more detailed information on Greece, Italy, Portugal, Germany is not available.

Table 1.5.2: Range of costs increase for increasing enforcement to Swiss standards

	$\Delta C'_i$ country specific	$\Delta \overline{C'}_i$ with more expensive additional units of enforcement	ΔC_{MAXi} such as to leave countries indifferent between increasing or not their enforcement
Greece	-	53.55%	439.57%
Portugal	-	30.35%	290.40%
Spain	8.19%	50.28%	454.8%
Italy	-	109.24%	1030.13 %
Ireland	6.02%	27.05%	275.37%
Norway	5.32%	51.26%	507.43%
Japan	10.78%	10.78%	107.90 %
New Zealand	4.57%	18.37%	204.19%
US	3.66%	27.18%	302.45 %
UK	1.19%	15.01%	171.23%
Germany	-	10.04%	104.60%
Australia	1.91%	6.12%	69.87%
France	2.67%	6.34%	65.95%
Denmark	1.74%	8.28%	94.26%
Sweden	2.31%	12.70%	139.83 %
Netherlands	1.16%	3.79%	40.87%
Austria	0.85%	1.83%	21.38%

enforcement costs, Japan. The second column of Table 1.5.2 reports these alternative costs estimates ($\Delta \overline{C'}_i$). While there are some exceptions, even by these more conservative estimates for most countries raising their enforcement to Swiss standards implies an increase in tax revenue collection costs by less than 10%. Average costs of the policy that raises all countries' enforcement standards to the Swiss level are thus equivalent to at most 26% of the average tax administration's budget.

In order to provide a notion of the benefits of this policy, Table 1.5.2 shows

percentage increases in tax collection costs that leave countries indifferent in terms of tax revenues between adopting or not the policy of increasing enforcement to Swiss standards (ΔC_{MAXi}). In most cases, for countries to actually lose tax revenues when applying this policy, total revenue collection costs would have to more than double. In the case of Italy, Greece, Spain, Norway, and the US costs would have to more than quadruple for the policy to not be self financing. On average ΔC_{MAXi} is equal to 250%, suggesting that even by conservative estimates ($\Delta \overline{C'}_i$), increases in tax revenues associated to the policy of adopting Swiss enforcement standards are around ten times larger than increases in tax collection costs. Thus, for most countries potential benefits of increasing their enforcement standards to the Swiss level are large. Not only will informality be reduced but most likely tax revenues will be higher even after taking into account the increase in enforcement cost.

1.6   Conclusion

The informal economy in high-income countries is large. Most models of the informal economy focus on developing countries where informality is linked to issues such as dual labor markets for productive (formal) and less productive (informal) workers, limited access to credit, and fixed costs of setting up a business. However, the informal economy in high-income countries is different because it is mainly linked to tax evasion. Among high-income countries, there is a positive relation between tax rates and and size of the informal economy and a negative relationship between informal economy and various indices of institutional quality. In this paper, these two relationships, the positive one between tax rates and size of the informal economy and the negative one between the informal economy and various indices of institutional quality constitute the building blocks for a model of the informal economy in high-income countries.

A calibrated version of the model quantifies the influence of tax rates and governance quality on informality. It shows that differences in tax rates alone can only account for approximately 33% of the observed variation in informal economy across high-income countries, while differences in governance quality, the extent to which these tax rates are enforced, can account for about 43% of the variation. When combining both, differences in tax rates and differences in governance quality, the model accounts for 56% of the variation in informality across high-income countries.

Among the three ways to reduce informality – higher fines, lower tax rates, stronger enforcement – the latter is found to be the most effective. If all countries were to increase their enforcement level by an average 20% and adopt Switzerland's level of enforcement, average informality across 21 high-income countries would drop by around 15%. I estimate costs of increasing enforcement and find average costs of this policy to be equivalent to at most 26% of the average tax administration's budget, one tenth of the average increase in tax revenues associated to the reduction in informality.

In the simple model of informality presented in this chapter, government authorities act myopically and purely mechanically, applying the same fine with the same probability to firms evading taxes once or 100 times. In order to model tax authorities actions more realistically, one might want to consider a framework that incorporates fines for tax evasion or the probability of being caught depending on an individual's history of tax evasion. This extension introduces an additional heterogeneity that varies along time and so will individuals occupational choices, i.e. firms' entry and exit decisions. While it is not clear how much this alternative framework will alter the quantitative results of this chapter, it seems particularly interesting for the study of the interplay between tax evasion and entry and exit of firms, which could be an interesting road for future research.

Chapter 2

Migration, Wages, and Parental Background: Obstacles to Entrepreneurship and Growth in East Germany

2.1 Introduction

East Germany's economic performance has been quite dismal for the last decade. Since 1991, unemployment rates in East Germany and Berlin have been twice as high as rates in West Germany, ranging from official rates of $15-20\%$ to unofficial rates of $25-30\%$.[1] Furthermore, while other transition countries such as the Czech Republic, Poland, and Hungary are growing to catch up with the rest of Europe, East Germany's economy is stagnating. Its GDP per capita remains below 70% of West Germany's (Statistisches Ämter

---

[1] Unofficial unemployment rates take into account the so-called "hidden unemployed", individuals who do not appear as officially unemployed due to some form of active labor market policy (training programmes, wage subsidies, early retirement schemes); for unofficial rates: Sachverständigenrat (2007), for official rates: Bundesagentur für Arbeit (2008).

der Länder (2009)). For the last decade, East Germany's economy has grown
more slowly than the economies of Poland, Hungary, and the Czech Republic
(see Figure 2.1.1).[2]

Figure 2.1.1: Growth Rates of Real GDP per Capita (chained)
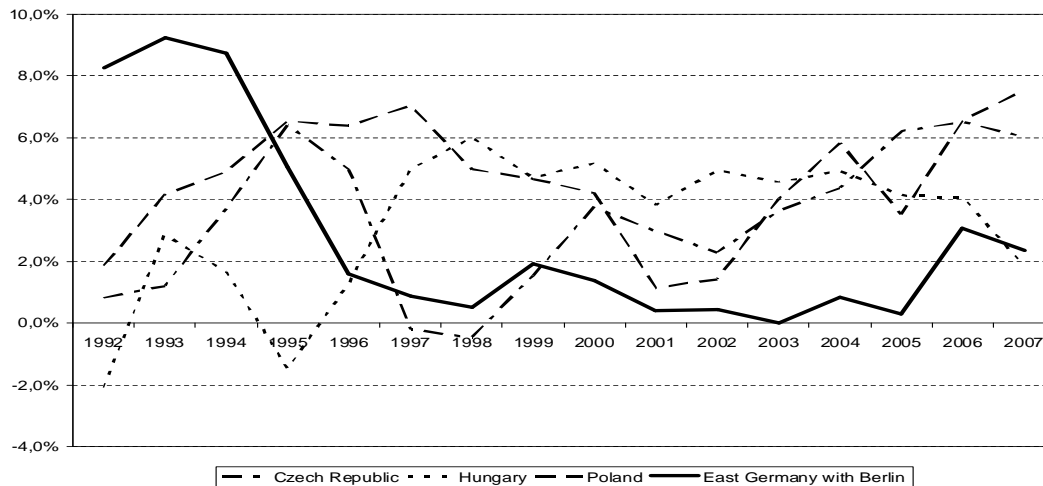
Data: Heston et al. (2009), Statistisches Ämter der Länder (2009) (for East Germany)

Policy makers have identified fostering entrepreneurship as the key to em-
ployment creation and economic growth in East Germany: "The Organisation
for Economic Co-operation and Development (OECD) and its Local Economic
and Employment Development Programme has been working with the Federal
Ministry of Transport, Building and Urban Affairs (BMVBS) since 2005 on
an analytical and practical project on Strengthening entrepreneurship in East
Germany as a critical lever for economic growth and employment creation"
(OECD (2007)).[3]

---

[2]Accumulated growth rates for real GDP per capita for 1992 to 2007 for East Germany,
Poland, Hungary, and the Czech Republic are 152%, 195%, 162%, and 163% respectively.
Indeed, Slovenia's GDP per capita has already surpassed that of East Germany.

[3] Numerous newspaper articles have pointed out that the development of the 'Mittelstand'
– the small and medium sized enterprise sector– is essential for the revival of the East
German economy. However, "in practice, the development of east Germany's Mittelstand
is proceeding painfully slowly. Self-employment is still much lower than in west Germany.

Less than twenty years ago, private entrepreneurial activity was extremely restricted or even forbidden in East Germany, Czechoslovakia, Poland, and Hungary. However, today the lack of entrepreneurship seems to be persisting still in East Germany, while other transition economies have managed to overcome this hurdle.[4]

Table 2.1.1: Number of Enterprises

Number of Enterprises per 1000	inhabitants	labor force participants	employed individuals
East Germany* (incl. firms with zero employment)	37.2	72.4	87.0
Czech Republic	83.4	165.4	179.7
Hungary	55.3	132.5	142.8
Poland	37.0	81.7	99.3

Data: Eurostat (2005) (NACE: C-I;K), *Statistisches Bundesamt (2008)

Table 2.1.1 displays the number of enterprises per 1000 inhabitants, labor force participants, and employed individuals for East Germany, the Czech Republic, Hungary, and Poland. There are significantly fewer enterprises in East Germany, only 37 per 1000 inhabitants – this number includes firms with zero employment – compared to 83 per 1000 inhabitants in the Czech Republic.[5] When taking into account differences in labor force participation or unemployment, East Germany has even fewer enterprises compared to some other transition countries.[6]

Small businessmen in east Germany face a number of handicaps, mostly to do with being new to the game;" (The Economist (1996)).

[4]In Hungary, liberalization of communist rules began in the 1970's and by the 1980's a so-called 'second economy' of privately owned businesses had developed. The private sector was officially non-existent in Czechoslovakia but more important in Poland where family farms dominated the agriculture (OECD (1992)).

[5]The number of firms per 1000 inhabitants in developed countries range from 14 in the US, to 20 in all of Germany (excluding firms with zero employment) to 26, 30, and 37 in the UK, Netherlands, or France respectively (OECD (2005)).

[6]Earle and Sakova (2000) point out that high rates of unemployment and little welfare provision in transition countries might push individuals into self-employment and thus far from being successful business owners these own-account workers differ little from the un-

In 1990, with the end of the communist era, setting up a firm was legalized and simplified, opening up a whole new set of occupational choices in East Germany, Czechoslovakia, Poland, and Hungary. There was, however, a significant difference between other transition countries and East Germany, as the latter was integrated into the established economy of West Germany.[7] In this chapter I argue that three key aspects of East Germany's integration into West Germany hindered a fruitful development of entrepreneurship: migration possibilities to West Germany, the way East German wages were regulated upon reunification, and a great importance of parental background for entrepreneurship in West Germany.[8]

First, since 1989 the unrestricted mobility of East Germans has led to major migration flows within Germany. Between 1989 and 2002 net migration to West Germany amounted to 1.3 million people, an equivalent of 7.5% of the original population of the German Democratic Republic (GDR) (Heiland (2004)). The Czech Republic and Hungary, on the contrary were net recipients of migration during 1990-1998.[9] Especially young and skilled East Germans are likely to migrate to West Germany (Hunt (2006a) and Ragnitz (2007)). Between 1995 and 2007, 19% of East Germans aged 18 to 29 left East for West

---

employed. However, numbers in Table 2.1.1 refer to self-employed with employees, i.e. they operate on a larger scale than that of mere subsistence, making it unlikely that many of them are own-account workers escaping from unemployment.

[7]This obviously increased East Germany's market size tremendously and if there were a general correlation between large markets and low entrepreneurship rates this could explain differences between East Germany and other transition countries. However, while the US, has relatively few entrepreneurs, two other large markets, China (high entrepreneurship) vs. Russia (low entrepreneurship) display stark differences in entrepreneurship rates (see e.g. Bosma et al. (2009), OECD (2009)).

[8]Formal aspects of doing business are actually more favorable in Germany than in other transition countries. However, as of 2009, starting a business is easier in the Czech Republic and Hungary than in Germany, mainly due to a reduced number of days and procedures involved (The World Bank (2009)).

[9]Migration to the Czech Republic and Hungary was mainly from other transition countries. Poland lost between 0.5% and 3.9% of its original population to migration between 1990 and 1998 (United Nations (2002)).

Germany. Figure 2.1.2 shows that since 1998 East Germany has been losing 1-2% of its young population to migration each year.[10]

Figure 2.1.2: Net migration from East to West Germany for 18-29 year-olds

Data: Statistische Ämter des Bundes und der Länder (2007), excluding Berlin.

Second, presumably in order to restrict the number of East Germans migrating to West Germany, West German labor unions pressed for parity of East and West German wages (see e.g.Akerlof et al. (1991), Sinn (1991)).[11] In 1991, wages in East Germany were set to 50% of West German wages despite a lower ratio of East- to West German labor productivities. By 1995, East German wages had reached up to 70% and more of West German wages (Burda (2008), Sinn (1991), and Fuchs-Schündeln and Izem (2007)).[12]

---

[10]Compared to international migration rates, these are very large numbers; e.g. current annual net migration rates from Ecuador and Mexico are 0.8% and 0.4% respectively (CIA (2008)). It is very likely that numbers for Figure 2.1.2 are upward biased as individuals might be counted more than once, migrating back and forth between East and West Germany. However, this only happens in case of formal changes of residence and thus Figure 2.1.2 is not contaminated by the presence of commuters.

[11]Officially, labor unions demanded wage equity out of concern for East-West German equity and East German welfare.

[12]Between 1990 and 1997, wages in Poland and the Czech Republic relative to wages in West Germany remained stable at around 10-20% (Sinn (1991)).

Third, entrepreneurial parental background was and is decisive for occupational choices of West Germans. Pistrui et al. (2000) find that 60% of West German entrepreneurs have a parent who had been an entrepreneur. Contrariwise in East Germany there was no past generation that could pass on knowledge on how to run a business in the newly established market economy and despite abundant government aids only few individuals in East Germany set up their own business.[13]

The particular situation of East Germany, its poor economic performance, and the contrast between the other transition economies and East Germany raise several questions: Why do only few East Germans set up a business in East Germany?[14] And can the resulting lack of entrepreneurship in East Germany be linked to low economic growth? What role does each of the proposed key aspects of East Germany's integration into West Germany play? How do the unrestricted mobility of East Germans, the policy of fixing East German wages as fractions of West German wages, and the importance of entrepreneurial parental background in West Germany influence occupational choices of East Germans and thus economic growth?

In order to address these questions, both qualitatively and quantitatively, I build a model economy that places Lucas (1978)' span-of control model into an overlapping-generations framework. Individuals in the model economy are characterized by their innate talent and their parental background. Managerial knowhow is a combination of these two characteristics.[15] Given

___

[13] Between 1991 and 2005, East Germany received annual public transfers equal to $4.1\% - 5.4\%$ of West German GDP (Wurzel (2001), Hunt (2006b)). Transfers for support to enterprises and business-near infrastructure made up between 0.63% and 0.99% of West German GDP (Wurzel (2001)). Sinn (1991) even speaks of negative capital costs for investing in East Germany at the onset of transition.

[14] Diewald et al. (2006) study life-courses of East Germans after reunification and find that transitions into self-employment between 1992 and 1996 have been "surprisingly rare". In particular, they find that "only 4.1 percent of our sample made this step during the Window of opportunity [1/90-6/92], and 3.8 percent did so in the second period [7/92-3/96]" (pg.73).

[15] Managerial knowhow is obviously a multidimensional object and apart from parental

their managerial knowhow individuals decide to be unemployed, to work, or to set up a business. The innate talent of entrepreneurs determines economic growth. Hence, there is a direct link between individuals' occupational choice and aggregate economic performance. After one generation each individual is replaced by a child of random talent.[16] Children inherit bequests and in case their parent was an entrepreneur they also receive information about how to run a business. As in Hassler and Rodríguez Mora (2000), when technological growth is low, there are few changes in the business environment and past information about how to run a business is valuable. Managerial knowhow of children of entrepreneurs will be higher. They will be the ones to set up their own business, rather than the most talented individuals. Hence, talent is not optimally allocated, individuals' occupational choices exert a negative externality on economic growth and growth remains low. On the other hand, when technological growth is high, past information depreciates fast, and managerial knowhow will be determined by individuals' innate talent only. The most talented individuals become entrepreneurs, allocation of talent is optimal, the externality is positive and technological growth remains high.

I first calibrate this basic model to West Germany before reunification, in particular to pin down the key parameters governing the role of parental background and the link between entrepreneurship and growth. I then present an extended version of the model economy that captures the integration of East into West Germany. While both Germanies share capital and goods markets, labor markets are locally separated. The government fixes wages in East Ger-

---

background and innate talent, empirical studies have highlighted for instance inheritance of capital (Blanchflower and Oswald (1998)) and attitudes towards one's own abilities (Arenius and Minniti (2005)) as important factors influencing an individual's decision to set up a business. In this chapter I abstain from these and other additional important aspects and I argue that to a large extent innate talent and parental background are able to pick up e.g. aspects of parental wealth and personal attitudes.

[16]Zero correlation of talent between parents and children is a strong assumption. While I will not provide results for alternative assumptions on this correlation, in the course of this chapter however, I will indicate and discuss the effects of this assumption on calibration and results.

many above labor productivity and as fractions of West German wages and finances a lower rental rate of capital for East Germany. Individuals can pay a moving cost and work or set up a business in the other part of Germany.[17]

Wages set above labor productivity make becoming an entrepreneur less attractive and East Germans choose to work instead of setting up their own business. While East Germans' general skills are comparable to those of West Germans, they lack any parental background in entrepreneurship.[18] Their average managerial knowhow is thus lower than that of many West Germans who have learned from their parents how to run a business. Despite investment aids for setting up businesses in East Germany, the most talented East Germans migrate to West Germany to set up businesses there. They thus contribute to growth in West Germany, whereas in East Germany few mediocre entrepreneurs imply low economic growth. Given too many workers and too few entrepreneurs in an environment where wages are fixed, there is involuntary unemployment in East Germany.

Over time East and West Germany become more similar. But even though relative moving costs decrease and spill-over effects cause total factor productivity to converge, under the current integration scenario more and more East Germans migrate to West Germany. The result is a constantly shrinking East German population that is being reduced to immobile individuals. Counterfactual experiments show that had East Germany integrated into a social mobile West Germany, or had East German wages been flexible, or had

---

[17]I abstain from the possibility of commuting; i.e. for instance living in East Germany and working in West Germany. This seems to be a common choice for East Germans (Hunt (2006a)). However, for most individuals commuting is a temporary occupational choice as they commute for a limited amount of time and /or as students, while in the model of this chapter occupational and migration choices are permanent.

[18]Dunn et al. (1997) find no significant differences in economic returns to college and vocational degrees between West and East Germans working in West Germany. Krueger and Pischke (1995) estimate very similar coefficients for returns to years of schooling for West Germans and East Germans working in West Germany.

migration between East and West Germany been restricted, there would be more entrepreneurs, less unemployment as well as higher economic growth in East Germany. However, while flexible wages and a social mobile West Germany would have also led to more output and higher economic growth for all of Germany, migration restrictions are exclusively beneficial to East German output and economic growth.

2.1.1 Related Literature

This chapter builds on Hassler and Rodríguez Mora (2000). The authors bring forward various empirical evidence on the negative relation between rates of technological and economic growth and the value of parental background. This relationship implies a positive relation between rates of technological and economic growth and higher intergenerational social and occupational mobility. Kuznets (1966) writes on this matter :"One would tend to assume that internal income mobility is more limited in stagnant or slowly growing countries, than in those showing rapid growth; and there are implications also for the trends in income mobility over the long span of growth within a country."(pg.205).[19] Both relationships between economic growth and social mobility and economic growth and parental background arise in the model of this chapter and have also been subject to a larger literature on economic growth, social mobility, and the allocation of talent.[20] According to this literature, entrepreneurial parental background has a positive effect on entrepreneurship on the individual level but negatively affects aggregate variables, as little intergenerational occupational

---

[19]According to Olson (1982) a rigid social class structure and low economic growth are just two different ways in which a misallocation of talent due to rent seeking manifests itself in a society.

[20]A seminal paper on the optimal allocation of talent and economic growth is Murphy et al. (1991). Recently, the topic of the allocation of resources across productive units and its implications for productivity and growth has received a great deal of attention, see e.g. Hsieh and Klenow (2009), Guner et al. (2008), and Restuccia and Rogerson (2008) among others.

and social mobility is associated with low economic growth.[21] Caselli and Gennaioli (2005) provide a model where missing markets result in the prevalence of dynastic firms. As in this chapter, managers being selected according to their family ties rather than their talent leads to lower total factor productivity. In Galor and Tsiddon (1997), similar to this chapter, parental background and growth are negatively related and as technology adoption evolves, parental background gains importance, wages become more equal, and technological progress slows down. In the model of this chapter a positive value for parental background in entrepreneurship inhibits an optimal allocation of talent that would maximize the externality of talented entrepreneurs on economic growth.

