

AID, DRUGS, AND INFORMALITY: ESSAYS IN EMPIRICAL  
ECONOMICS

Ola Granström



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EFI THE ECONOMIC RESEARCH INSTITUTE



Dissertation for the Degree of Doctor of Philosophy  
Stockholm School of Economics

**KEYWORDS:** Aid efficiency; Altruism; Corruption; Dictator game; Experiment; Foreign aid; Identifiable victim effect; Informal sector; Innovation; Occupational choice; Paternalism; Pharmaceuticals; Philanthropy; Product cycle; Wage discrimination.

©EFI and the author, 2008  
ISBN NR 978-91-7258-756-4

PRINTED BY:  
Elanders Gotab, Stockholm 2008

DISTRIBUTED BY:  
EFI, The Economic Research Institute  
Stockholm School of Economics  
P O Box 6501, SE-113 83 Stockholm  
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To my parents



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## Acknowledgements

I am indebted to many people for their support throughout my work on this Ph.D. thesis.

First and foremost, I wish to express my sincere gratitude to my advisor Magnus Johannesson. I can honestly say that Magnus has been an ideal thesis advisor! He has a remarkable intuition for economics and econometrics, and he is extraordinarily generous with his time and knowledge. Also, Magnus has never hesitated to offer the kind of hands-on guidance I needed not to lose stamina during this sometimes marathon-like exercise. It has been truly inspiring having Magnus as my advisor, and for that I am thankful.

My coauthors Anna Breman and Elena Bardasi both deserve praise for good collaboration. By sharing their ideas and knowledge, they have allowed me to learn considerably more than if I had embarked on these research projects alone. I am also indebted to Erik Lindqvist, Erik Mohlin and Robert Östling for valuable suggestions on how to improve the papers, hands-on econometric tips, as well as many interesting and fun discussions. Ola Andersson, too, deserves credit for helpful comments and discussions, as well as for contributing a lot to the great time I had at Pompeu Fabra in Barcelona.

The administrative staff at the Department is fantastic, and a warm thank you goes to Carin Blanksvärd, Ritva Kiviharju, Anneli Sandbladh and Lilian Öberg for their friendliness and support. They are very much appreciated. Also, financial support from the Jan Wallander och Tom Hedelius stiftelse is gratefully acknowledged.

I have appreciated the company of my many colleagues at the Stockholm Doctoral Program in Economics. In particular, let me thank: Peter Gustafsson, for countless interesting discussions, authoritative musical guidance, and for believing in the beautiful art of the *korulösning*; Fredrik Wilander, for being a great guy who rarely says no to discussing life and economics over a beer or two; and Marieke Bos, for always offering a fun and healthy non-Swedish view on things and for cooking great dinners. Thanks also to Mia Hinnerich and Kristin Magnusson. The Uppsala Ph.D. trio – Christian Andersson, Jon Enqvist and Erik Post – are also great friends (though they've had the bad habit of beating us at Trivial Pursuit...).

I was lucky to start my Ph.D. studies together with five guys who have come to mean a great deal to me: Milo Bianchi, Erik Höglin, Henrik Lundvall, Per Sonnerby, and Björn Tyrefors. Together they made my Ph.D. experience a whole lot easier – and much more fun! *Grande maestro* Milo deserves *mille grazie* for always being willing to help out (with the impenetrable first-year problem sets, for instance), for his great sense of humor, and for inviting us to spend some truly unforgettable days in Sorbolo. I am indebted to Erik for his friendship, for all the laughter, the inspiring coffee breaks and daily rock quizzes, help on algebraic details, and a whole range of late-night discussions over intoxicating beverages