As in the recent literature on cross-border flows of managerial talent, the model of this chapter allows for entrepreneurs to set up their business in the other part of Germany. However, unlike results in Burnstein and Monge-Naranjo (2009) managerial talent does not flow from West Germany, a region with large 'firm-embedded productivity' towards East Germany where labor is abundant, because East German wages are set above labor productivity. And even though the immediate implementation of West German regulations in East Germany makes both regions' entrepreneurial environments alike, West Germans do not set up businesses in East Germany. Managerial talent moving towards similar environments as in Pica and Rodríguez Mora (2007) is again obscured by the East German wage setting policy.

This chapter is also related to the vast literature that discusses East Germany's disappointing growth experience. Hunt (2008) provides a recent review of this literature. There is a general consensus that the wage setting policy

---

[21]There is a large empirical literature on the determinants of entrepreneurship. Having had a parent who was an entrepreneur is found to have a positive effect on oneself setting up one's own business. Dunn and Holtz-Eakin (1996) find intergenerational linkage in self-employment to be stronger along non-financial lines than along financial lines. Arenius and Minniti (2005) find that simply knowing other entrepreneurs is positively and significantly related to being a nascent entrepreneur.

has been the main cause for East Germany's high unemployment rates (see e.g. Akerlof et al. (1991) and Sinn (1991)).[22] According to Snower and Merkl (2006) high unemployment rates in East Germany are a consequence of the wage setting policy in combination with generous welfare provisions. Canova and Ravn (2000) also assign an important role to welfare provisions in magnifying the contraction of output and employment caused by differences in skill level and capital endowment of East and West Germans. Burda and Hunt (2001) claim a dampening effect of the wage-setting policy on migration. In the framework of a labor search model, Uhlig (2006) argues that low networking due to a lack of established production leads to a low productivity and high out-migration situation in East Germany. Apart from the paper by Canova and Ravn (2000) none of these authors provide general equilibrium models for East Germany's economic experience.

This chapter contributes to the literature by being the first one, to the best of my knowledge, that explicitly models the link between a lack of entrepreneurship and low economic growth in East Germany.[23] In the framework of a general equilibrium model it applies the theory established by the literature on social mobility and economic growth to the context of economic transition. From the historical unique context of a generation without parental background in entrepreneurship arises the natural question of its implications for economic growth. This chapter tries to address this question and to provide some quantification of the implications for the case of East Germany.[24]

---

[22]In addition, fixed wages impeded an offsetting of initial effects of the currency union between West and East Germany.

[23]A recent paper by Bajona and Locay (2009) considers the period before transition and establishes a similar link between a reduced stock of managerial knowledge and low growth rates for planned economies.

[24]Conceptually this chapter is also related to studies that exploit the incidence of economic transition as a natural experiment to study entrepreneurship as e.g. Fuchs-Schündeln (2009) and Earle and Sakova (1999). While these papers are empirical studies, this chapter exploits this fact in a theoretical framework.

The remaining of this chapter is organized as follows. Section 2.2 presents the basic model that is thought to represent West Germany before 1990. This model is then calibrated to West German data before 1989. An extended version of the model that captures the reunification of East and West Germany is presented in Section 2.3. This extended model is then calibrated to data after reunification and its results are discussed. Section 2.4 presents the counterfactual experiments. Section 2.5 concludes.

2.2 Basic Model (West Germany before Reunification)

Each period the economy is inhabited by a continuum of individuals of mass one. Individuals differ in initial endowments of capital inherited from their parents and in managerial knowhow. Managerial knowhow is composed of innate talent and parental background. An individual's parental background refers to his parent's occupation of either having been an entrepreneur or having been a worker. According to their managerial knowhow individuals chose to become entrepreneurs or workers. Entrepreneurs produce a homogeneous good by using labor, capital, and their knowhow as inputs. Individuals live for one period, during which they receive their parents' bequests, make optimal occupational choices, lend or borrow capital, work, consume, and pass on bequests to their children. Each individual has one parent and is replaced by one child of random talent. Each period there is a mass L_t^0 individuals whose parents were workers, and a mass L_t^1 individuals whose parents were entrepreneurs, with $L_t^0 + L_t^1 = 1$. The government in this economy manages an unemployment insurance and collects taxes.

Preferences An individual born in period t derives utility from personal consumption, c_t, and bequests, b_t, left to his child

$$U(c_t, b_t) = c_t^{\omega} b_t^{1-\omega}, \tag{2.2.1}$$

with $0 < \omega < 1$. The parameter ω reflects the importance of personal consumption for an individual's utility relative to bequests left to children.

Endowments Each individual has one unit of productive time that he supplies inelastically. In addition he is endowed with the bequest from his parent, denoted by x_t. Individuals also differ in their managerial knowhow (z_t).

Managerial Knowhow Managerial knowhow is composed of innate talent (q) and parental background (p). Innate talent is independent and identically distributed across time and individuals in $Q = (0, \bar{q}]$, with cdf $F(q)$ and density $f(q)$. Parental background is a variable that is equal to one if one's parent was an entrepreneur and zero otherwise, $p \in \{0, 1\}$. Managerial knowhow is defined as the product of innate talent, (q) and parental background, (p)

$$z_t^p = q(1 + \phi_t p),$$

where $\phi_t \geq 0$ reflects the value that being an entrepreneur's child has for an individual's managerial knowhow in period t. The basic idea is that an entrepreneur passes on information to his child about how to run a business. This private information enhances an individual's managerial knowhow.

Production Every entrepreneur has access to the same technology. He uses his managerial knowhow (z_t^p), employs workers of efficiency units (n_t), and rents capital (k_t) to produce a single output (y_t) used for consumption and bequests

$$y_t = F(z_t^p, n_t, k_t) = A_t(z_t^p)^{1-\gamma+\kappa}(k_t^{\nu} n_t^{1-\nu})^{\gamma}, \tag{2.2.2}$$

where $\gamma \in (0,1)$ is the span-of-control parameter and $\kappa > 0$ determines the curvature of the entrepreneur's profit function.[25] The capital share of production is given by $\nu\gamma \in (0,1)$. Capital depreciates at rate δ and A_t is total factor productivity (TFP) which grows at rate g_t.

Value of Parental Background Following Hassler and Rodríguez Mora (2000) the value of parental background, ϕ_{t+1} is defined as a decreasing function of the growth rate of TFP

$$\phi_{t+1} = a(g_t), \tag{2.2.3}$$

with $a(g_t) \geq 0$ and $\frac{\partial a(g_t)}{\partial g_t} < 0$.[26] Fast technological change implies that today resembles yesterday less and that the value of private information inherited from parents is being reduced. When TFP growth is high, past information about how to run a business becomes completely worthless and everyone's managerial knowhow is solely defined by their innate talent

$$\lim_{g_t \to \infty} a(g_t) = 0.$$

Entrepreneurs Entrepreneurs choose optimal amounts of labor and capital in order to maximize their profits net of income taxes (τ). For any efficiency unit of labor hired entrepreneurs contribute $\tau_t^u w_t$ to the unemployment insurance. Given a wage rate (w_t) and a rental rate for capital (R_t), the

---

[25]In the original Lucas (1978)' span-of-control model wages are constant in talent and κ is equal to zero. Following Chang (2000), in the model of this chapter unemployment benefits are constant, wages are linearly increasing in talent and thus profits need to increase more than linearly with talent which requires setting $\kappa > 0$.

[26]Instead, ϕ_t could be defined as a decreasing function of output growth. Given that the steady-state growth rate of TFP is equal to $(1-\nu\gamma)$ times the growth rate of output, results will most likely be similar.

entrepreneurs' problem is

$$\max_{\{n_t, k_t\}} \Pi_t = (1 - \tau)[A_t(z_t^p)^{1-\gamma+\kappa}(k_t^\nu n_t^{1-\nu})^\gamma - (1 + \tau_t^u)w_t n_t - R_t k_t]. \quad (2.2.4)$$

Combining the two first order conditions of this maximization problem, the optimal capital-labor ratio for entrepreneurs is given by

$$\frac{k_t}{n_t} = \frac{\nu}{1 - \nu}\frac{(1 + \tau_t^u)w_t}{R_t}, \quad (2.2.5)$$

which is increasing in the contribution to the unemployment insurance (τ_t^u). The entrepreneur's profits are

$$\pi_t(z_t^p; .) = (1-\tau)(1-\gamma)A_t^{\frac{1}{1-\gamma}}(z_t^p)^{\frac{1-\gamma+\kappa}{1-\gamma}}\left(\frac{\gamma(1-\nu)}{(1+\tau_t^u)w_t}\right)^{\frac{\gamma}{1-\gamma}}\left(\frac{\nu}{1-\nu}\frac{(1+\tau_t^u)w_t}{R_t}\right)^{\frac{\nu\gamma}{1-\gamma}}. \quad (2.2.6)$$

Higher wages (w_t), higher income taxes (τ), higher contributions to the unemployment insurance (τ_t^u), as well as higher interest rates (R_t), and a larger span-of-control parameter (γ) all reduce the entrepreneur's profits. A higher level of managerial knowhow (z_t^p) on the other hand, increases profits of the entrepreneur. Since $\frac{\partial z_t^p}{\partial \phi_t} \geq 0$, profits are also increasing in the value of entrepreneurial parental background. Given the negative relation between the growth rate of TFP and the value of an entrepreneurial parental background (see Equation 2.2.3), low technological growth today implies higher profits for children of entrepreneurs in the future.

Workers Workers supply their efficiency units of labor inelastically. Their talent (q) is transformed linearly into efficiency units of labor so that their net wage as workers is given by

$$(1 - \tau_t^u - \tau)w_t q. \quad (2.2.7)$$

Workers also pay income taxes (τ). Mimicking the German unemployment insurance, both employers and workers contribute the same fraction τ_t^u of

workers' gross wages to the insurance scheme.[27]

Unemployed Unemployed individuals receive a fraction ς of the wage rate per efficiency unit as unemployment benefits (v_t)

$$v_t = \varsigma w_t,$$

which are paid independently of an individual's talent.

2.2.1 Decisions

Individuals can choose to set up their own business, to become workers, or to be unemployed. Given perfect foresight, they compare among potential incomes from the three occupations and choose the one that maximizes their income.[28] Individuals also decide about consumption and bequests left to their children.

Becoming an Entrepreneur Individuals compare their potential wage (Equation 2.2.7), to the profits they could make as entrepreneurs (Equation 2.2.6). Whenever, $\pi_t(z_t^p; .) \geq (1 - \tau_t^u - \tau) w_t q$, they set up their own business. The cut-off value of managerial knowhow $(\hat{z}_t^p)$ describing the individual who is indifferent between working or setting up a business is given by

$$\hat{z}_t^p = \left((1 + \phi_t p)^{-1} w_t^{\frac{1 - \nu\gamma}{1 - \gamma}} R_t^{\frac{\nu\gamma}{1 - \gamma}} \Psi_t^{-1} (1 - \tau)^{-1} (1 + \tau_t^u)^{\frac{\gamma - \nu\gamma}{1 - \gamma}} (1 - \tau_t^u - \tau) \right)^{\frac{1 - \gamma}{\kappa}},$$
(2.2.8)

---

[27]For any worker of type q hired by a firm, the firm contributes $\tau_t^u w_t q$ to unemployment insurance and pays a gross wage of $w_t q$ to the worker of which the government automatically deducts a fraction $(1 - \tau_t^u - \tau)$ for income tax and unemployment insurance.

[28]Note that parents' decisions do not take into account that becoming an entrepreneur generates a value of parental background and thus a possibly higher managerial knowhow for their children.

where $\Psi_t = A_t^{\frac{1}{1-\gamma}}(1-\gamma)(\gamma(1-\nu))^{\frac{\gamma}{(1-\gamma)}}(\frac{\nu}{1-\nu})^{\frac{\nu\gamma}{1-\gamma}}$. The threshold of occupational choice $\hat{z}_t^p$, is decreasing in the value of entrepreneurial parental background. Individuals whose parents were entrepreneurs set up a business at a lower level of managerial knowhow than individuals whose parents were workers. When TFP grows fast, the value of entrepreneurial parental background vanishes ($\phi_t \to 0$) and the two thresholds for marginal entrepreneurs from different family backgrounds coincide. Higher wages make being a worker more attractive relative to being an entrepreneur. As long as the capital share is restricted to be smaller than unity ($\nu\gamma < 1$) higher wages increase the threshold of occupational choice, leading to fewer entrepreneurs. A higher rental rate for capital reduces entrepreneurial profits and also increases the threshold. Income taxes (τ) and the contribution to the unemployment insurance (τ_t^u) have ambiguous effects on the occupational choice of individuals, because they reduce both, wages of workers and profits of entrepreneurs. However, profits of entrepreneurs are affected less by an increase in any of the two as higher contributions to the unemployment insurance are part of labor costs and as thus deductible from profit taxes. Hence higher income taxes lead to more entrepreneurs and as long as the share of capital in production is restricted to values smaller than unity ($\nu < 1$), higher contributions to the unemployment insurance also reduce the threshold of occupational choice, leading to more entrepreneurs.

Becoming a Worker Individuals then compare unemployment benefits (v_t) to their potential wage (Equation 2.2.7). The marginal worker, the individual with talent $\hat{q}_t$ is indifferent between working or being unemployed

$$\hat{q}_t = \frac{\varsigma}{(1 - \tau_t^u - \tau)}. \tag{2.2.9}$$

This threshold is independent of both the wage rate and an individual's parental background. Figure 2.2.3 displays the thresholds of occupational choice for individuals from an entrepreneurial family background and for those from a

working family background.
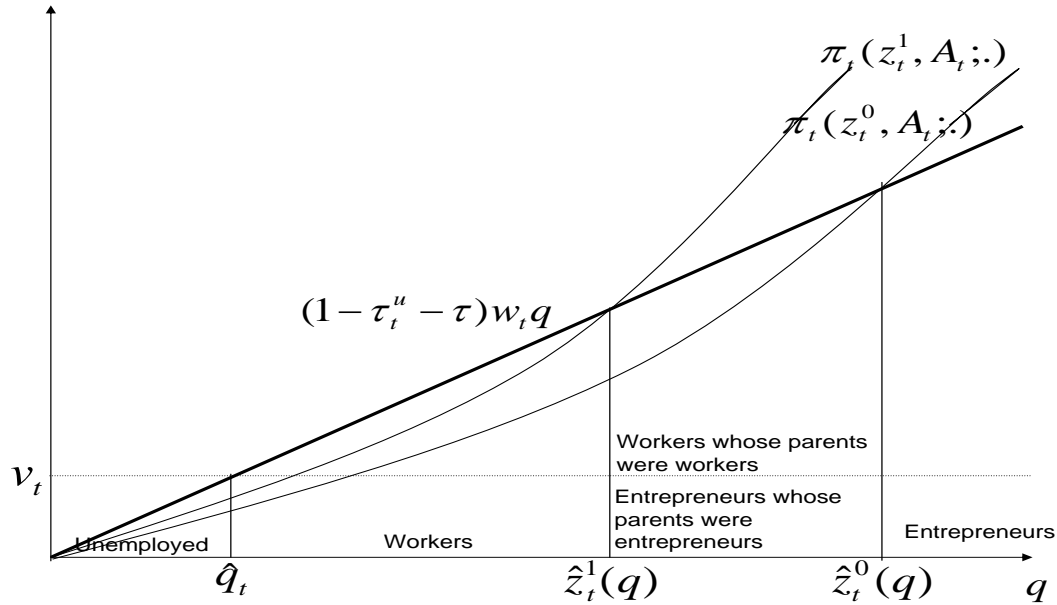
Figure 2.2.3: Thresholds of Occupational Choice

The Individual's Problem An individual born in period t receives his bequest (x_t) and chooses an optimal occupation that determines how he will employ his labor endowment and his bequest. The individual then is unemployed, works, or runs a business. Finally he consumes and leaves a bequest to his child. Formally the individual's problem is

$$\max_{c_t \geq 0, b_t \geq 0} c_t^{\omega} b_t^{1-\omega}$$

subject to

$$
\begin{aligned}
c_t + b_t &= x_t(1 + R_t - \delta) + I^u_{q<\hat{q}_t} v_t + I^w_{\hat{q}_t < q < \hat{z}^p_t(q)}(1 - \tau^u_t - \tau)w_t q + \\
&\quad + I^e_{\hat{z}^p_t(q) < z^p_t(q) < \overline{z^p_t}(q)} \pi_t(z^p_t; .).
\end{aligned}
$$

Individuals can lend their bequests to firms at the competitive rental rate, R_t. The first order conditions of the individual's problem give rise to the following two optimal decisions:

$$c_t(z_t^p; .) = \omega[x_t(1 + R_t - \delta) + I^u_{q < \hat{q}_t} v_t + I^w_{\hat{q}_t < q < \hat{z}_t^p(q)} (1 - \tau_t^u - \tau) w_t q +$$
$$+ I^e_{\hat{z}_t^p(q) < z_t^p(q) < \overline{z_t^p}(q)} \pi_t(z_t^p; .)],$$

$$b_t(z_t^p; .) = (1 - \omega)[x_t(1 + R_t - \delta) + I^u_{q < \hat{q}_t} v_t + I^w_{\hat{q}_t < q < \hat{z}_t^p(q)} (1 - \tau_t^u - \tau) w_t q +$$
$$+ I^e_{\hat{z}_t^p(q) < z_t^p(q) < \overline{z_t^p}(q)} \pi_t(z_t^p; .)].$$

The individual spends a fraction ω of his income on consumption and leaves the rest as a bequest to his child. In addition to these two optimal decisions the solution to the individual's problem includes his optimal occupational choice.

2.2.2 Aggregate Economy

Aggregate Capital Supply Each period the economy's aggregate capital stock (X_t) is determined by the sum of all bequests from last period

$$X_t = L^0_{t-1} \int_0^{\bar{z}^0} b_{t-1}(z_{t-1}^0; .) f(q) dq + L^1_{t-1} \int_0^{\bar{z}^1_{t-1}} b_{t-1}(z_{t-1}^1; .) f(q) dq, \quad (2.2.10)$$

where b_{t-1} represent bequest decisions taken last period. Last period's individuals were either children of workers L^0_{t-1} or children of entrepreneurs L^1_{t-1}.[29]

---

[29]Given perfect capital markets and the warm glow motive for bequests in agents' utility, there is no need to follow the joint distribution of wealth and managerial knowhow in this economy.

Growth Rate The growth rate of TFP is defined as a one-period percentage change in the level of TFP

$$g_t = \frac{A_t - A_{t-1}}{A_{t-1}}.$$

Following Hassler and Rodríguez Mora (2000), the growth rate of TFP is a positive function of the innate talent of last period's entrepreneurs relative to the size of the population ($\bar{Q}_{t-1}$),

$$g_t = h(\bar{Q}_{t-1}),$$

where

$$\bar{Q}_{t-1} = L^0_{t-1} \int_{\hat{z}^0_{t-1}}^{\bar{z}^0} q f(q) dq + L^1_{t-1} \int_{\hat{z}^1_{t-1}}^{\bar{z}^1_{t-1}} q f(q) dq,$$

and with h being some increasing function of $\bar{Q}_{t-1}$.[30] The innate talent of last period's entrepreneurs is the sum of innate talent of entrepreneurs who are children of workers L^0_{t-1} and those who are children of entrepreneurs L^1_{t-1}. Given these two groups of individuals and a fixed fraction of entrepreneurs in the economy, $\bar{Q}_{t-1}$ is maximized by assigning occupations such that the span of innate talent is the same for both groups, i.e. the least talented and the most talented entrepreneur from both parental backgrounds have to coincide. However, in case the value of parental background is high there will be more entrepreneurs with an entrepreneurial family background. Hence, aggregate innate talent of entrepreneurs will be lower and the individual's occupational choice thus exerts a negative externality on the economy's growth rate.

---

[30]Hassler and Rodríguez Mora (2000) reason the positive relationship between entrepreneurs' innate talent and TFP growth as follows: 'the higher the individual entrepreneur's ability to learn or understand or to deal with new or trying situations, the larger will the individual's technological innovations be. This will create a feedback mechanism whereby rapid technology growth creates an environment in which the sorting of individuals to entrepreneurial positions is based on intelligence, not on social background."(pg.889). Note that population size is unity.

Government   The government collects income taxes from entrepreneurs and workers and uses them for pure government consumption. Contributions to the unemployment insurance scheme from both workers and entrepreneurs have to be such as to fully finance benefits paid to the unemployed in each period. Each period the government has to fulfill the following two constraints

$$
\begin{aligned}
G_t \; = \;\; & \tau \{ L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} (y_t - w_t(1 + \tau_t^u) n_t - R_t k_t) f(q) dq + \\
& + L_t^0 \int_{\hat{z}_t^0}^{\bar{z}^0} (y_t - w_t(1 + \tau_t^u) n_t - R_t k_t) f(q) dq + \\
& + L_t^1 \int_{\hat{q}_t}^{\hat{z}_t^1} w_t q f(q) dq + L_t^0 \int_{\hat{q}_t}^{\hat{z}_t^0} w_t q f(q) dq \},
\end{aligned}
\tag{2.2.11}
$$

and

$$
v_t \int_0^{\hat{q}_t} f(q) dq = 2 \tau_t^u w_t \left(L_t^0 \int_{\hat{q}_t}^{\hat{z}_t^0} q f(q) dq + L_t^1 \int_{\hat{q}_t}^{\hat{z}_t^1} q f(q) dq \right).
\tag{2.2.12}
$$

Equilibrium   In equilibrium all three markets for goods, capital, and labor must clear. Labor supply is given by the productive time of those individuals who are neither entrepreneurs nor opt for unemployment. Denote by $n_t(z_t^p; .)$ and $k_t(z_t^p; .)$ optimal demands for labor and capital services by an entrepreneur born in period t who has managerial knowhow z_t^p. Then for the labor market to clear we require aggregate labor demand

$$
N_t^d = L_t^0 \int_{\hat{z}_t^0}^{\bar{z}^0} n_t(z_t^0; .) f(q) dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} n_t(z_t^1; .) f(q) dq,
\tag{2.2.13}
$$

to be equal to aggregate labor supply $N_t^s = L_t^0 \int_{\hat{q}_t}^{\hat{z}_t^0} q f(q) dq + L_t^1 \int_{\hat{q}_t}^{\hat{z}_t^1} q f(q) dq$.

For the capital market to clear we require aggregate capital demand to equal

aggregate capital supply

$$K_t^d = L_t^0 \int_{\hat{z}_t^0}^{\bar{z}^0} k_t(z_t^0; .) f(q) dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} k_t(z_t^1; .) f(q) dq = X_t. \qquad (2.2.14)$$

With $y_t(z_t^p; .)$ being the supply of goods by any entrepreneur of knowhow z_t^p, for market clearing in the goods market we require

$$L_t^0 \int_{\hat{z}_t^0}^{\bar{z}^0} y_t(z_t^0; .) f(q) dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} y_t(z_t^1; .) f(q) dq = L_t^0 \int_0^{\bar{z}^0} (c_t(z_t^0; .) +$$

$$+ b_t(z_t^0; .)) f(q) dq + L_t^1 \int_0^{\bar{z}_t^1} (c_t(z_t^1; .) + b_t(z_t^1; .)) f(q) dq - X_t(1 - \delta) + G_t.$$

$$(2.2.15)$$

Aggregate consumption, bequests, and government consumption have to equal the sum of aggregate production and the depreciated capital stock.

The law of motion for the mass of entrepreneurs is given by the following equation

$$L_t^1 = L_{t-1}^0 \int_{\hat{z}_{t-1}^0}^{\bar{z}^0} f(q) dq + L_{t-1}^1 \int_{\hat{z}_{t-1}^1}^{\bar{z}_{t-1}^1} f(q) dq. \qquad (2.2.16)$$

We can now define a competitive equilibrium for the model economy. Given an initial capital stock, X_0, an initial fraction of entrepreneurs L_0^1, and their talent, $\bar{Q}_{-1}$, a government policy, $\{\tau, \varsigma\}$, and a sequence of prices for labor and capital $\{w_t, R_t\}_0^\infty$, a competitive equilibrium is a collection of sequences $\{c_t(z_t^p; .), b_t(z_t^p; .), I_{q<\hat{q}_t}^u, I_{\hat{q}_t<q<\hat{z}_t^p(q)}^w, I_{\hat{z}_t^p(q)<z_t^p(q)<\bar{z}_t^p(q)}^e, \hat{z}_t^p, \hat{q}_t, \tau_t^u, G_t\}_0^\infty$ for $p \in \{0, 1\}$ such that:

1. $\{c_t(z_t^p; .), b_t(z_t^p; .), I_{q<\hat{q}_t}^u, I_{\hat{q}_t<q<\hat{z}_t^p(q)}^w, I_{\hat{z}_t^p(q)<z_t^p(q)<\bar{z}_t^p(q)}^e\}_0^\infty$ solves the individual's problem for each $p \in \{0, 1\}$ and for each t;

2. all three markets, for goods, capital, and labor clear, i.e. equations

(2.2.13)-(2.2.15) hold for all t;

3. $\{(\tau_t^u\}_0^\infty$ is such that the unemployment insurance is self-financing, equation 2.2.12 holds for all t;

4. $\{G_t\}_0^\infty$ is such that equation 2.2.11 holds for all t.

2.2.3 Calibration

Before presenting the extended version of the model economy that describes the reunification of West and East Germany, I first calibrate the basic model economy to West Germany before reunification. I fix parameter values for preferences and technology and pin down key parameters governing the role of parental background and the link between entrepreneurship and growth. Some parameters are assigned values based on a-priori information, while others are calibrated to match certain statistics of the West German economy before reunification. I also specify the function $h(\bar{Q}_{t-1})$ that relates innate talent of entrepreneurs and TFP growth and the function $a(g_t)$, relating TFP growth and the value of parental background for entrepreneurship.[31]

Fixing Parameter Values For the mean log-talent (μ) and its dispersion (σ), I use values of 2.11 and 0.58 respectively as estimated by Chang (2000) using the US wage distribution for non-supervisory workers. A more regulated German labor market and lower labor-market participation by low-skilled individuals make the use of a West German wage distribution less adequate for estimating a distribution of talents. Factors other than underlying talent lead to higher mean and lower variation in wages.[32] The US wage distribution, since it is less contaminated by policies, seems to be a better reflection of individuals' talent. The span-of-control parameter (γ) is set to 0.865. Using 3-digit

---

[31]One period in this economy is equivalent to one generation - 20 years.

[32]Gernandt and Pfeiffer (2007) estimate a wage distribution for West Germany for gross hourly wages for prime age dependent male workers for 1984-1989, with mean 2.42 and standard deviation 0.118.

industry data, Burnside et al. (1995) estimate returns to scale in production to lie between 0.81 and 0.92. I choose the midpoint of their values. Taking the average over annual values for 1970-1989 for the ratio of depreciation of fixed private capital over gross private capital stock gives me an annual depreciation rate, δ of 4.6% (Statistisches Bundesamt (2006)).

The remaining five parameters are chosen to match the first five calibration targets of Table 2.2.2. The importance of capital (ν) is calibrated to a value of 0.3468 in order to target a capital share of 0.3 as reported by the Deutsche Bundesbank (2001) for West Germany for 1970 to 1989. The parameter for the relative importance of consumption in utility (ω) is assigned a value of 0.8035 to match an average annual capital-output ratio of 2.32 for West Germany for 1970-1989 (Statistisches Bundesamt (2006)). The unemployment benefit as a fraction of the wage rate per efficiency unit (ς) is calibrated to 2.649 in order to target an average unemployment rate of 5.4% for West Germany between 1970 and 1989 (Bundesagentur für Arbeit (2007)). The parameter for the curvature of the profit function (κ) is assigned a value of 0.101 to match the fraction of entrepreneurs in the model to a business ownership rate of 6.9%, as estimated by Entrepreneurs International (Compendia (2002)) for West Germany for 1972 to 1989.[33] The parameter for the income tax rate (τ) is calibrated to a value of 0.175 to match the ratio of tax revenues to GDP in the model to taxes on income and profits as percentage of GDP of 12.2% for West Germany for 1975 to 1990 (OECD (2006)).

Specifying Functional Forms The two center pieces of the model economy are 1)the function relating entrepreneurs' innate talent to technological growth and 2)the function relating technological growth to the value of entrepreneurial parental background for managerial knowhow. The model's results are essen-

---

[33]In this data set business owners include self-employed and owners/managers of incorporated businesses whose income includes profits as well as a salary. Unpaid family workers are excluded. The business ownership rate is constructed by dividing the number of business owners by the total labor force. Data is available from 1972 onwards.

Table 2.2.2: Calibration Targets

	Data	Model
Capital Share (1970-1989)	0.3	0.3
Capital-Output Ratio (1970-1989)	2.32	2.32
Unemployment Rate (1970-1989)	5.4%	5.4%
Business Ownership Rate (1972-1989)	6.9%	6.9%
Tax Revenues to GDP (1975-1990)	12.2%	12.2%
Average Annual Growth Rate of GDP (1971-1989)	2.26%	2.26%
Percentage of Entrepreneur with Entrepreneurial Parent (1997)	60%	60%

tially determined by the functional forms and parameter values assigned to these functions. Careful calibration is thus crucial for obtaining sensible results for the basic model as well as for the extended version of the model economy.[34]

I specify the function $h(\bar{Q}_{t-1})$ relating innate talent of entrepreneurs to the growth rate of TFP as follows:

$$g_t = h(\bar{Q}_{t-1}) = \frac{1}{(1 + e^{-\bar{Q}_{t-1}})^{1/\alpha}}.$$

To obtain a positive relationship between innate talent of entrepreneurs and technological growth, $\alpha \geq 0$ has to hold. I choose α equal to 0.22 to match that between 1971 and 1989 real West German GDP per capita grew at an average annual rate of 2.26% (Statistisches Bundesamt (2006)). Finally, I specify the function $a(g_t)$ that relates TFP growth to the value of entrepreneurial parental background

$$\phi_{t+1} = a(g_t) = \frac{\bar{\phi}}{1 + g_t},$$

where $\bar{\phi}$ is a parameter. This parameter is assigned a value of 0.957 to match

---

[34]Figures A.2.1.1 and A.2.1.2 of Appendix A.2.1 provide a sensitivity analysis for these two key parameters.

the intergenerational persistence in occupations.[35] According to Pistrui et al.
(2000) 60% of West German entrepreneurs have a parent who had been an
entrepreneur. I set the calibration target for the percentage of entrepreneurs
whose parents were entrepreneurs to 60%. Table 2.2.3 reports all parameter
values.[36]

Table 2.2.3: Parameters

Mean Log Talent (μ)	2.11
Dispersion in Log Talent (σ)	0.58
Span-of-Control (γ)	0.865
Annual Depreciation Rate (δ)	0.046
Importance of Capital (ν)	0.3468
Relative Importance of Consumption in Utility (ω)	0.8035
Unemployment Benefit (ς)	2.649
Curvature of Profit Function(κ)	0.101
Income Tax (τ)	0.175
Parameters for Functions:	
Relating Entrepreneurs' Talent to Growth (α)	0.22
Relating Growth to Value of Parental Background ($\bar{\phi}$)	0.957

I simulate the model economy until convergence to a balanced growth path.
The model hits its calibration targets of Table 2.2.2 well. In addition, the
model is also able to generate statistics on average firm size, unemployment
benefits to mean nominal wage, and contributions to unemployment insurance
in line with data.[37]

---

[35]Zero correlation of talent between parents and children requires assigning a relatively
high value to $\bar{\phi}$ in order to be able to account for the persistence in occupations.

[36]Appendix A.2.2 provides a discussion on the calibration target for the intergenerational
persistence of occupations.

[37]See Appendix A.2.3 for details.

2.3 Extended Model (Reunified Germany)

Having presented the basic framework I am now ready to extent the model economy to account for aspects of reunification in order to be able to address the two main questions of this chapter: Did East Germany's integration into an established economy - West Germany - hinder a fruitful development of entrepreneurship? And did the resulting lack of entrepreneurship affect economic growth in East Germany?

In this chapter, the German reunification is modeled as the economic integration of a smaller region into a larger one. Both regions share common goods and capital markets, but their labor markets are locally separated. The government fixes wages in East Germany at a fraction $(1 - \lambda_t)$ of West German wages and governmental investment aids lower the rental rate for capital in East Germany to $R_t^* = (1 - \chi_t)R_t$. Initially, TFP in East Germany is lower than in West Germany $(A_t^* < A_t)$. The economy's aggregate capital stock is given by the sum of the two capital stocks. In contrast to West Germans, all East Germans of the first generation after reunification are children of workers. Paying a fixed moving cost individuals can opt for working or setting up a business in the other part of Germany.[38] In each region there is a fraction of θ individuals who are mobile and a fraction of $(1 - \theta)$ individuals who are immobile. Immobile individuals face infinitely high moving costs $(\eta_t^h = \infty)$ and more mobile individuals face lower moving costs (η_t^l).[39] The distribution of innate talent $f(q)$, is identical for East and West Germans.

---

[38]Individuals migrate with their children and thus depending on migration and occupational choices made by the first generation of East Germans, their offspring will be East or West German children of workers or entrepreneurs.

[39]I introduce this additional heterogeneity to account for reasons other than wage differentials or education (here $\approx$ innate talent) that induce migration decisions from East to West Germany, e.g. age, family ties (see e.g. Burda (1993))

2.3.1 West Germans

Upon reunification West Germans can migrate to East Germany and set up a business there, taking advantage of the lower labor cost and a lower rental rate of capital. However, TFP in East Germany is lower and moving requires the payment of a fixed cost. No West German migrates to East Germany to work there, as wages in East Germany are lower. Given a fixed cost for moving from West to East Germany (η_t^j) with $j \in \{h, l\}$, a wage rate for East Germany $(1 - \lambda_t)w_t$, and a reduced rental rate for capital $(1 - \chi_t)R_t$, the problem of a West German who sets up his business in East Germany is

$$\max_{\{n_t, k_t\}} \Pi_t = (1-\tau)[A_t^*(z_t^p)^{1-\gamma+\kappa}(k_t^\nu n_t^{1-\nu})^\gamma - (1-\lambda_t)(1+\tau_t^u)w_t n_t - (1-\chi_t)R_t k_t - \eta_t^j].$$

(2.3.1)

Smaller discounts on wages (λ_t) and on the rental rate of capital (χ_t) as well as higher moving costs (η_t^j), reduce profits of West Germans who set up their businesses in East Germany.[40] Their optimal profits are denoted by $\pi_t(z_t^p, A_t^*, \eta_t^j; .)$. Individuals in West Germany compare their potential profits from setting up a business in East Germany to the potential incomes resulting from the previously discussed occupations. They compare profits from setting up a business in East Germany (Equation 2.3.1) to profits they can make as entrepreneurs in West Germany (Equation 2.2.6). The cut-off value of managerial knowhow $\tilde{z}_t^{p,j}$, describes the individual who is indifferent between setting up his business in West or East Germany

$$\tilde{z}_t^{p,j} = \left(\eta_t^j (w_t(1 + \tau_t^u)^{\frac{(1-\nu)\gamma}{1-\gamma}} R_t^{\frac{\nu\gamma}{1-\gamma}} \Psi_t^{-1} \left(\frac{A_t^*}{A_t(1 - \lambda_t)^{\frac{(1-\nu)\gamma}{1-\gamma}}(1 - \chi_t)^{\frac{\nu\gamma}{1-\gamma}}} - 1 \right)^{-1} \right)^{\frac{1-\gamma}{1-\gamma+\kappa}}.$$

(2.3.2)

This threshold of occupational choice is independent of an individual's parental background, $\tilde{z}_t^{p,j} = \tilde{z}_t^j$. Higher moving cost (η_t^j), a lower discount on wages (λ_t), and a lower discount on the rental rate of capital (χ_t), all reduce

---

[40] Moving costs are assumed to be deductible from profit taxes.

entrepreneurial income in East Germany and thus raise the threshold.

As managerial knowhow is defined in the interval $z_t^p \in (0, \bar{z}_t^p]$ this threshold needs to be strictly positive, i.e:

$$\frac{A_t^*}{A_t(1 - \lambda_t)^{\frac{(1-\nu)\gamma}{1-\gamma}}(1 - \chi_t)^{\frac{\nu\gamma}{1-\gamma}}} - 1 > 0.$$

This is the case only if

$$(1 - \lambda_t)^{(1-\nu)\gamma}(1 - \chi_t)^{\nu\gamma} < \frac{A_t^{*1-\gamma}}{A_t}.$$

Only if the discount on wages and the discount on the rental rate of capital are large enough to offset the reduced TFP in East Germany do West German individuals prefer to set up a business in East Germany over setting it up in West Germany. If discounts are too small, or differences in TFP are large, no West German individual opts for setting up his business in East Germany. In this case, or if moving costs are very large, or if there are no mobile individuals, thresholds of occupational choices for West Germans after reunification remain unaltered and are as displayed in Figure 2.2.3.[41]

2.3.2   East Germans

For East Germans, reunification implies free occupational choices. They can decide to set up their own business, to become a worker, to be unemployed, or they can migrate to West Germany to work or to set up a business there.[42]

---

[41]See Appendix A.2.4 for additional comparisons West Germans make to choose their optimal occupation.

[42]East German unemployed receive the same benefits as West German unemployed, hence for them the option to migrate to West Germany is never better than staying in East Germany, given that migration is costly. As of 2007, social welfare benefits are the same in East and West Germany but already in 1992 East German benefits were just 4% below those of West Germany (Bundesministerium für Arbeit und Soziales (2008)).

East German Workers East Germans have full knowledge of the wage setting policy. With a certain probability ψ_t, they rationally expect to be involuntarily unemployed when choosing to work in East Germany.[43] East German workers earn a fraction $(1 - \lambda_t)$ of West German wages and both voluntary and involuntary unemployed East Germans receive unemployment benefits v_t.[44] Thus expected income of those staying in East Germany to work is given by

$$(1 - \psi_t)(1 - \tau_t^u - \tau)(1 - \lambda_t)w_t q + \psi_t v_t. \tag{2.3.3}$$

East Germans who migrate to West Germany to work there earn the same wage as West Germans, less a moving cost $\eta_t^{*,j}$

$$(1 - \tau_t^u - \tau)w_t q - \eta_t^{*,j}. \tag{2.3.4}$$

East German Entrepreneurs East German entrepreneurs face the following profit maximization problem

$$\max_{\{n_t, k_t\}} \Pi_t = (1 - \tau)[A_t^*(z_t^p)^{1-\gamma+\kappa}(k_t^\nu n_t^{1-\nu})^\gamma - (1 - \lambda_t)(1 + \tau_t^u)w_t n_t - (1 - \chi_t)R_t k_t]. \tag{2.3.5}$$

Greater gaps between East and West German wages (λ_t), and East and West German rental rates of capital (χ_t) increase profits of East German entrepreneurs. Denote their optimal profits by $\pi_t(z_t^p, A_t^*; .)$. East Germans who set up a business in West Germany face the following profit maximization problem

$$\max_{\{n_t, k_t\}} \Pi_t = (1 - \tau)[A_t(z_t^p)^{1-\gamma+\kappa}(k_t^\nu n_t^{1-\nu})^\gamma - (1 + \tau_t^u)w_t n_t - R_t k_t - \eta_t^{*,j}]. \tag{2.3.6}$$

---

[43]One might argue that initially East Germans did not have any notion of unemployment as many authors have described that under the communist regimes, the "threat of unemployment was therefore virtually nil[...]" (Roland (2000), pg.9). or that East Germany was " a society in which unemployment was never experienced as a direct threat to the individual", Pohl (1996)(pg.64). However, given that periods are equal to one generation the model cannot accommodate a process of learning during one's lifetime and thus it seems sensible to assume that East German's form rational expectations.

[44]Note that given this uncertainty, the individual problem for the East German thus corresponds to maximizing his expected utility, $E_t[U(c_t, b_t)]$.

Higher moving costs $(\eta_t^{*,j})$ reduce profits of East Germans who set up a business in West Germany. Higher West German TFP (A_t) on the other hand, increases their profits. Denote their optimal profits by $\pi_t(z_t^p, A_t, \eta_t^{*,j}; .)$.

Occupational Choices   East Germans compare potential incomes from being unemployed, working or setting up a business in East Germany, and working or setting up a business in West Germany. Figure 2.3.4 displays one possible realization of four thresholds of occupational choice for mobile East Germans of the first generation after reunification.[45]
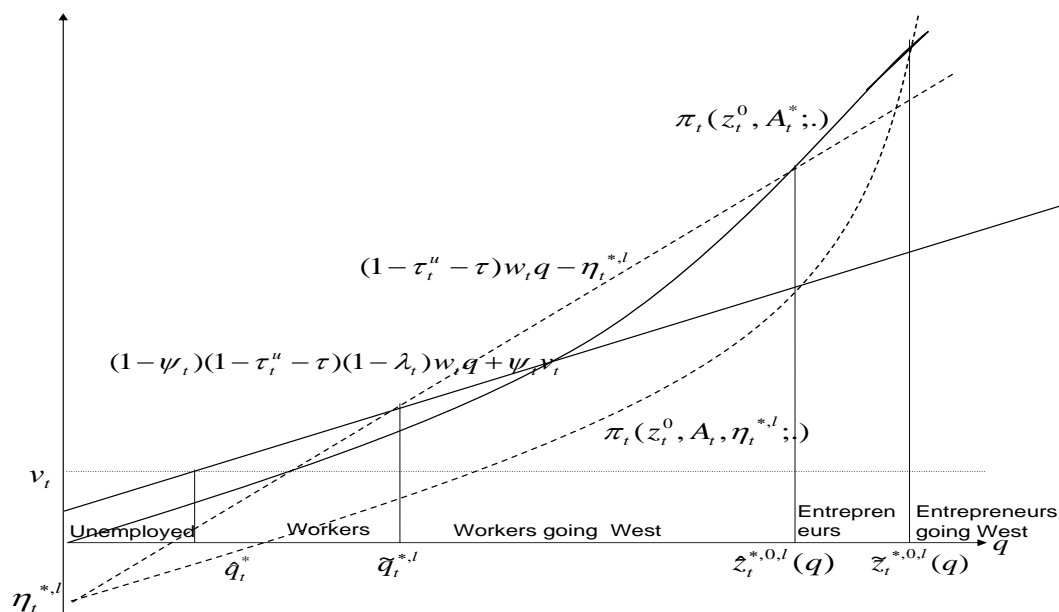

Figure 2.3.4: Possible thresholds for occupational choice for mobile East Germans of first generation after reunification.

---

[45]In order to keep the discussion tractable I only discuss income comparisons relevant for the case displayed in Figure 2.3.4. For additional comparisons East Germans make to choose their optimal occupation see Appendix A.2.4.

East German individuals compare their potential wage in West Germany (Equation 2.3.4) to the wage they can earn in East Germany (Equation 2.3.3). The cut-off value, $\tilde{q}_t{}^j$, describes the East German individual who is indifferent between working in East or West Germany

$$\tilde{q}_t{}^j = \frac{\psi_t \varsigma w_t + \eta_t^{*,j}}{(1 - \tau_t^u - \tau)(\psi_t + \lambda_t - \psi_t \lambda_t) w_t}. \tag{2.3.7}$$

Higher moving cost $(\eta_t^{*,j})$ reduce labor income in West Germany and thus the benefits from migration and raise the threshold as well as do higher wages in East Germany, a lower λ_t. A positive possibility of involuntary unemployment ψ_t, reduces the potential income of working in East Germany and thus lowers the threshold. Comparing their potential wage in West Germany to the profits they can make as entrepreneurs, East Germans set up their own business in East Germany whenever, $\pi_t(z_t^p, A_t^*; .) \geq (1 - \tau_t^u - \tau) w_t q - \eta_t^{*,j}$. The cut-off value, $\hat{z}_t^{*,p,j}$, describes the East German individual who is indifferent between working in West Germany or setting up a business in East Germany.[46] Furthermore, East Germans measure profits they can make as entrepreneurs in East Germany, against profits they can make setting up their business in West Germany. The cut-off value, $\tilde{z}_t^{*,p,j}$ describes the East German individual who is indifferent between setting up his business in East or West Germany

$$\tilde{z}_t^{*,p,j} = \left(\eta_t^{*j} \left(w_t(1 + \tau_t^u) \right)^{\frac{(1-\nu)\gamma}{1-\gamma}} R_t^{\frac{\nu\gamma}{1-\gamma}} \Psi_t^{-1} \left(1 - \frac{A_t^*}{A_t(1-\lambda_t)^{\frac{(1-\nu)\gamma}{1-\gamma}}(1-\chi_t)^{\frac{\nu\gamma}{1-\gamma}}} \right)^{-1} \right)^{\frac{1-\gamma}{1-\gamma+\kappa}}. \tag{2.3.8}$$

This threshold of occupational choice is independent of the individual's parental

---

[46] Note that the profit function for entrepreneurs in East Germany and the function for wage income in West Germany might cross twice. Initially being an entrepreneur in East Germany is always better than working in West Germany, due to fixed moving costs. However, with increasing talent wage income increases and individuals are able to pay the fixed costs and thus might prefer to work in West Germany instead of setting up a business in East Germany. Given increasing returns to knowhow for entrepreneurs, there might exist a second threshold where setting up a business in East Germany becomes again more attractive as opposed to working in West Germany, $(\hat{z}_t^{*,0,l}(q)$ in Figure 2.3.4$)$.

background, $\tilde{z}_t^{*,p,j} = \tilde{z}_t^{*,j}$. Higher moving cost $(\eta_t^{*,j})$ reduce entrepreneurial income in West Germany and increase the threshold. Higher wages in East Germany on the other hand, a lower λ_t, reduce entrepreneurial income in East Germany and thus lower the threshold as does a higher rental rate for capital, a lower χ_t. This threshold is positive only if

$$(1 - \lambda_t)^{(1-\nu)\gamma}(1 - \chi_t)^{\nu\gamma} > \frac{A_t^{*\,1-\gamma}}{A_t}.$$

Only if the discount on wages and the discount on the rental rate of capital are small enough to not offset the higher TFP in West Germany do East German individuals decide to set up a business in West Germany. Finally, individuals also compare the unemployment benefit v_t to their potential wage in East Germany (Equation 2.3.3). The cut-off value $\hat{q}_t^*$, describing the East German individual who is indifferent between working in East Germany or being unemployed is given by

$$\hat{q}_t^* = \frac{\varsigma}{(1 - \tau_t^u - \tau)(1 - \lambda_t)}. \tag{2.3.9}$$

2.3.3 Aggregate Economy

Lemma 2.3.1 *There exists no equilibrium after reunification in which both, West and East German individuals become entrepreneurs in both, East and West Germany.*[47]

There will hence only exist equilibria with either East Germans setting up businesses in East and West Germany or West Germans setting up businesses in East and West Germany.

Growth Rates The growth rate of East German TFP is defined as a positive function of the innate talent of entrepreneurs setting up a business in East

---

[47]For the proof of Lemma 2.3.1 see Appendix A.2.6.

Germany ($\bar{Q}^*{}_t$) relative to P^*_{t+1}, the East German population of next period,
i.e. after migration decisions have been taken

$$g^*_{t+1} = h(\bar{Q}^*{}_t/P^*_{t+1}).$$

Analogously, the growth rate of West German TFP depends positively on the
innate talent of entrepreneurs setting up a business in West Germany ($\bar{Q}_t$),

$$g_{t+1} = h(\bar{Q}_t/P_{t+1}).$$

Government After reunification, the government collects income taxes in
both, East and West Germany. The government also fixes the discount on
East German wages (λ_t) as well as the discount on the rental rate of capital in
East Germany (χ_t). Government tax revenues are used to finance the difference
in the rental rate to lenders but the government cannot run a deficit.[48] Each
period contributions to the unemployment insurance from both workers and
entrepreneurs in East and West Germany have to be such as to fully finance
all unemployment benefits. Let $K^{d,*}_t$ be aggregate capital demand in East
Germany, W_t denotes aggregate net wages of the economy, Π_t are aggregate
after-tax profits, and UB_t are aggregate unemployment benefits. Each period
the government has to fulfill the following two constraints

$$G_t + \chi_t R_t K^{d,*}_t = \tau(\Pi_t + W_t) - \tau\tau^u_t W_t, \qquad (2.3.10)$$

with $G_t \geq 0 \;\forall t$, and

$$UB_t = 2\tau^u_t W_t. \qquad (2.3.11)$$

Equilibrium Given that East German wages are fixed above labor produc-
tivity, equilibria after reunification are characterized by involuntary unemploy-

---

[48]In none of the calibrated versions of the model economy is the restriction on zero debt
binding; i.e. investment aids never exceed tax revenues.

ment in East Germany.[49] I require that for an equilibrium there be market clearing in the common markets for goods and capital, and in at least the labor market in West Germany. I allow for the possibility of closure of the East German labor market. Denote aggregate labor demand in East and West Germany by $N_t^{d,*}$ and N_t^d respectively. $N_t^{s,*}$ and N_t^s are aggregate labor supply in East and West Germany. Aggregate capital demand in West Germany is denoted by K_t^d. Let $Y_t^{s,*}$ and Y_t^s be aggregate supply of goods in East and West Germany respectively. Aggregate capital supply after reunification, X_t is given by the sum of the initial capital stocks of West and East Germany. For the capital market to clear we require

$$X_t = K_t = K_t^{d,*} + K_t^d. \tag{2.3.12}$$

For the goods market to clear the following has to hold

$$
\begin{aligned}
Y_t^{s,*} + Y_t^s \;=\; & \omega\{\Pi_t + W_t + UB_t + (1 + R_t - \delta)X_t\} + (1 - \omega)\{\Pi_t + W_t + \\
& + UB_t + (1 + R_t - \delta)X_t\} + G_t + \chi_t R_t K_t^{d,*} + \\
& + \Xi_t - (1 - \delta)X_t.
\end{aligned}
\tag{2.3.13}
$$

Aggregate consumption, aggregate bequests, government consumption, and aggregate moving costs (Ξ_t) have to equal the sum of production and the depreciated aggregate capital stock.[50] The labor market in West Germany has to clear, i.e. aggregate labor supply has to equal aggregate labor demand

$$N_t^s = N_t^d. \tag{2.3.14}$$

---

[49]Involuntary unemployment is assigned randomly. As entrepreneurs hire 'efficiency units' they are indifferent between hiring few very capable or many less efficient workers.

[50]See Appendix A.2.5 for the explicit aggregation of the intelligence of entrepreneurs, the components of the two government constraints, the components of the equilibrium equations, an explicit definition of aggregate moving costs, as well as for the laws of motions for entrepreneurs in East and West Germany.

We require the labor market in East Germany to be in positive net supply

$$N_t^{s,*} \geq N_t^{d,*}. \tag{2.3.15}$$

Aggregate labor supply has to be bigger or equal aggregate labor demand. In case the difference between supply and demand in the East German labor market is positive, there is involuntary unemployment.[51] In equilibrium the probability of involuntary unemployment expected by East Germans, ψ_t has to equal the realized rate of involuntary unemployment, i.e.

$$\psi_t = \frac{N_t^{s,*} - N_t^{d,*}}{P_{t+1}^*}. \tag{2.3.16}$$

We can now define an equilibrium for the model economy after reunification.[52] Given an initial aggregate capital stock X_t, an initial fraction of entrepreneurs L_t^1 for West Germany, and their talent Q_{t-1}, a government policy, $\{\tau, \varsigma, \lambda_t, \chi_t\}$, moving costs $\{\eta_t^j, \eta_t^{*,j}\}$ for $j \in \{h,l\}$ and prices for labor and capital as well as a probability of involuntary unemployment in East Germany $\{w_t, R_t, \psi_t\}$, an equilibrium is a collection of

$$\{c_t(z_t^p, \eta_t^j; .), c_t(z_t^p, \eta_t^{*,j}; .), b_t(z_t^p, \eta_t^j; .), b_t(z_t^p, \eta_t^{*,j}; .), \mathbf{I},$$
$$, \mathbf{I}^*, \hat{z}_t^{p,j}, \hat{z}_t^{*,p,j}, \hat{q}_t, \hat{q}_t^*, \tilde{z}_t^j, \tilde{z}_t^{*,j}, \tilde{q}_t^j, \tau_t^u, G_t\},$$

for $p \in \{0,1\}$ and $j \in \{h,l\}$ such that:

1. $\{c_t(z_t^p, \eta_t^j; .), b_t(z_t^p, \eta_t^j; .), \mathbf{I}\}$ solves the individual's problem for West Germans of types $p \in \{0,1\}$ and $j \in \{h,l\}$;

---

[51] Migration and occupational choices are only altered until expected involuntary unemployment is equal to the realized rate. An individual who finds himself involuntarily unemployed cannot reconsider his choice.

[52] Contrariwise to the equilibrium for West Germany before reunification, the equilibrium after reunification is not competitive, given the imposed wage in the East German labor market. For tractability, indicator functions of occupational choice for West Germans ($\mathbf{I}$) and East Germans ($\mathbf{I}^*$) are not explicitly stated.

2. $\{c_t(z_t^p, \eta_t^{*,j}; .), b_t(z_t^p, \eta_t^{*,j}; .), \mathbf{I}^*\}$ solves the individual's problem for East Germans of types $p \in \{0, 1\}$ and $j \in \{h, l\}$ who are not involuntarily unemployed;

3. for those individuals in East Germany who are involuntarily unemployed optimal decisions about personal consumption and bequests coincide with those of voluntarily unemployed individuals;

4. the rate of involuntary unemployment coincides with East Germans's expectations, equation 2.3.16 holds;

5. markets for goods and capital and the West German labor market clear;

6. the East German labor market is in positive net supply or inactive;

7. (τ_t^u) is such that the unemployment insurance is self-financing, equation 2.3.11 holds;

8. the government's budget is balanced, equation 2.3.10 holds with $G_t \geq 0$.

2.3.4 Calibration

For the extended model economy, I maintain parameters values as fixed and calibrated for the basic model (see Table 2.2.3).[53] However, some additional parameters need to be specified. I fix values for the discount on wages as well as initial values for relative population size, and capital stock, and calibrate values for relative TFP, the discount on the rental rate, the fraction of mobile Germans, and their moving costs in order to match certain reunification statistics.

---

[53]Alesina and Fuchs-Schündeln (2007) find that it takes two generations for East German preferences to convert to those of West Germans. Assuming a different value for the preference parameter ω, for East Germans does not have a direct effect on their occupational choices.

In 1991, wages in East Germany were set to 50% of West German wages, by 1995, they were fixed at 70% and by 2007 they had reached about 80% of West German wages. I use the intermediate value and set λ_t to 0.3. The original population of the GDR was equal to one fourth the size of the West German population.[54] In order to estimate the initial capital stock of the East German economy, I use data on the German gross capital stock measured in prices of 2000, from the Statistisches Bundesamt (2006) and Statistisches Ämter der Länder (2009). In 1991, the per-capita capital stock of East Germany was less than half the per capita capital stock of West Germany, i.e. $X_t^* = 0.43X_t$. The remaining parameters, relative TFP, the discount on the rental rate of capital in East Germany χ_t, the fraction of mobile individuals θ, and their moving costs η_t^l are calibrated to match the calibration targets displayed in Table 2.3.4.

Table 2.3.4: Calibration Targets for the Extended Model Economy

	Data	Model
East to West German Labor Productivity	68%	67%
East-West Net Migration as % of Eastern Population	7.5%	7.5%
Investment Aid to West German GDP	1%	1%
East German Unemployment	27%	27%

The ratio of East to West German labor productivity measured as GDP per employed person rose from 35% in 1991 to 78% in 2007 (Statistisches Bundesamt (2006)). I take the average value over the years 1991 to 2007 and set the calibration target for the ratio of labor productivities to 68%. I set the initial ratio of East to West German TFP, $\frac{A_t^*}{A_t}$ to 0.7451 to match this target to the model's ratio of output over workers and managers in East and West Germany. The discount on the rental rate of capital in East Germany χ_t, is calibrated to a value of 0.201 to match a ratio of investment-aid to West German GDP

---

[54]The mass of the entire German population is normalized to one; P_t individuals live in West Germany and $P_t^* = 1 - P_t$ individuals live in East Germany. After reunification, migration may alter the population size of East and West Germany.

of 1%.[55] According to Wurzel (2001) between 1991 and 1995 annual public transfers for support to enterprises and business-near infrastructure were in the range of 0.63% and 0.99% of West German GDP.[56]

The fraction of mobile individuals θ, is assigned a value of 0.5 to match that net migration from East Germany between 1989 and 2002 amounted to 7.5% of the original population of East Germany. I calibrate moving costs for mobile Germans η_t^l, to a value equal to 42.34% of per-capita GDP of a pre-reunification generation in the model, in order to match an unemployment rate of 27%. While, the average official East German unemployment rate for 1991 to 2007 was 17.5% (Bundesagentur für Arbeit (2008)), adding the so called "hidden" unemployed, those who do not appear as officially unemployed due to some form of active labor market policy (training programmes, wage subsidies, early retirement schemes) increases the unemployment rate to around 27% (Sachverständigenrat (2007)).[57] Table 2.3.5 contains all additional parameter values for the extended model economy.

2.3.5   Results

I simulate the extended model economy for one period (one generation). The extended model economy hits the calibration targets of Table 2.3.4 well. Table 2.3.6 displays additional results for one generation after reunification.

---

[55]The estimated value of $\chi_t = 0.201$ is somewhat in line with Ragnitz (2002) who finds that in 2000 most firms in East Germany still received investment aids of around one quarter of their investment costs.

[56]These do not include special depreciation allowances, debt servicing expenditure and credits.

[57]The Sachverständigenrat (2007) publishes numbers of registered and hidden unemployed. Between 1993 and 2003, the number of hidden unemployed in East Germany was on average equal to 55% of registered unemployed. Moving costs for East Germans $\eta_t^{*,j}$ are assumed to be equal to moving costs for West Germans. Immobile Germans face infinitely high moving costs, $\eta_t^h = \infty$.

Table 2.3.5: Additional Parameters for the Extended Model Economy

Discount on East German Wages (λ_t)	0.3
Initial Ratio of East to West German Population	0.25
Initial Ratio of East to West German Capital Stock	0.43
Initial Ratio of East to West German TFP	0.7451
Discount on East German Rental Rate (χ_t)	0.201
Fraction of Mobile Germans (θ)	0.5
Moving Costs for Mobile Germans (η_t^l)	$0.4234\frac{Y_{t-1}}{P_{t-1}}$

Results show a lack of entrepreneurship in East Germany as pointed out by the OECD (2007). After reunification 6.4% of East Germans set up their own business, but around 24% of them do so in West Germany. Of those who stay in East Germany only 5.3% set up a business, compared to 6.9% of West Germans before reunification. After reunification, no West German migrates to East Germany to set up a business there. The fraction of West German entrepreneurs decreases slightly to 6.8%, due to a higher interest rate. A lower aggregate per capita capital stock and high capital demand by East German firms that face lower capital costs lead to a rise in the interest rate. In addition, the lower per capita capital stock reduces the aggregate capital-output ratio.

The inflow of talented East German entrepreneurs raises the fraction of entrepreneurs in the new West German population to 7.1%. Relative accumulative talent of entrepreneurs in West Germany increases and causes West German TFP to grow at an annual rate of 1.66%, compared to 1.57% before reunification. East German entrepreneurs are immobile or less talented individuals and relative accumulative talent of entrepreneurs in East Germany is 13.6% lower than in West Germany. Thus, TFP in East Germany grows at a lower rate of 1.42%. On the aggregate, TFP grows at an annual rate of 1.61%. Increased aggregate TFP growth leads to a slight decrease in the value of parental background. Having had a parent who was an entrepreneur increases one's managerial knowhow by 69.5%, ($\phi = 0.695$).

Table 2.3.6: Reunification: Results After One Generation

Entrepreneurship	
Entrepreneurs	6.7%
Entrepreneurs in East Germany	5.3%
East German Entrepreneurs	6.4%
... of those going West	23.8%
Entrepreneurs in West Germany	7.1%
West Germans Entrepreneurs	6.8%
... of those going East	0
Entrepreneurial background individuals becoming entrepreneurs	59.5%
Working background individuals becoming entrepreneurs	3.6%
Value of Entrepreneurial Parental Background	0.695
Entrepreneurs 's relative accumulative talent	1.43
... in East $(\bar{Q}_t^*/P_{t+1}^*)$	1.27
... in West $(\bar{Q}_t/P_{t+1})$	1.47
Germany	
Annual Capital-Output Ratio	2.26
Annual Rental Rate of Capital	6.8%
Unemployment Rate	9.4%
Annual Growth Rate of TFP	1.61%
Investment Aid to Government Revenue	6.6%
Fraction of Taxes Paid in West Germany	89.5%
Contribution to Unemployment Insurance	1.65%
Fraction of Contributions paid in East Germany	10.5%
Fraction of Unemployment Benefits Paid in East Germany	52.6%
West Germany	
Annual Growth Rate of TFP	1.66%
Annual Growth Rate of GDP per capita	2.25%
Unemployment Rate	5.5%
Average Firm Size	12.4
East Germany	
Annual Output per Capita East to West	51.7%
Annual Growth Rate of TFP	1.41%
Unemployment Rate	27%
of those involuntarily unemployed	33.4%
Fraction of Workers going West	8.7%
Average Firm Size	13.0
Moving Costs to annual GDP per capita East	12.5%

The fraction of individuals from an entrepreneurial parental background who become entrepreneurs decreases slightly, from 60% to 59.5%, while the fraction of those from a working family background increases from 3% to 3.6%. This is due to the fact that all East German entrepreneurs have a working family background.[58] In the first generation after reunification, GDP per capita in West Germany increases by 2.25% annually, only slightly lower than the annual GDP growth rate of 2.26% for West Germany before reunification. The model's estimates of the per capita GDP ratio for East to West Germany of 52% is eight percentage points lower than the average ratio of 60% for 1991 to 2008 in the data (Statistisches Ämter der Länder (2009)).

About one third of the East German unemployed, around 10% of the East German population, are involuntarily unemployed. The remaining two-thirds, 17% of East Germans, decide not to work. As benefits are indexed by West German wages the fraction of voluntarily unemployed in East Germany clearly exceeds the one in West Germany.[59] The West German unemployment rate remains almost unchanged and aggregate unemployment increases to 9.4%. This result of the model is very much in line with data. Average aggregate unemployment between 1992 and 2007 was 9.8% (Bundesagentur für Arbeit (2007)). More unemployed individuals and unchanged unemployment benefits require an increase in the contribution to unemployment insurance to 1.65%. More than half of all unemployment benefits are paid out in East Germany, while contributions by East German workers and entrepreneurs make up only 10.5%. Data by the Bundesagentur für Arbeit (2006) indicate a cross subsidizing of unemployment benefits between East and West Germany but to a lesser extent. Between 1996 and 2006, on average 35.4% of unemployment benefits were paid out in East Germany.

---

[58]According to Solga (2006), *elite reproduction* (i.e. outflow from *nomenklatura* to upper service class positions) in East Germany was limited and education and acquired skills rather than party membership were the dominant criteria for elite recruitment after 1989.

[59]This result is in line with findings by Snower and Merkl (2006) and Canova and Ravn (2000) who assign an important role to generous welfare provisions in explaining low output and employment in East Germany.

Income of the unemployed in East Germany is thus subsidized by West German contributions and workers and entrepreneurs in West Germany contribute 89.5% to government revenues of which 6.6% are used for investment aids for entrepreneurs in East Germany. Entrepreneurs in East Germany hire on average 0.6 workers more than entrepreneurs in West Germany. This results of the model is consistent with data showing that the small and medium sized sector is relatively more important in West than in East Germany.[60] Around 9% of East German workers migrate to West Germany. Their moving costs and those of East Germans entrepreneurs are equal to around 12.5% of annual East German GDP per capita.

Micro-Data   Ideally one would want to compare the model's results to micro-data on the interaction of occupational choice and migration. Table 2.3.7 displays statistics on East-West migration and self-employment taken from the unbalanced German Socioeconomic Panel (SOEP) for 1992 to 2006. However, given the very small sample size – for instance there are only 32 observations over 14 years on East German self-employed who migrate permanently to West Germany – these statistics can only be viewed as suggestive.

Table 2.3.7: SOEP Unbalanced Panel Data for Labor Force Participants, age 18-65, 1992-2006 (number of observations)

	West Sample A	East Sample C
Self-employed	8.8% (765)	7.0% (395)
Permanent migrants to East and West respectively	1.1% (92)	10.5% (597)
Permanent migrants among Self employed	1.0% (8)	8.1% (32)

Differences in self-employment rates between East and West Germany are

---

[60] Data from the Statistisches Bundesamt (2008) shows that in 2004 there were 39 and 33.8 firms with 0-9 employees, 2.9 and 2.7 firms with 10-49 and 0.7 and 0.7 firms with 50 and more employees in West and East Germany respectively (per 1000 inhabitants).

of a similar magnitude as estimated by the model.[61] While in the model the
fraction of entrepreneurs in East Germany is 25% lower than the fraction of
entrepreneurs in West Germany, data in Table 2.3.7 indicates a difference of
20% in the fractions of self-employed in East and West Germany. Migration
from East to West Germany is slightly higher in this data set than in the data
used for calibration. Migration from West to East is very limited and despite
the larger West German population for every four self-employed migrating from
East to West, there is one West German self-employed setting up his business
in East Germany. Compared to the model's results, fewer East German self-
employed seem to migrate to West Germany.

Future Outlook "For value added in East Germany to reach 90 per cent
of that of West Germany by 2020, the East German economy would have to
grow by an above-average 4-5 per cent a year." (Gesprächskreis Ost (2004), own
translation). Stakes for East Germany to reach West German levels of output
are high. In order to be able to provide some future outlook for East Ger-
many given the current reunification scenario, I simulate the extended model
economy for five additional generations. I assume that over time moving costs
decrease and spill-over effects cause TFP levels in East and West Germany to
converge. While simulating the model economy for more periods can provide
some future perspectives, these cannot be contrasted with data. However, de-
mographic forecasts for East Germany turn out to coincide with some of the
model's predictions.[62]

While the situation for West Germany will change little – rates of unemploy-
ment, fraction of entrepreneurs, and GDP growth remain stable – the situation
in East Germany will be characterized by empty regions with very few active
individuals. Given a high probability of involuntary unemployment East Ger-

---

[61]Difference in levels between model and data are most likely due to the fact that the
fraction of entrepreneurs in the model refers to self-employed with employees while the data
set includes also own-account workers.

[62]See Appendix A.2.7 for details on results.

man workers will continue to migrate to West Germany. Low talent individuals and immobile individuals will stay behind. In the following generation these individuals will be replaced by a child of random talent who will be immobile or mobile with a probability of 50%. And of these children only the least able and the immobile will stay in East Germany. This process will repeat itself the following generation. The East German population will thus be continuously shrinking.[63] If innate talent of parents and children were positively correlated in this model, over time the East German population would be reduced to least able individuals only. While the model's scenario is obviously an extreme case, numerous newspaper articles, as "Geschichten vom Verschwinden" (Tagesspiegel 27.05.2006) or "Waiting for the East to flourish", (BBC News, 09/09/2005) or "Wieder der doofe Rest" (Spiegel, 3/2002), or "Tearing itself down; Depopulation of eastern Germany" (The Economist, 12/04/2008) have been discussing the situation of deserted regions in East Germany.[64]

2.4 Counterfactual Experiments

Given prospects of a deserted East Germany, the question arises: How could East Germany's growth experience been different? Especially the wage-setting policy seems to oppress incentives to become an entrepreneur. In addition social rigidities in West Germany that assign an important role to parental background make it difficult for East German individuals who want to set up their own business to compete with West Germans in terms of managerial knowhow. And free migration implies an attractive outside option for East Germans to work or set up a business in West Germany. In this section I perform three counterfactual experiments that assume for the first period after reunification, 1)East Germany having flexible wages, 2)East Germany integrating into a so-

---

[63]If the long run allocation will be a completely depopulated East Germany depends on the speed of convergence of TFPs versus the decline in moving costs.

[64]A study of the Berlin Institut (2007) shows that high rates of migration in some regions of East Germany can be linked to local issues of increasing crime and radical political movements.

cially mobile West Germany, and 3)migration restriction for East and West Germans. Results of all experiments are presented face to face with results for one period after reunification (Benchmark results). For results of all counterfactual scenarios to be comparable to the Benchmark scenario I adjust the discount on the rental rate of capital, χ_t, in order to keep the amount of investment aid paid at the Benchmark level.

2.4.1   Flexible Wages

In this counterfactual experiment I allow for wages to freely adjust in each of the locally separated labor markets. I assume that moving costs, and unemployment benefits paid are maintained as specified in Tables 2.2.3 and 2.3.5.[65] I lower the discount on the rental rate of capital to $\chi_t = 0.1799$, such that investment aids paid to East German firms are as in the Benchmark case. Table 2.4.8 displays results of this counterfactual experiment.

If wages in East Germany are to adjust freely, they fall. Gross wages per efficiency units are 2% lower than in the Benchmark scenario. This fall is large enough to reduce unemployment by nine percentage points to 18%. All unemployment is voluntary. The fact that the share of voluntarily unemployed is more than three times the one in West Germany is due to welfare provisions being linked to West German wages. Lower East German wages translate into higher profits for entrepreneurs, and a larger fraction of East Germans set up a business in East Germany, 5.6% compared to 5.3%. Less unemployment and more entrepreneurs imply higher output. Per capita output in East Germany is 12% higher while per capita output in West Germany drops slightly. Thus,

---

[65]Note that the guess on involuntary unemployment in East Germany in this case is zero and Equation 2.3.3 reduces to $(1 - \tau_t^u - \tau)w_t^* q$. In order to avoid introducing a motive for unemployed to migrate as well, unemployment benefits in both parts of Germany are specified as fractions of West German wages.

Table 2.4.8: Flexible Wages

	Flexible Wages	Benchmark
Wage per efficiency unit East	98.0	100
Entrepreneurs in East Germany	5.6%	5.3%
East German Entrepreneurs	6.4%	6.4%
... of those going West	17.1%	23.8%
Unemployed East	18.1%	27%
of those involuntarily unemployed	0	33.4%
Net Wage per efficiency unit West	100.4	100
Annual Output per Capita East to West	58.5%	51.7%
Annual Output per capita East	112.4	100
Annual Output per capita West	99.2	100
Total Annual Output per capita	100.4	100
Annual Growth Rate of TFP East	1.55%	1.41%
Annual Growth Rate of TFP West	1.63%	1.66%
Annual Growth Rate of TFP Total	1.61%	1.61%
Average profits Entrepreneur in East	105.0	100
Average profits Entrepreneur in West	100.8	100
Average profits Entrepreneur West German	100.4	100
Average profits Entrepreneur East German in West	113.5	100
Net migration to Population East	5.1%	7.5%
Fraction of Workers going West	5.2%	8.7%

the ratio of GDP per capita East-to West increases to 58.5%. Lower labor costs in East Germany make it relatively less profitable to set up a business in West Germany over setting it up in East Germany and fewer entrepreneurs migrate, 17% compared to 23% in the benchmark scenario. More and more talented entrepreneurs in East Germany cause East German TFP to grow at an annual rate of 1.55%. In West Germany on the other hand, there are fewer talented entrepreneurs from East Germany which leads to a reduction in output per capita and TFP growth under the flexible wage scenario. West German workers are better off because due to the reduced contribution to unemployment insurance their net wages increase slightly.

Increased migration of workers that was supposedly feared by labor unions who pressed for equal wages in East and West Germany does not happen. While workers' wages are lower, their expected wages increase as the threat of involuntary unemployment is eliminated. Hence, less workers migrate to West Germany, 5.2% compared to 8.7% under the Benchmark scenario. Overall migration is reduced by almost one third and of all East Germans, 5.1% leave. In terms of welfare, East German workers are worse off while all entrepreneurs and West German workers gain. On average the East German individual is better off. This positive effect for East Germany dominates and while overall TFP growth remains unchanged, output per capita is slightly higher under the flexible wage scenario. Given that consumption is a fixed fraction of output in this model, flexible wages are welfare improving for all of Germany.

2.4.2 Integration into Socially Mobile West Germany

If East Germany had integrated into a social mobile economy, where an individual's managerial knowhow was solely defined by his innate talent, the initial disadvantage of missing generations of entrepreneurs in East Germany would have become obsolete. For this counterfactual experiment I maintain the wage discounts for East Germany but set the value of parental background in entrepreneurship to zero and I lower the discount on the rental rate of capital to $\chi_t = 0.1836$, such that investment aids paid to East German firms are as in the Benchmark case. Average managerial knowhow is the same for East and West Germans. But in order for the average German managerial knowhow in this scenario to be equal to the one in the reunification scenario the parameter for the mean log talent μ is raised to 2.148. Table 2.4.9 displays the model's results for the integration of East Germany into a socially mobile economy.

Table 2.4.9: Integration into Socially Mobile Economy

	Integration into Socially Mobile Economy	Benchmark
Wage per efficiency unit West	97.9	100
Entrepreneurs in East Germany	5.6%	5.3%
East German Entrepreneurs	8.4%	6.4%
... of those going West	37.3%	23.8%
Average profits Entrepreneur in East	103.3	100
Average profits Entrepreneur in West	118.1	100
Average profits Entrepreneur West German	122.0	100
Average profits Entrepreneur East German in West	86.41	100
Unemployed East	19.2%	27%
of those involuntarily unemployed	17.9%	33.4%
Annual Growth Rate of TFP East	1.53%	1.41%
Annual Growth Rate of TFP West	1.92%	1.66%
Annual Growth Rate of TFP Total	1.85%	1.61%
Annual Output per Capita East to West	57.1%	51.7%
Annual Output per capita East	110.8	100
Annual Output per capita West	100.3	100
Total Annual Output per capita	101.3	100
Net migration to Population East	6.7%	7.5%
Workers going West	4.9%	8.7%
Entrepreneurial Backgr.		
Indvs. Becoming Entrepreneurs	5.26%	59.5%
Working Backgr.		
Indvs. Becoming Entrepreneurs	5.92%	3.6%

If East Germany integrates into a socially mobile economy, the fraction of East Germans who become entrepreneurs is 31% higher than under the Benchmark scenario, 8.4% instead of 6.4% of East Germans set up their own business. However 37.3% of them do so in West Germany. Unemployment is reduced by eight percentage points from 27% to 19% but 3.4% of the East German population is still involuntary unemployed. Migration is slightly lower due to the reduction in involuntary unemployment, 6.4% of East Germans migrate to West Germany compared to 7.5% in the Benchmark case. How-

ever, the composition of migrants changes. More East Germans migrate to West Germany to set up their business and fewer East Germans migrate to work in West Germany, 4.9% compared to 8.7%. Higher employment leads to more output. East Germany produces 10% more output per capita and its TFP grows at a rate 8.5% higher compared to the Benchmark case. Given, no additional value of parental background talent is optimally allocated and aggregate TFP growth is higher, overall output per capita is higher and welfare improves with respect to the Benchmark scenario. East German output per capita increase by more is equal to 57% of West German per capita GDP. As parental background has no value, the fraction of entrepreneurs coming from an entrepreneurial family background is reduced to values for individuals coming from a working family background. The fact that the latter fraction is slightly larger than the former, 5.9% versus 5.2% is entirely due to the fact that all East German entrepreneurs are children of workers. For West German individuals these fractions are identical.

2.4.3 Migration Restriction

If East Germans are not allowed to migrate their occupational choices are those of West Germans before reunification. For this policy experiment I assume that all East and West Germans are immobile, i.e. have infinitely large moving costs.[66] I maintain all parameter values as well as the wage discount but lower the discount on the rental rate of capital to $\chi_t = 0.167$, such that investment aids paid to East German firms are as in the Benchmark case. Table 2.4.10 displays the model's results for the case of no migration between East and West Germany.

---

[66]I set the fraction of mobile Germans (θ) to zero.

Table 2.4.10: Migration Restrictions

	No Migration	Benchmark
Entrepreneurs in East Germany	5.4%	5.3%
Average profits Entrepreneur in East	113.5	100
Average profits Entrepreneur in West	99.4	100
Average profits Entrepreneur West German	100.2	100
Gross Wage per efficiency unit West	100	100
Contribution to Unemployment Insurance	1.5%	1.65%
Net Wage per efficiency unit West	100.2	100
Unemployed East	21.3%	27%
of those involuntarily unemployed	23.2 %	33.4%
Annual Growth Rate of TFP East	1.66%	1.41%
Annual Growth Rate of TFP West	1.60 %	1.66%
Annual Growth Rate of TFP Total	1.61%	1.61%
Annual Output per Capita East to West	61.4%	51.7%
Annual Output per capita East	116.7	100
Annual Output per capita West	98.3	100
Total Annual Output per capita	99.7	100
Average Firm Size	13.6	13.0

Without the option to migrate 5.4% of East Germans decide to set up their own business. Those talented entrepreneurs who opt for migration under the reunification scenario set up their businesses in East Germany given migration restrictions. Thus, average profits in East Germany increase by 13% despite the lower discount on the rental rate of capital. More talented entrepreneurs hire more workers and the average firm size increase by 0.6 workers. More employment is thus created and unemployment is reduced by about six percentage points. Still 23.2% of the unemployed, i.e. about 5% of the East German population is involuntary unemployed. More and more talented entrepreneurs also contribute to TFP growth which is high at 1.66% annually, an increase of 18% over TFP growth in the Benchmark case. More and better entrepreneurs and higher employment lead to more output. Without the option to migrate East German per capita output is 17% larger compared to the Benchmark scenario. West Germany on the other hand, deprived of the inflow of talented entrepreneurs from East Germany sees its output per capita

reduced by around 2% and faces lower TFP growth. In the case of complete restrictions on migrations the negative effects for West Germany dominate and while overall TFP growth remains constant, output per capita is 0.3% lower compared to the Benchmark scenario and thus welfare slightly decreases.

2.5   Conclusion

East Germany's post-1989 experience is and has been remarkably different from that of other transition countries. Its integration into an established and highly regulated economy hindered a fruitful development of entrepreneurial activity. While East Germany is still suffering the consequences of its lack of entrepreneurship, as high rates of unemployment and low economic growth, other transition countries are flourishing. When parental background in entrepreneurship is nonexistent the most talented individuals become entrepreneurs. They innovate and contribute to economic growth. This optimal allocation of talent did not happen in East Germany. Especially the West German policy of fixing wages in East Germany at a fraction of West German wages oppressed incentives to set up businesses.[67] In addition the option to migrate to West Germany drew in the most talented and mobile East Germans, while the importance of entrepreneurial parental background in West Germany, implied an initial disadvantage for East Germans who lacked any entrepreneurial tradition.

Prospects for East Germany are devastating and speak of deserted regions. Counterfactual experiments show that East Germany's experience could have been better had wages been flexible in East and West Germany, had West Germany been a socially mobile economy where parental background in entrepreneurship played no role, or had migration to West Germany been very

---

[67]For Southern Italy, Alesina et al. (2001) find a similar negative effect of a government wage setting policy - high public sector wages - on entrepreneurship.

costly. However, while flexible wages and a social mobile West Germany would have also led to more output and higher economic growth for all of Germany, migration restrictions would have been exclusively beneficial to East German output and economic growth. The lack of entrepreneurship, employment, and economic growth in East Germany would have been less severe had West German policy makers opted for flexible wages in both parts of Germany. Contrary to conventional wisdom, this policy would have decreased migration from East to West Germany as the threat of involuntary unemployment had disappeared and expected wages for those staying in East Germany would have increased. Based on the calibration of the model, in a world of flexible wages around 416,000 fewer East Germans would have migrated to work or set up a business in West Germany.

In essence, East Germany's economic take-off seems to have been hindered by West German policies and institutions.[68] The model's result for the counterfactual scenarios even suggest that under the current reunification scenario, West Germany benefited from a selective inflow of migration. One is thus left with the question to what extent the current reunification scenario has been self-serving for West Germans.

---

[68] This finding is in line with that of various other authors (see e.g. Diewald et al. (2006) or Bonin and Zimmermann (2000)).

Bibliography

Dennis J. Aigner, Friedrich Schneider, and Damayanti Ghosh. Me and my shadow: estimating the size of the U.S. hidden economy from time series data. In William A. Barnett, Ernst R. Berndt, and Halbert White, editors, *Dynamic Econometric Modeling. Proceedings of the third international symposium in econometric theory and econometrics*. New York, 1988.

George A. Akerlof, Andrew K. Rose, Janet L. Yellen, Helga Hessenius, Rudiger Dornbusch, and Manuel Guitian. East Germany in from the Cold: The Economic Aftermath of Currency Union. *Brookings Papers on Economic Activity*, 1:1–105, 1991.

Ângel Alañón Pardo and Miguel Gómez de Antonio. Evaluación y análisis espacial del grado de incumplimiento fiscal para las provincias españolas (1980-2000). *Hacienda Pública Española*, 171(4):9–32, 2004.

Alberto Alesina and Nicola Fuchs-Schündeln. Good Bye Lenin (Or Not)?, The Effect of Communism on People's Preferences. *American Economic Review*, 97(4):1507–1528, 2007.

Alberto Alesina, Stephan Danninger, and Massimo Rostagno. Redistribution Through Public Employment: The Case of Italy. Staff Papers No. 48 (3), International Monetary Fund, 2001.

Pedro S. Amaral and Erwan Quintin. A Competitive Model of the Informal Sector. *Journal of Monetary Economics*, 53(7):1541–53, 2006.

António R. Antunes and Tiago V. de V. Cavalcanti. Start up costs, limited enforcement and the hidden economy. *European Economic Review*, 51(1): 203–224, 2006.

Pia Arenius and Maria Minniti. Perceptual Variables and Nascent Entrepreneurship. *Small Business Economics*, 24(3):233–257, 2005.

Richard Arum and Walter Müller. The Reemergence of Self-Employment: Comparative Findings and Empirical Propositions. In Richard Arum and Walter Müller, editors, *The Reemergence of Self-Employment: A Comparative Study of Self-Employment Dynamics and Social Inequality*, pages 426–454. Princeton, 2004.

S. Borağan Aruoba. Informal Sector, Government Policy and Institutions. mimeo, University of Maryland, 2009.

Claustre Bajona and Luis Locay. Entrepreneurship and productivity: The slow growth of the planned economies. *Review of Economic Dynamics*, 12 (3):505–522, 2009.

Berlin Institut. Not am Mann. Von Helden der Arbeit zur neuen Unterschicht? Lebenslagen junger Erwachsener in wirtschaflichen Abstiegsregionen der neuen Bundesländer. Berlin Institut für Bevölkerung und Entwicklung, 2007.

David G. Blanchflower and Andrew J. Oswald. What Makes an Entrepreneur? *Journal of Labor Economics*, 16(1):26–60, 1998.

Holger Bonin and Klaus F. Zimmermann. The Post-Unification German Labor Market. Discussion Paper No. 185, IZA, 2000.

Niels Bosma, Zoltan J. Acs, Erkko Autio, Alicia Coduras, and Jonathan Levie. Global Entrepreneurship Monitor 2008 Executive Report. Global Entrepreneurship Research Consortium (GERA), 2009.

Richard Breen and Ruud Luijkx. Social Mobility in Europe between 1970 and 2000. In Richard Breen, editor, *Social Mobility in Europe*. Oxford University Press, 2004.

Bundesagentur für Arbeit. Arbeitsmarkt 2006. Amtliche Nachrichten der Bundesagentur für Arbeit, 55. Jahrgang, Sondernummer 1, 2006.

Bundesagentur für Arbeit. Arbeitsmarkt in Zahlen, Arbeitslose, August. Statistik der Bundesagentur für Arbeit, Nürnberg 2007.

Bundesagentur für Arbeit. Statistik der Bundesagentur für Arbeit. `http://www.pub.arbeitsamt.de/hst/services/statistik/aktuell/iiia4/zr_alo_qu_west_ostb.xls.`, 2008.

Bundesministerium für Arbeit und Soziales. Entwicklung der Regelsätze. 2008.

Michael C. Burda. The determinants of East-West German migration: Some first results. *European Economic Review*, 37(2-3):452–461, 1993.

Michael C. Burda. What kind of shock was it? Regional Integration and Structural Change in Germany after Unification. *Journal of Comparative Economics*, 36(4):557–567, 2008.

Michael C. Burda and Jennifer Hunt. From Reunification to Economic Integration: Productivity and the Labor Market in Eastern Germany. *Brookings Papers on Economic Activity*, 2:1–71, 2001.

Craig Burnside, Martin Eichenbaum, and Sergio Rebelo. Capital Utilization and Returns to Scale. Working Paper No. 5125, NBER, 1995.

Ariel T. Burnstein and Alexander Monge-Naranjo. Foreign Know-How, Firm Control, and the Income of Developing Countries. *Quarterly Journal of Economics*, 124(1):197–231, 2009.

Francesco Busato and Bruno Chiarini. Market and underground activities in a two-sector dynamic equilibrium model. *Economic Theory*, 23(4):831–861, 2004.

Fabio Canova and Morten O. Ravn. The Macroeconomic Effects of German Unification: Real Adjustments and the Welfare State. *Review of Economic Dynamics*, 3(3):423–460, 2000.

Fransesco Caselli and Nicola Gennaioli. Dynastic Management. *Journal of the European Economic Association*, 3(2-3):679–689, 2005.

Yongsung Chang. Wages, business cycles, and comparative advantage. *Journal of Monetary Economics*, 46(1):143–171, 2000.

Alberto Chong and Mark Gradstein. Inequality and Informality. *Journal of Public Economics*, 91(1/2):159–179, 2007.

CIA. The World Factbook. Central Intelligence Agency, 2008.

Compendia. COMPENDIA 2000.2: a harmonized data set of business ownership rates in 23 OECD countries. `http://data.ondernemerschap.nl/`, 2002. Entrepreneurs International.

Steven J. Davis and Magnus Henrekson. Tax Effects on Work Activity, Industry Mix and Shadow Economy Size: Evidence from Rich-Country Comparisons. Working Paper No.10509, NBER, 2004.

Áureo de Paula and José A. Scheinkman. The Informal Sector. Working Paper No.13486, NBER, 2007.

Deutsche Bundesbank. Monthly Report. July 2001.

Martin Diewald, Heike Solga, and Anne Goedicke. Old Assets, New Liabilties? How Did Individual Characteristics Contribute to Labor Market Success or Failure After 1989? In Martin Diewald, Anne Goedicke, and Karl Ulrich Mayer, editors, *After the Fall of the Wall. Life Courses in the Transformation of East Germany*, pages 65–88. Stanford, 2006.

DIW. Wochenbericht 50/95. Deutsches Institut für Wirtschaftsforschung, Berlin 1995.

Simeon Djankov, Rafael La Porta, Florencio Lopez-De-Silanes, and Andrei Shleifer. The Regulation of Entry. *Quarterly Journal of Economics*, 117(1): 1–37, 2002.

Thomas Dunn and Douglas Holtz-Eakin. Financial Capital, Human Capital and the Transition to Self-Employment: Evidence from Intergenerational Links. Working Paper No. 5622, NBER, 1996.

Thomas A. Dunn, Michaela Kreyenfeld, and Mary E. Lovely. Communist Human Capital in a Capitalist Labor Market: The Experience of East Germans and Ethnic German Immigrants to West Germany. In *Proceedings of the 2nd International Conference of German Socio-Economic Panel Study Users 1996*, pages 151–158. Berlin, 1997. Vierteljahreshefte zur Wirtschaftsforschung.

John S. Earle and Zuzana Sakova. Entrepreneurship from Scratch: Lessons on the Entry Decision into Self-Employment from Transition Countries. Discussion Paper No. 79, IZA, 1999.

John S. Earle and Zuzana Sakova. Business start-ups or disguised unemployment? Evidence on the character of self-employment from transition economies. *Labour Economics*, 7(5):575–601, 2000.

Robert Eriksson and John H. Goldthorpe. *The Constant Flux A Study of Class Mobility in Industrial Societies*. Claredon Press, Oxford, 1993.

European Commission. SMEs in Europe 2003. Observatory of European SMEs, No. 7, 2003.

Eurostat. Structural Business Statistics (Industry, Construction, Trade and Services) Annual enterprise statistics broken down by size classes. `http://epp.eurostat.ec.europa.eu`, 2005.

Edgar L Feige. The UK's Unobserved Economy: A Preliminary Asessment. *Journal of Economic Affairs*, 1(4):205–212, 1981.

Martin Floden and Jesper Lindé. Idiosyncratic Risk in the United States and Sweden: Is There a Role for Government Insurance? *Review of Economic Dynamics*, 4(2):406–437, 2001.

Bernard Fortin, Nicolad Marceau, and Luc Sarvard. Taxation, wage controls and the informal sector. *Journal of Public Economics*, 66(2):293–312, 1997.

Bruno S. Frey and Hannelore Weck. Estimating the Shadow Economy: A 'Naive' Approach. *Oxford Economic Papers New Series*, 35(1):23–44, 1983.

Eric Friedman, Simon Johnson, Daniel Kaufmann, and Pablo Zoido-Lobaton. Dodging the Grabbing Hand: The Determinants of Unofficial Activity in 69 Countries. *Journal of Public Economics*, 76(3):459–493, 2000.

Nicola Fuchs-Schündeln. On Preferences for Being Self-Employed. *Journal of Economic Behavior and Organization*, 71(2):162–171, 2009.

Nicola Fuchs-Schündeln and Rima Izem. Explaining the Low Labor Productivity in East Germany-A Spatial Analysis. Working Paper No. 1307, Kiel Institute of World Economics, 2007.

Oded Galor and Daniel Tsiddon. Technological Progress, Mobility, and Economic Growth. *American Economic Review*, 87(3):363–382, 1997.

Rainer Geißler. *Die Sozialstruktur Deutschlands: Zur gesellschaftlichen Entwicklung mit einer Bilanz zur Vereiningung.* VS Verlag für Sozialwissenschaften, Wiesbaden, 2006.

Johannes Gernandt and Friedhelm Pfeiffer. Rising Wage Inequality in Germany. *Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik)*, 227(4):358–380, 2007.

Gesprächskreis Ost. Kurskorrektur des Aufbau Ost. Bericht des Gesprächskreises Ost der Bundesregierung, 2004.

Hans H. Glismann and Klaus Schrader. Die Reform der deutschen Arbeitslosenversicherung vor dem Hintergrund ihrer Geschichte. Arbeitspapier Nr. 1112, Kiel Institute for the World Economy, 2002.

Arthur S. Goldberger. Economic and Mechanical Models of Intergenerational Transmission. *American Economic Review*, 79(3):504–513, 1989.

Douglas Gollin. Getting Income Shares Right. *Journal of Political Economy*, 110(2):458–474, 2002.

Nezih Guner, Gustavo Ventura, and Yi Xu. Macroeconomic Implications of Size-Dependent Policies. *Review of Economic Dynamics*, 11(4):721–744, 2008.

John Hassler and Jose V. Rodríguez Mora. Intelligence, Social Mobility and Growth. *American Economic Review*, 90(4):888–908, 2000.

Frank Heiland. Trends in East-West German Migration from 1989 to 2002. *Demographic Research*, 11(7):174–193, 2004.

Alan Heston, Robert Summers, and Bettina Aten. Penn World Table Version 6.3. Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, 2009.

Chang-Tai Hsieh and Pete J. Klenow. Misallocation and Manufacturing TFP in China and India. *Quarterly Journal of Economics*, 124(4):1403–1448, 2009.

Jennifer Hunt. Staunching Emigration from East Germany: Age and Determinants of Migration. *Journal of the European Economic Association*, 4(5): 1014–1037, 2006a.

Jennifer Hunt. Is the Transition in East Germany a Success? In Just Seven Years the Czech Republic Will be Richer. Memo, 2006b.

Jennifer Hunt. The Economics of German Reunification. In Steven N. Durlauf and Lawrence E. Blume, editors, *The New Palgrave Dictionary of Economics*. Palgrave Macmillan, second edition, 2008.

International Conference of Labour Statisticians. Resolution concerning statistics of employment in the informal sector adopted by the Fifteenth International Conference of Labour Statisticians (January 1993).

Simon Johnson, Daniel Kaufmann, and Pablo Zoido-Lobaton. Regulatory Discretion and the Unofficial Economy. *American Economic Review*, 88(2): 387–392, 1998.

Daniel Kaufmann, Aart Kraay, and Massimo Mastruzzi. Governance Matters V: Aggregate and Individual Governance Indicators for 1996-2005. The World Bank, 2006.

Sabine B. Klein. Familiy Businesses in Germany. Significance and Structure. *Family Business Review*, 13(3):157–181, 2000.

Alan B. Krueger and Jörn-Steffen Pischke. A Comparative Analysis of East and West German Labor Markets Before and After Unification. In Richard B. Freeman and Lawrence F. Katz, editors, *Differences and Changes in Wage Structure*, pages 405–446. Chicago, 1995.

Simon Kuznets. *Modern Economic Growth: Rate, Structure, and Spread.* Yale University Press, New Haven and London, 1966.

Bernhard F. Lentz and David N. Laband. Entrepreneurial Success and Occupational Inheritance among Proprietors. *Canadian Journal of Economics*, 23(3):563–579, 1990.

Norman A. Loayza. The Economics of the Informal Sector. A simple Model and Some Empirical Evidence from Latin America. Policy Research Working Paper No. 1727, World Bank, 1997.

Henning Lohmann and Silvia Luber. Trends in Self-Employment in Germany: Different Types, Different Developments? In Richard Arum and Walter Müller, editors, *The Reemergence of Self-Employment: A Comparative Study of Self-Employment Dynamics and Social Inequality*, pages 36–74. Princeton, 2004.

Robert E. Jr. Lucas. On the Size Distribution of Business Firms. *Bell Journal of Economics*, 9(2):508–523, 1978.

Angus Maddison. *Monitoring the World Economy 1820-1992*. OECD Development Centre, Paris, 1995.

Randall K. Morck, David A. Stangeland, and Bernard Yeung. Inherited Wealth, Corporate Control, and Economic Growth the Canadian Disease? In *Concentrated Corporate Ownership*, pages 319–372. National Bureau of Economic Research, 2000.

Pamela Mueller. Entrepreneurship in the Region: Breeding Ground for Nascent Entrepreneurs? *Small Business Economics*, 27(1):41–58, 2006.

Walter Müller and Reinhard Pollak. Social Mobility in West Germany: The Long Arms of History Discovered? In Richard Breen, editor, *Social Mobility in Europe*. Oxford University Press, 2004.

Kevin M. Murphy, Andrei Shleifer, and Robert W. Vishny. The Allocation of Talent: Implications for Growth. *Quarterly Journal of Economics*, 106(2): 503–530, 1991.

Stephen Nickell and Luca Nunziata. Labour Market Institutions Database. Center for Economic Performance, 2001.

OECD. Employment Outlook 1992. Organisation for Economic Co-Operation and Development, Paris 1992.

OECD. Taxing Wages Special Feature: Thresholds for Paying Income Tax and Social Security Contributions 2002-2003. Organisation for Economic Co-Operation and Development, Paris 2003.

OECD. OECD stats. `http://stats.oecd.org/WBOS/index.aspx`, Paris 2005. Organisation for Economic Co-Operation and Development.

OECD. Revenue Statistics 1965-2005. Organisation for Economic Co-Operation and Development, Paris 2006.

OECD. Strengthening entrepreneurship and local economic development in East Germany, Centre for Entrepreneurship, SMEs and Local Development. Organisation for Economic Co-Operation and Development, Paris 2007.

OECD. Education at a Glance 2007: OECD Indicators. Organisation for Economic Co-Operation and Development, Paris 2007.

OECD. Factbook 2009: Economic, Environmental and Social Statistics. Organisation for Economic Co-Operation and Development, Paris 2009.

OECD's Centre for Tax Policy Administration. Tax Administration in OECD and Selected Non-OECD Countries: Comparative Information Series. Organisation for Economic Co-Operation and Development, Paris 2006.

Mancur Olson. *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities*. Yale University Press, New Haven and London, 1982.

Giovanni Pica and Jose V. Rodríguez Mora. Who's Afraid of a Globalized World? Foreign Direct Investments, Local Knowledge and Allocation of Talents. Working Paper No. 184, Centre for Studies in Economics and Finance University of Salerno, 2007.

David Pistrui, Harold P. Welsh, Oliver Wintermantel, Jianwen Liao, and H.J. Pohl. Entrepreneurial Orientation and Familiy Forces in the New Germany: Similarities and Differences Between East and West German Entrepreneurs. *Familiy Business Review*, 13(3):251–264, 2000.

Rüdiger Pohl. The Transition from Communism to Capitalism in East Germany. *Society*, 33(4):62–65, 1996.

Jose Mauricio Jr. Prado. Government Policy in the Formal and Informal Sectors. Stockholm University Seminar Paper No.751, Institute for International Economic Studies, 2007.

Edward C. Prescott. Theory Ahead of Business Cycle Measurement. In K. Brunner and A.H. Meltzer, editors, *Real Business Cycles, Real Exchange Rates and Actual Policies*. Carnegie-Rochester, 1986. Conference Series on Public Policy 25.

Joachim Ragnitz. Wirtschaftsförderung in Ostdeutschland: Wirkungen, Nebenwirkungen und ein Reformvorschlag. IWH Diskussionspapier Nr. 167, Institut für Wirtschaftsforschung Halle, 2002.

Joachim Ragnitz. Explaining the East German Productiviy Gap- The Role of Human Capital. Working Papers 1310, Kiel Institute for the World Economy, 2007.

Joachim Ragnitz and Lutz Schneider. Demographische Entwicklung und ihre ökonomischen Folgen. Wirtschaft im Wandel 6, Institut für Wirtschaftsforschung Halle, 2007.

Diego Restuccia and Richard Rogerson. Policy Distortions and Aggregate Productivity with Heterogenous Plants. *Review of Economic Dynamics*, 11 (4):707–720, 2008.

Gérard Roland. *Transition and Economics Politics, Markets, and Firms*. Massachusetts Institute of Technology, 2000.

Sachverständigenrat. Abgrenzung der verdeckten Arbeitslosigkeit (Anhang IV C) Auszug aus dem Jahresgutachten 2007/08. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, 2007.

Pierre-Daniel G. Sarte. Informality and rent-seeking bureaucracies in a model of long-run growth. *Journal of Monetary Economies*, 46(1):173–197, 2000.

Friedrich Schneider. The Size and Development of the Shadow Economies of 22 Transition and 21 OECD Countries. Discussion Paper No.514, IZA, 2002.

Friedrich Schneider and Dominik H. Enste. Shadow Economies: Size, Causes and Consquences. *Journal of Economic Literature*, 38(1):77–14, 2000.

Helmut Schneider, Friedrich und Badekow. *Ein Herz für Schwarzarbeiter. Warum die Schattenwirtschaft unseren Wohlstand steigert.* Econ, Berlin, 2006.

Hans-Werner Sinn. Germany's Economic Unification An Assesment After Ten Years. *Review of International Economics*, 10(1):113–128, 1991.

Dennis J. Snower and Christian Merkl. The Caring Hand that Cripples: The East German Labor Market after Reunification. *American Economic Review*, 96(2):375–382, 2006.

Heike Solga. The Rise of Meritocracy? Class Mobility in East Germany Before and After 1989. In Martin Diewald, Anne Goedicke, and Karl Ulrich Mayer, editors, *After the Fall of the Wall. Life Courses in the Transformation of East Germany*, pages 140–169. Stanford, 2006.

Gary Solon. Cross-Country Differences in Intergenerational Earnings Mobility. *Journal of Economic Perspectives*, 16(3):59–66, 2002.

Statistische Ämter des Bundes und der Länder. Wanderungsstatistik, Zu- und Fortzüge nach Altersgruppen (über Gemeindegrenzen). 2007.

Statistisches Ämter der Länder. Volkswirtschaftliche Gesamtrechunungen Entstehung, Verteilung und Verwendung des Bruttoinlandsprodukts in den Ländern und Ost-West-Großraumregionen Deutschlands 1991 bis 2008 Reihe 1, Band 5. Statistisches Landesamt Baden-Württemberg, Stuttgart 2009.

Statistisches Bundesamt. Volkswirtschaftliche Gesamtrechunungen, Inlandsproduktsberechnug, Revidierte Jahresergebnisse 1970 bis 1991. Fachserie 18, Reihe S.29, Wiesbaden 2006.

Statistisches Bundesamt. Unternehmensregister Unternehmen nach zusammengefassten Rechtsformen im Berichtsjahr 2005. 2008.

The Economist. Divison of labour. Barbara Beck Nov. 9 1996 Vol. 341 Iss. 7991 p- Survey 10, London 1996.

The World Bank. Doing Business 2009. Comparing Regulation in 181 Economies. The International Bank for Reconstruction and Development, Washington, D.C. 2009.

Jim Thomas. Quantifying the Black Economy:'Measurement without Theory' Yet Again? *Economic Journal*, 109(456):F381–F389, 1999.

Transparency International. Corruption Perceptions Index 2001 and 2002. `http://transparency.org/`, 2002.

Harald Uhlig. Regional Labor Markets, Network Externalities and Migration: The Case of German Reunification. *American Economic Review*, 96(2):383–387, 2006.

United Nations. International Migration from Countries with Economies in Transition : 1980-1999. Population Division, Department of Economic and Social Affairs, United Nations Secretariat, 2002.

United Nations. Creating an environment at the national and international levels conducive to generating full and productive employment and decent work for all, and its impact on sustainable development. Report of the Secretary-General, 2006.

United Nations. Statistics Division. 2010.

Colin C. Williams and Jan Windebank. *Informal Employment in Advanced Economies. Implications for Work and Welfare*. Routledge, London, 1998.

World Economic Forum. Global Competitiveness Index 2006. `http://www.weforum.org`, 2003. Data for 2002 from Kaufmann et al. (2006).

World Value Survey. `http://www.worldvaluessurvey.org/`, 2000.

Eckhard Wurzel. The Economic Integration of Germany's New Länder. Economics Department Working Paper No. 307, Organisation for Economic Co-Operation and Development, Paris, 2001.

Appendices to Chapter 1

A.1.1 Measures of the Informal Economy

Figure A.1.1.1: Different Estimates of Informal economy in OECD countries for 89/90
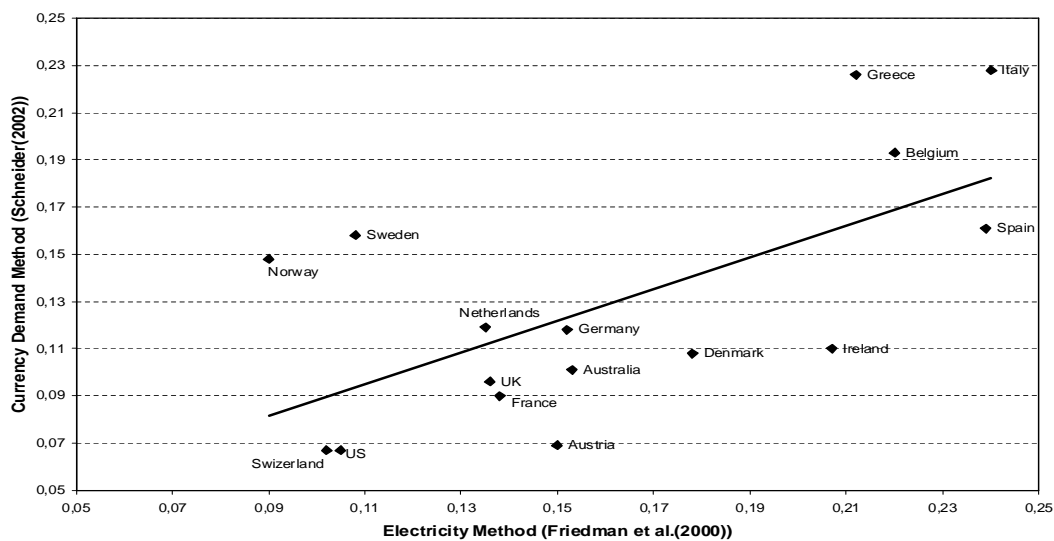
Data: Schneider (2002) and Friedman et al. (2000)

Schneider (2002) estimates the informal economy either by the currency demand approach that attributes any changes in 'excess' demand in currency to increases in informality or by the so-called DYMIMIC (dynamic multiple-indicators multiple-causes) model that incorporates multiple causes of informality into the estimation. The basic idea of the currency demand method is to estimate the ratio of cash holdings to current and deposit accounts by running

regressions. Explanatory variables are interest rate, per capita income, proportion of wages and salaries, and tax rates. Schneider (2002) then compares the demand for currency when taxes are at their lowest value to the demand for currency at current tax rates. He attributes this difference in currency demand to the informal economy. Two assumption are crucial: All transactions in the informal sector are paid in cash and income velocity in the informal economy is the same as in the formal economy. The DYMIMIC method or model approach incorporates multiple driving forces of the informal economy into its estimation. A detailed description of this method can be found in Aigner et al. (1988). The currency demand method and the model approach are just two of many ways to try to measure something not measured by statistical offices and government institutions. The transactions approach developed by Feige (1981) is similar to the currency demand method. It estimates the income which should have been produced by all non-financial transactions and compares it to the observed income in an economy. The difference is thought to have been generated by the informal sector. Other methods apply surveys, discrepancies between expenditure and income, or differences between official and actual labor force participation rate to estimate the size of the informal economy. Friedman et al. (2000) use estimates of the informal economy obtained by the so called physical input or electricity method. Schneider and Enste (2000) provide an overview of all of these methods. There is no overall accepted method and all are criticized for various reasons (see Thomas (1999)). Estimates obtained by Schneider (2002) and those of Friedman et al. (2000) differ but they are highly correlated (see Figure A.1.1.1). Schneider (2002) is the only one who provides complete estimates for the informal economy for all high-income OECD countries for the period 1989-2002. Davis and Henrekson (2004) and Busato and Chiarini (2004) also use his estimates.

A.1.2 Robustness Check

Benchmark Country To check the robustness of the results to the choice of the Benchmark country I calibrate the model to data for Sweden. After France, Sweden is the second most representative country. Its average firm size, informal economy, and employment and establishment shares of firms with less than ten employees are second closest to the mean values of these four variables across all 21 high-income countries (for calibration details see Tables A.1.2.2 and A.1.2.3). When Sweden is chosen as the Benchmark country for calibration the model's main results are preserved (see Table A.1.2.1).[A.1.1] The model with differences in tax rates alone can only account for little of the variation in informality across high-income countries while differences in governance quality seem to play a more important role. Overall, all model specifications account for less variation when calibrated to Sweden but they improve slightly in terms of the rank correlation coefficient. Mean informality is higher than in the data. In addition, when choosing Sweden as the Benchmark country the positive relationships between informal economy and tax rates as well as the negative relation between informal economy and governance quality are preserved.

Table A.1.2.1: Results for Model Calibrated to Sweden

	Model with Differences in:		
	Taxes Only	Gov. Only	Taxes + Gov.
Mean Informality	0.179	0.201	0.189
Coefficient of Variation	0.32	0.42	0.53
Rank correlation coefficient (Spearman)	0.47	0.42	0.79

[A.1.1]Calibration targets are from the same sources as those for the original calibration (see Section 1.3). Note that in contrast to France fines for tax evasion in Sweden are defined as surcharges on undeclared income rather than tax evades, hence here $s = \frac{M}{\pi^*}$. The capital-output ratio for Sweden is taken from Floden and Lindé (2001).

Table A.1.2.2: Calibration Targets and Model Values for Sweden

	Target	Model
Average firm size	7	7
Employment share of micro firms (0-9 employees)	38.4%	38.4%%
Establishment share of micro firms (0-9 employees)	93.4%	82.5%
Capital-output ratio	2	2
Capital share	0.323	0.323
Surcharge on undeclared income	0.4	0.4
Informal economy	19.1%	19.1%

Table A.1.2.3: Parameter Values-Sweden

Depreciation rate (δ)	0.1
Span-of-Control (γ)	0.71
Mean log-managerial ability (μ)	0
Dispersion in log-managerial ability (σ)	2.202
Discount factor (β)	0.9421
Importance of capital (ν)	0.4549
Parameter for probability of getting caught (θ)	0.00492
Fine for evading taxes (M)	0.7

Measure of Governance Quality   To check the robustness of results to the choice of the measure of governance quality I simulate the model with differences in tax rates and differences in governance quality using alternative measures.[A.1.2]   The positive relationship between tax rates and informality is preserved when alternative measures of governance quality are used. The same holds true for the negative relationship between governance quality and informality. Table A.1.2.4 reports statistics for the model with differences in tax rates and differences in governance quality when alternative measures are used. In all cases, the coefficient of variation is closer to the one in the data suggesting that when using alternative measures the model can account for more variation in informality across high-income countries. However, along

---

[A.1.2]Data for alternative measures of governance quality are taken from Kaufmann et al. (2006) and Transparency International (2002).

other dimensions a model using alternative measures of governance quality performs worse. Mean informality is between three and 6 percentage points lower, indicating that France is ranked lower in all other alternative governance indicators compared to the GCI-Governance Index. In addition, results for all alternative measures are associated to a lower rank correlation coefficient.

Table A.1.2.4: Results for Model with Differences in Tax Rates and Alternative Measures of Governance Quality

	Mean Informality	Coefficient of Variation	Rank correlation coefficient (Spearman)
Rule of Law	0.11	1.91	0.56
Regulatory Quality	0.10	1.48	0.45
Transparency International	0.11	1.51	0.46
Government Effectiveness	0.13	1.56	0.56
Control of Corruption	0.10	2.59	0.41

A.1.3 Data Appendix

Table A.1.3.1: Data on costs of tax collection*

	C_i	c_{wi}	S_i
	costs of revenue collection per 100 unit revenue	fraction of wage costs in revenue collection costs	proportion of staff assigned to enforcement tasks
Greece	1.65	0.861	-
Portugal	1.51	0.832	-
Spain	0.83	0.672	0.348
Italy	0.42	0.513	-
Ireland	0.91	0.73	0.4
Norway	0.59	0.59	0.36
Japan	1.67	0.786	0.827
New Zealand	0.83	0.581	0.619
US	0.57	0.729	0.3940
UK	1.04	0.594	0.158
Germany	1.8	0.853	-
Australia	1.16	0.638	0.501
France	1.41	0.808	0.43
Denmark	0.87	0.663	0.439
Sweden	0.57	0.718	0.535
Netherlands	1.39	0.647	0.401
Austria	0.91	0.844	0.708

* OECD's Centre for Tax Policy Administration (2006).

Appendices to Chapter 2

A.2.1 Sensitivity Analysis

Figure A.2.1.1: Sensitivity Analysis for α and $\bar{\phi}-$Growth Rate (g)
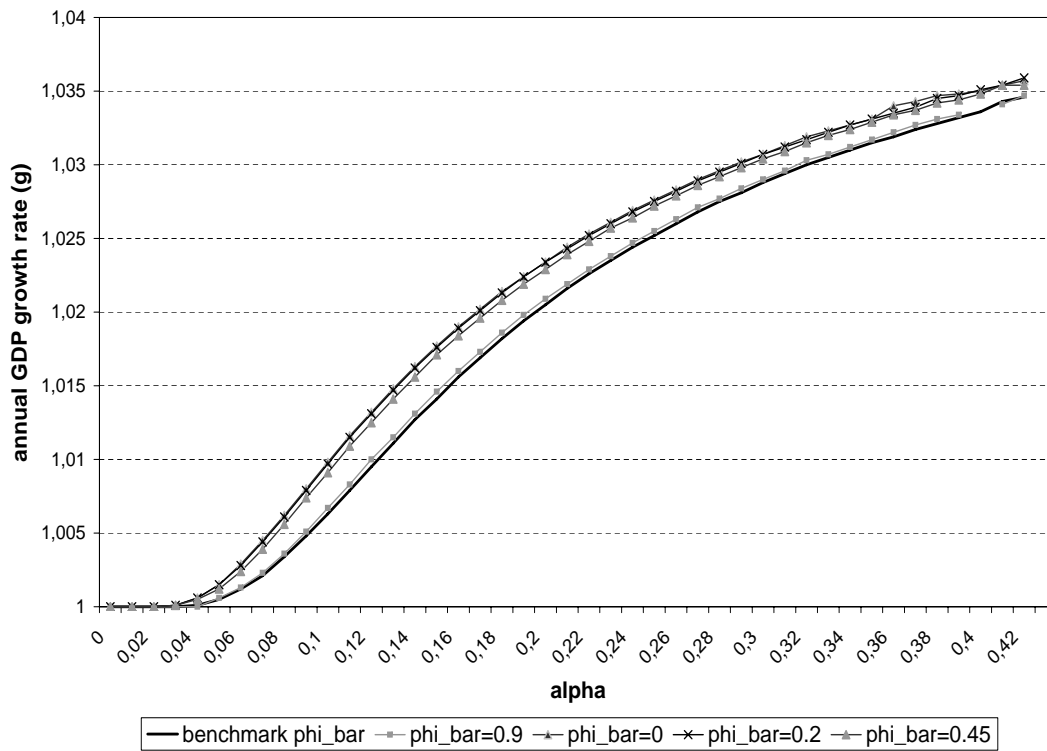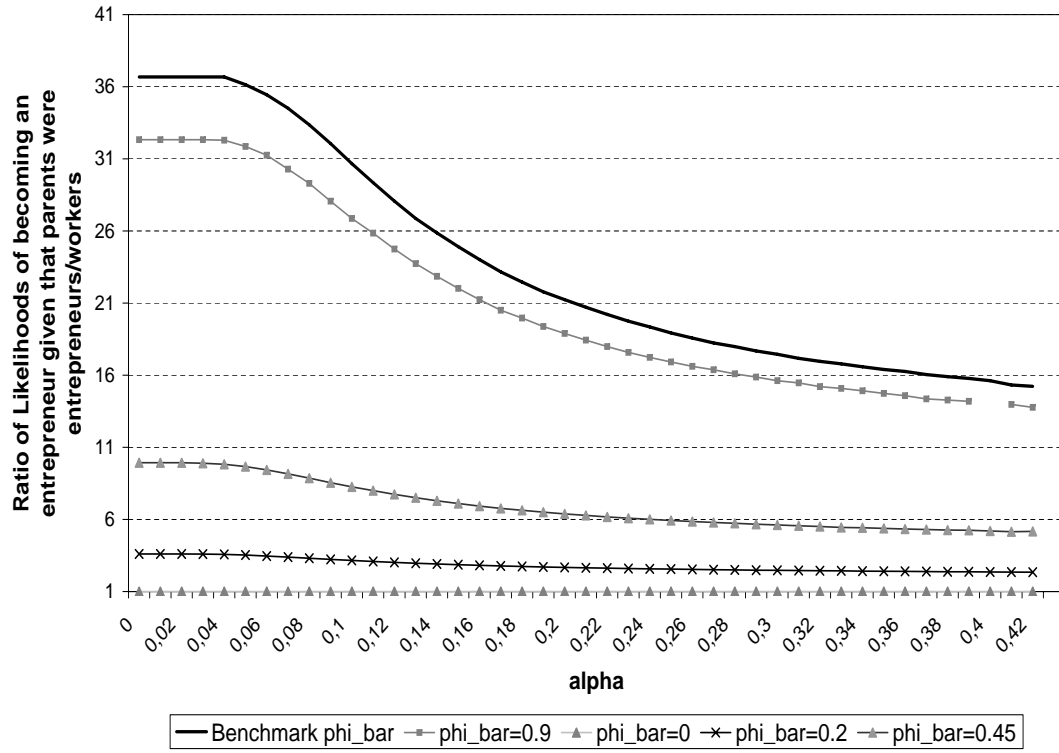
Figure A.2.1.2: Sensitivity Analysis for α and $\bar{\phi}$ - Ratio of Likelihoods

A.2.2 Discussion- Intergenerational Persistence of Occupations

How many entrepreneurs come from an entrepreneurial family background? Looking at West German data for 1970 and 1980, Arum and Müller (2004) find that 14.7% of all self-employed had a self-employed father. Lohmann and Luber (2004) report that between 1984 and 1988, 36% of West German males with a self-employment family background became self-employed. On the other end of the scale, Klein (2000) finds that only 39% of all German family firms are in their founder generations, rising the likelihood of being an entrepreneur if one's parents were so to 61%. Similarly, Pistrui et al. (2000) find that 60% of West German entrepreneurs have a parent who had been an entrepreneur. According to Mueller (2006) German employees whose parents have been self-employed are about 1.5 times as likely to start a business as others.[A.2.1] Geißler (2006) differentiates between social mobility of entrepreneurs with more than 10 employees and those operating on a smaller scale. He estimates that 50% of the former and 19% of the latter had parents who were also entrepreneurs. Given the broad span of estimates for the persistence of entrepreneurship across generations, I consider alternative interpretations of occupational inheritance. Within the framework of the model the most wealthy individuals, who consume more and leave more bequests to their children, will always be entrepreneurs. Hence, one can clearly distinguish three different economic 'classes' in the model: the unemployed, the working class, and the entrepreneurial class. The question of 'how many entrepreneurs come from an entrepreneurial family background?' can thus be turned into a question of 1)class mobility and/or 2)wealth persistence and/or 3)earnings mobility.

West Germany is generally found to be a society of relatively little class mobility. Erikson and Goldthorpe (1993) conclude that in West Germany "quite

---

[A.2.1]For the US Lentz and Laband (1990) find that 50% of all self-employed proprietors are 2nd generation proprietors.

contrary to a [...] 'semi-classless' form of society and a 'land of fluidity' [...] historically formed influences on class-mobility chances have largely retained their power" (p.151) Müller and Pollak (2004) consider class mobility in West Germany and find that for the periods 1976-80, 1982-90, and 1991-99, 64%, 63%, and 63% of large employers, and higher and lower grade professionals with higher technical, administrative and managerial occupations remained within their class. Furthermore, the authors conclude that "we cannot find any major changes in (absolute) mobility experiences in the last quarter of the twentieth century." (pg.91) "Germany continues to have strong inheritance effects [...] as well as particularly marked distinctions between a manual and non-manual space of social mobility."(pg.110) "In sum [...] in Germany a large part of the effects of origin class on class destination is mediated through education. In particular the hierarchical component in class-mobility results from class inequalities in educational participation and education-based class allocation."(pg.106) This observation combined with recent data by the OECD (2007) showing that "students from a blue-collar background are about one-half as likely to be in higher education as compared with what their proportion in the population would suggest."(pg.116) indicate little class mobility in West Germany.[A.2.2]

Estimates of wealth persistence by Morck et al. (2000) also sketch a picture of rather limited intergenerational mobility in West Germany, while Solon (2002) cites estimates of intergenerational earnings elasticity that describe Germany as a country of relatively high earnings mobility. However, as Goldberger (1989) points out: "Naturally enough the sociologists' models incorporate outcomes other than income or earnings. Now suppose that intergenerational links are stronger for occupation or socioeconomic status than for income or earnings. Then restricting attention to the monetary measures could lead

---

[A.2.2]Comparing social mobility among European countries, Breen and Luijkx (2004) conclude that "Germany, France, Italy, and Ireland seem to be the least fluent countries [...] [in]-notably Germany- there is no statistically significant change[...] towards a weaker association between origins and destinations." (pg 73).

an economist to understate the influence of family background on inequality."(pg.513). Estimates on class mobility provide the most widely encompassing concept of the dependence of one's status on family background. In the model class mobility and occupational mobility coincide and thus given that Pistrui et al. (2000)'s and Müller and Pollak (2004)'s estimates are very similar I am confident using the former as a target for calibration.

A.2.3 Results Basic Model

Table A.2.3.1 presents additional steady state results for the basic model representing West Germany before reunification. On average, entrepreneurs are twice as talented as the average individual, and entrepreneurs from a working family background are 2.4 times as talented as entrepreneurs from an entrepreneurial family background. Having had a parent who was an entrepreneur increases one's managerial knowhow by around 70%, ($\phi = 0.70$). Only 3% of individuals from a working family background set up their own business, compared to 60% of individuals whose parents were entrepreneurs.

TFP grows at an annual rate of 1.57%. The annual rental rate of capital in the model is 6.6%, somewhat higher than 5.2% – the deflated average of German government long-term bond yields over 1970-1989, (Heston et al. (2009) and United Nations (2010)). The model generates an average firm size of 12.7 workers per firm which is slightly higher than data suggests. Entrepreneurs International (Compendia (2002)) indicate that between 1972 and 1989 the average West German firm had approximately 11 employees. The ratio of unemployment benefits to mean nominal wage in the model is 28.3% and thus comes very close to the ratio of monthly social subsidies to the monthly nominal average equivalent income of 0.29 for West Germany for 1991(Bundesministerium für Arbeit und Soziales (2008) and DIW (1995)).[A.2.3] Contributions

---
[A.2.3]According to a letter from the Bundesministerium für Arbeit und Soziales, equivalent

Table A.2.3.1: Additional Steady State Average Results: Annual Values

Entrepreneurship	
Working Background Individuals Becoming Entrepreneurs	3.0%
Entrepreneurs Accumulative Talent ($\bar{Q}_t$)	1.4
Relative Average Intelligence of Entrepreneurs	2.2
Av. Talent of Entrepreneurs	
from Working vs. Entrepreneurial Background	2.4
Value of Entrepreneurial Parental Background	0.7
West Germany before Reunification	
Growth Rate of TFP	1.57%
Annual Rental Rate of Capital	6.6%
Average Firm Size (Workers)	12.7
Contribution to Unemployment Insurance	0.87%
Unemployment Benefit as Fraction of Mean Nominal Wage	28.3%

to unemployment insurance with employers and employees each paying 0.87% of gross wages result somewhat lower in the model than in the data. According to Glismann and Schrader (2002) contributions to unemployment insurance by each employer and employee in West Germany between 1970 and 1989 were equal to 1.45% of gross income.

A.2.4   Additional Comparisons for Optimal Occupational Choices

Some of the comparisons individuals make in order to make their optimal occupational choice were omitted in the main body of the chapter in order to keep the discussion tractable. However, individuals have to compare among each occupation and rank them in order to make the right choice. Here I present additional comparisons as well as the resulting consequences for equilibrium

---

data for the time period 1970 to 1989 is not available.

equations.

West Germans West Germans also compare their wage income to profits from setting up a business in East Germany. Whenever $\pi_t(z_t^p, A_t^*, \eta_t^j; .) \geq (1 - \tau_t^u - \tau)w_t q$, they decide to set up a business in East Germany instead of working in West Germany. However, the threshold resulting from this choice is only relevant whenever $\tilde{z}_t^j \geq 0$, and $\tilde{z}_t^j \leq \hat{z}_t^p$, i.e. whenever the marginal entrepreneur who sets up his business in East Germany exists and has less knowhow than the marginal entrepreneur in West Germany. In this case in all equilibrium equations one would have to substitute the new threshold for $\hat{z}_t^p$ and $\bar{z}_t^p$ for $\tilde{z}_t^j$.

Individuals in West Germany also compare unemployment benefits to profits from setting up a business in East Germany. Whenever $\pi_t(z_t^p, A_t^*, \eta_t^j; .) \geq v_t$, they decide to set up a business in East Germany instead of being unemployed. Only if $\tilde{z}_t^j \geq 0$ and $\tilde{z}_t^j \leq \hat{z}_t^p$ and $\tilde{z}_t^j < q_t^\star$ does this choice become relevant, i.e. whenever the marginal entrepreneur who sets up his business in East Germany exists and has less knowhow than the marginal entrepreneur in West Germany and also less knowhow than the marginal worker.

East Germans East German individuals also compare working in East Germany to setting up a business in East Germany. Whenever $\pi_t(z_t^p, A_t^*; .) \geq (1 - \psi_t)(1 - \tau_t^u - \tau)(1 - \lambda_t)w_t q + \psi_t v_t$ they set up their own business in East Germany. However, this choice is only relevant whenever the resulting threshold is smaller than the one resulting from the choice between working in East or West Germany ($\tilde{q}_t^j$). In this case the marginal worker who goes to West Germany is more talented than the marginal entrepreneur in East Germany. Then only if the profit function for entrepreneurs in East Germany and the function for wage income in West Germany cross twice will there be any East German working in West Germany. In all equilibrium equations one would

have to substitute the new threshold for $\hat{z}_t^{*,p,j}$ and possibly $\tilde{q}$ for the second crossing of the profit function for entrepreneurs in East Germany and the function for wage income in West Germany.

East Germans compare incomes from working in West Germany to profits from setting up a business in West Germany. Whenever $\pi_t(z_t^p, A_t, \eta_t^{*,j}; .) \geq (1 - \tau_t^u - \tau)w_t q - \eta_t^{*,j}$, they decide to set up a business in West Germany instead of working there. This occupational choice is only relevant whenever the marginal entrepreneur who sets up his business in West Germany exists and has less knowhow than the marginal entrepreneur in East Germany. Then, depending on the curvature of the profit function there might be no East German who wants to set up his business in East Germany. It could also be the case that those with less talent than the marginal worker who migrates to West Germany set up their businesses in East Germany. If East Germans find it profitable to go to West Germany to set up a business there, discounts on wages and rental rate are not large enough to offset the lower TFP in East Germany. Hence, neither will West Germans set up a business in East Germany.

Individuals in East Germany also compare working in East Germany to setting up a business in West Germany. Whenever $\pi_t(z_t^p, A_t, \eta_t^{*,j}; .) \geq (1-\psi_t)(1-\tau_t^u - \tau)(1 - \lambda_t)w_t q + \psi_t v_t$, they decide to set up a business in West Germany instead of working in East Germany. Again this choice is only relevant if the marginal entrepreneur who sets up his business in West Germany exists and has less knowhow and talent than the marginal entrepreneur in East Germany and the marginal worker who migrates to West Germany.

Thresholds resulting from comparing unemployment benefits to wages paid in West Germany, or possible profits earned in East or West Germany, are never relevant. Situations in which they could matter are ruled out, given

that West Germans only migrate to East Germany to set up their businesses there.

A.2.5 Explicit Aggregation of Components of Equations

Denote by $n_t(z_t^p, A_t; .)$, $k_t(z_t^p, A_t; .)$, and $y_t(z_t^p, A_t; .)$ demands for labor and capital services and supply of goods by an entrepreneur born in West Germany who has managerial knowhow z_t^p and who sets up his business in West Germany. Demands and supply of entrepreneurs born in East Germany who set up their businesses in West Germany are $n_t(z_t^p, A_t, \eta_t^{*,j}; .)$, $k_t(z_t^p, A_t, \eta_t^{*,j}; .)$, and $y_t(z_t^p, A_t, \eta_t^{*,j}; .)$. Demands for labor and capital and supply of goods by entrepreneurs born in East Germany who set up their businesses in East Germany are denoted by $n_t(z_t^p, A_t^*; .)$, $k_t(z_t^p, A_t^*; .)$, and $y_t(z_t^p, A_t^*; .)$, whereas entrepreneurs born in West Germany who set up their businesses in East Germany demand $n_t(z_t^p, A_t^*, \eta_t^j; .)$ and $k_t(z_t^p, A_t^*, \eta_t^j; .)$ and supply $y_t(z_t^p, A_t^*, \eta_t^j; .)$. The population of West Germany is denoted by P_t. P_t^* denotes the East German population. Note that these aggregations are for equilibria as depict in Figure 2.3.4, with mobile East Germans moving to West Germany to work or set up a business and no West German moving to East Germany.

Intelligence of Entrepreneurs in East Germany

$$
\begin{aligned}
\bar{Q}^*{}_t &= \theta L_t^{*,0} \int_{\hat{z}_t^{*,0}}^{\bar{z}_t^{*,l}} q f(q) dq + \theta L_t^{*,1} \int_{\hat{z}_t^{*,1}}^{\bar{z}_t^{*,l}} q f(q) dq + \\
&\quad + (1-\theta) L_t^{*,0} \int_{\hat{z}_t^{*,0}}^{\bar{z}^0} q f(q) dq + (1-\theta) L_t^{*,1} \int_{\hat{z}_t^{*,1}}^{\bar{z}_t^1} q f(q) dq.
\end{aligned}
$$

Intelligence of Entrepreneurs in West Germany

$$\bar{Q}_t = L_t^0 \int_{\hat{z}_t^0}^{\bar{z}_t^l} qf(q)dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} qf(q)dq +$$
$$+ \theta L_t^{*,0} \int_{\tilde{z}_t^{*,l}}^{\bar{z}^0} qf(q)dq + \theta L_t^{*,1} \int_{\tilde{z}_t^{*,l}}^{\bar{z}_t^1} qf(q)dq.$$

Labor demand in West Germany after reunification:

$$N_t^d = L_t^0 \int_{\hat{z}_t^0}^{\bar{z}_t^0} n_t(z_t^0, A_t;.)f(q)dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} n_t(z_t^1, A_t;.)f(q)dq +$$
$$+ \theta L_t^{*,0} \int_{\tilde{z}_t^{*,l}}^{\bar{z}^0} n_t(z_t^0, A_t, \eta_t^{*,l};.)f(q)dq +$$
$$+ \theta L_t^{*,1} \int_{\tilde{z}_t^{*,l}}^{\bar{z}_t^1} n_t(z_t^1, A_t, \eta_t^{*,l};.)f(q)dq.$$

Labor supply in West Germany after reunification:

$$N_t^s = L_t^0 \int_{\hat{q}_t}^{\hat{z}_t^0} qf(q)dq + L_t^1 \int_{\hat{q}_t}^{\hat{z}_t^1} qf(q)dq +$$
$$+ \theta L_t^{*,0} \int_{\tilde{q}_t^l}^{\hat{z}_t^{*,0,l}} qf(q)dq + \theta L_t^{*,1} \int_{\tilde{q}_t^l}^{\hat{z}_t^{*,1,l}} qf(q)dq.$$

Labor demand in East Germany after reunification:

$$N_t^{d,*} = \theta L_t^{*,0} \int_{\hat{z}_t^{*,0,l}}^{\tilde{z}_t^{*,l}} n_t(z_t^0, A_t^*;.)f(q)dq +$$
$$+ (1-\theta)L_t^{*,0} \int_{\hat{z}_t^{*,0,h}}^{\bar{z}_t^0} n_t(z_t^0, A_t^*;.)f(q)dq +$$
$$+ \theta L_t^{*,1} \int_{\hat{z}_t^{*,1,l}}^{\tilde{z}_t^{*,l}} n_t(z_t^1, A_t^*;.)f(q)dq +$$
$$+ (1-\theta)L_t^{*,1} \int_{\hat{z}_t^{*,1,h}}^{\bar{z}_t^1} n_t(z_t^1, A_t^*;.)f(q)dq.$$

Labor supply in East Germany after reunification:

$$
N_t^{s,*} \;=\; \theta P_t^* \int_{\hat{q}_t^*}^{\tilde{q}_t^h} q f(q)dq + (1-\theta)P_t^* \int_{\hat{q}_t^*}^{\tilde{q}_t^l} q f(q)dq.
$$

Capital demand after reunification:

$$
\begin{aligned}
K_t \;=\;& L_t^0 \int_{\hat{z}_t^0}^{\bar{z}_t^0} k_t(z_t^0, A_t; .)f(q)dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} k_t(z_t^1, A_t; .)f(q)dq + \\
& + \theta L_t^{*,0} \int_{\hat{z}_t^{*,0,l}}^{\bar{z}_t^{*,l}} k_t(z_t^0, A_t^*; .)f(q)dq + \theta L_t^{*,1} \int_{\hat{z}_t^{*,1,l}}^{\bar{z}_t^{*,l}} k_t(z_t^0, A^*t; .)f(q)dq + \\
& + (1-\theta)L_t^{*,0} \int_{\hat{z}_t^{*,0,h}}^{\bar{z}_t^0} k_t(z_t^0, A_t^*; .)f(q)dq + \\
& + (1-\theta)L_t^{*,1} \int_{\hat{z}_t^{*,1,h}}^{\bar{z}_t^1} k_t(z_t^0, A^*t; .)f(q)dq + \\
& + \theta L_t^{*,0} \int_{\tilde{z}_t^{*,l}}^{\bar{z}^0} k_t(z_t^0, A_t, \eta_t^{*,l}; .)f(q)dq + \theta L_t^{*,1} \int_{\tilde{z}_t^{*,l}}^{\bar{z}_t^1} k_t(z_t^1, A_t, \eta_t^{*,l}; .)f(q)dq.
\end{aligned}
$$

Aggregate moving costs:

$$
\Xi_t \;=\; \eta_t^{*,l}\theta[L_t^{*,0}(\int_{\tilde{q}_t^h}^{\hat{z}_t^{*,0,l}} f(q)dq + \int_{\tilde{z}_t^{*,l}}^{\bar{z}^0} f(q)dq) + L_t^{*,1}(\int_{\tilde{q}_t^l}^{\hat{z}_t^{*,1,l}} f(q)dq + \int_{\tilde{z}_t^{*,l}}^{\bar{z}_t^1} f(q)dq)].
$$

Law of motion for the mass of entrepreneurs in West Germany:

$$
\begin{aligned}
L_{t+1}^1 \;=\;& L_t^0 \int_{\hat{z}_t^0}^{\bar{z}_t^0} f(q)dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} f(q)dq + \\
& + \theta L_t^{*,0} \int_{\tilde{z}_t^{*,l}}^{\bar{z}^0} f(q)dq + \theta L_t^{*,1} \int_{\tilde{z}_t^{*,l}}^{\bar{z}^1} f(q)dq.
\end{aligned}
$$

Law of motion for the mass of entrepreneurs in East Germany:

$$L_{t+1}^{*,1} = \theta L_t^{*,0} \int_{\hat{z}_t^{*,0,l}}^{\bar{z}_t^{*,l}} f(q)dq + (1-\theta)L_t^{*,0} \int_{\hat{z}_t^{*,0}}^{\bar{z}_t^0} f(q)dq +$$

$$+ \theta L_t^{*,1} \int_{\hat{z}_t^{*,1,l}}^{\bar{z}_t^{*,l}} f(q)dq + (1-\theta)L_t^{*,1} \int_{\hat{z}_t^{*,1,}}^{\bar{z}_t^1} f(q)dq.$$

Goods supply after reunification:

$$Y_t^{s,*} + Y_t^s = L_t^0 \int_{\hat{z}_t^0}^{\bar{z}_t^0} y_t(z_t^0, A_t; .)f(q)dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^1} y_t(z_t^1, A_t; .)f(q)dq +$$

$$+ \theta L_t^{*,0} \int_{\hat{z}_t^{*,0,l}}^{\bar{z}_t^{*,l}} y_t(z_t^0, A_t^*; .)f(q)dq +$$

$$+ \theta L_t^{*,1} \int_{\hat{z}_t^{*,1,l}}^{\bar{z}_t^{*,l}} y_t(z_t^1, A_t^*; .)f(q)dq +$$

$$+ (1-\theta)L_t^{*,0} \int_{\hat{z}_t^{*,0,h}}^{\bar{z}_t^0} y_t(z_t^0, A_t^*; .)f(q)dq +$$

$$+ (1-\theta)L_t^{*,1} \int_{\hat{z}_t^{*,1,h}}^{\bar{z}_t^1} y_t(z_t^1, A_t^*; .)f(q)dq +$$

$$+ \theta L_t^{*,0} \int_{\tilde{z}_t^{*,l}}^{\bar{z}^0} y_t(z_t^0, A_t, \eta_t^{*,l}; .)f(q)dq +$$

$$+ \theta L_t^{*,1} \int_{\tilde{z}_t^{*,l}}^{\bar{z}_t^1} y_t(z_t^1, A_t, \eta_t^{*,l}; .)f(q)dq.$$

Right hand side of government budget constraint after reunification:

$$
\begin{aligned}
\tau\Pi_t + (\tau - \tau\tau_t^u)W_t \;=\; & \tau\Big\{ L_t^1 \int_{\hat{z}_t^{1,l}}^{\bar{z}_t^0} \pi_t(z_t^1, A_t; .)f(q)dq + \\
& + L_t^0 \int_{\hat{z}_t^{0,l}}^{\bar{z}_t^1} \pi_t(z_t^0, A_t; .)f(q)dq + \\
& + \theta L_t^{*,1} \int_{\hat{z}_t^{*,1,l}}^{\bar{z}_t^{*,l}} \pi_t(z_t^1, A_t^*; .)f(q)dq + \\
& + \theta L_t^{*,0} \int_{\hat{z}_t^{*,0,l}}^{\bar{z}^{*,l}} \pi_t(z_t^0, A_t^*; .)f(q)dq \\
& + (1-\theta)L_t^{*,1} \int_{\hat{z}_t^{*,1,h}}^{\bar{z}_t^1} \pi_t(z_t^1, A_t^*; .)f(q)dq + \\
& + (1-\theta)L_t^{*,0} \int_{\hat{z}_t^{*,0,h}}^{\bar{z}^0} \pi_t(z_t^0, A_t^*; .)f(q)dq + \\
& + \theta L_t^{*,0} \int_{\bar{z}_t^{*,l}}^{\bar{z}^0} \pi_t(z_t^0, A_t, \eta_t^{*,l}; .)f(q)dq + \\
& + \theta L_t^{*,1} \int_{\bar{z}^{*,l}}^{\bar{z}_t^1} \pi_t(z_t^1, A_t, \eta_t^{*,l}; .)f(q)dq + \\
& + (\tau - \tau\tau_t^u)w_t\Big\{ L_t^1 \int_{\hat{q}_t}^{\hat{z}_t^1} qf(q)dq + \\
& + L_t^0 \int_{\hat{q}_t}^{\hat{z}_t^0} qf(q)dq + \\
& + \theta L_t^{*,1} \int_{\tilde{q}_t^l}^{\hat{z}_t^{*,1,l}} qf(q)dq + \theta L_t^{*,0} \int_{\tilde{q}_t^l}^{\hat{z}_t^{*,0,l}} qf(q)dq + \\
& + (\tau - \tau\tau_t^u)(1-\lambda_t)w_t \frac{N_t^{d*}}{N_t^{s*}}\Big\{ \theta L_t^{*,1} \int_{\hat{q}_t^*}^{\tilde{q}_t^l} qf(q)dq + \\
& + (1-\theta)L_t^{*,1} \int_{\hat{q}_t^*}^{\hat{z}_t^1} qf(q)dq + \theta L_t^{*,0} \int_{\hat{q}_t^*}^{\tilde{q}_t^l} qf(q)dq + \\
& + (1-\theta)L_t^{*,0} \int_{\hat{q}_t^*}^{\hat{z}_t^0} qf(q)dq \Big\}.
\end{aligned}
$$

Left hand side of unemployment insurance after reunification:

$$
\begin{aligned}
UB_t \;=\; & v_t\{P_t \int_0^{\hat{q}_t} f(q)dq + P_t^* \int_0^{\hat{q}_t^*} f(q)dq + \\
& + (1 - \frac{N_t^{d,*}}{N_t^{s,*}})[\theta L_t^{*,0} \int_{\hat{q}_t^*}^{\tilde{q}_t^h} f(q)dq + \\
& + (1-\theta)L_t^{*,0} \int_{\hat{q}_t^*}^{\hat{z}_t^0} f(q)dq + \\
& + \theta L_t^{*,1} \int_{\hat{q}_t^*}^{\tilde{q}_t^h} f(q)dq + (1-\theta)L_t^{*,1} \int_{\hat{q}_t^*}^{\hat{z}_t^0} f(q)dq]\}.
\end{aligned}
$$

Right hand side of unemployment insurance after reunification:

$$
\begin{aligned}
2\tau_t^u W_t \;=\; & 2\tau_u w_t\{L_t^0 \int_{\hat{z}_t^0}^{\bar{z}_t^0} n_t(z_t^0, A_t; .)f(q)dq + L_t^1 \int_{\hat{z}_t^1}^{\bar{z}_t^0} n_t(z_t^1, A_t; .)f(q)dq + \\
& + \theta L_t^{*,0} \int_{\tilde{z}_t^{*,l}}^{\bar{z}^0} n_t(z_t^0, A_t, \eta_t^{*,l}; .)f(q)dq + \\
& + \theta L_t^{*,1} \int_{\tilde{z}_t^{*,l}}^{\bar{z}_t^1} n_t(z_t^1, A_t, \eta_t^{*,l}; .)f(q)dq + \\
& + (1-\lambda_t)\{\theta L_t^{*,0} \int_{\hat{z}_t^{*,0,l}}^{\tilde{z}_t^{*,l}} n_t(z_t^0, A_t^*; .)f(q)dq + \\
& + (1-\theta)L_t^{*,0} \int_{\hat{z}_t^{*,0,h}}^{\bar{z}_t^0} n_t(z_t^0, A_t^*; .)f(q)dq + \\
& + \theta L_t^{*,1} \int_{\hat{z}_t^{*,1,l}}^{\tilde{z}_t^{*,l}} n_t(z_t^1, A_t^*; .)f(q)dq + \\
& + (1-\theta)L_t^{*,1} \int_{\hat{z}_t^{*,1,h}}^{\bar{z}_t^1} n_t(z_t^1, A_t^*; .)f(q)dq\}\}.
\end{aligned}
$$

A.2.6   Proof of Lemma 2.3.1

The threshold of managerial knowhow that determines who is indifferent between setting up a business in East or West Germany only exists for West German individuals if

$(1 - \lambda_t)^{(1-\nu)\gamma}(1 - \chi_t)^{\nu\gamma} < \frac{A_t^*}{A_t}^{1-\gamma}$ and for East Germans this threshold only exists if

$(1 - \lambda_t)^{(1-\nu)\gamma}(1 - \chi_t)^{\nu\gamma} > \frac{A_t^*}{A_t}^{1-\gamma}$. These conditions are mutually exclusive.

A.2.7   Results Reunification after 5 periods

It seems reasonable to assume that after one generation spill-over effects and common policies stimulating technology diffusion within Germany cause at least a partial convergence of TFP across the two Germanies. In order to account for this I assume that East German TFP evolves according to the following process

$$A_t^* = max(A_{t-1}^*(1 + g_t^*), \frac{1}{1 + e^{-\rho-t}}A_t). \qquad (A.2.71)$$

where in case of a lower growth rate of TFP in East Germany (g_t^*) than in West Germany an exogenous process leads to a final convergence of TFP levels. The parameter ρ is set to a value of 1.105 such as to match the initial ratio of TFP for $t = 1$. Simulating the model economy for five generations I eliminate the discount on wages and assume that the discount on wages is reduced as TFP grows. As East and West Germans become more alike, I assume that moving costs relative to GDP decrease over time, maintaining the absolute value of moving cost for mobile Germans η_t^l, constant. Table A.2.7.1 shows the evolution of relative moving costs, discount on the rental rate of capital, λ_t, and ratio of TFP for the four periods. Table **??** displays the model's results for the fifth generation after reunification. Four generations after reunification,

Table A.2.7.1: Evolution of Discount on Wages, Moving Costs, TFP Ratio

Period after Re-unification	Discount on Wage	Moving Costs as fractions of West German GDP per Capita of Previous Period		Ratio East-to-West German TFP
	λ_t	$\eta_t^l \frac{Y_{t-1}^w}{P_{t-1}}$		$\frac{A_t^*}{A_t}$
1	0.3	0.4234		0.7451
2	0.2283	0.3331		0.7512
3	0.1086	0.1910		0.8914
4	0.0429	0.1172		0.9571
5	0.0162	0.0714		0.9838

almost 75% of the original population of East Germany has left. While 6.8% of the East German population sets up their own business, 35.7% of them do so in West Germany; i.e. only 5.9% of East Germans set up their business in East Germany. This is qualitatively consistent with estimations by Ragnitz and Schneider (2007) who predict numbers of newly self-employed in East Germany to decrease with respect to 2002 by about 15% in 2010 and by almost 30% in 2020. And few entrepreneurs imply low employment. 21.4% of the East German labor force is unemployed and 13.7% of all unemployment in East Germany is involuntary.

Table A.2.7.2: Reunification: Results After Five Generation

Entrepreneurship	
Entrepreneurs in East Germany	5.9%
East Germans Becoming Entrepreneurs	6.8%
... of those going West	35.7%
Entrepreneurs in West Germany	7.0%
West Germans Becoming Entrepreneurs	%
... of those going East	0
West Germany	
Annual Growth Rate of TFP	1.61%
Annual Growth Rate of GDP	2.44%
Unemployment Rate	5.4%
East Germany	
Annual Growth Rate of TFP	1.28%
Annual Growth Rate of GDP	1.57%
Accumulated Net migration to Population East	74.5%
Unemployment Rate	21.4%
of those involuntarily unemployed	13.7%
Workers going West	29.6%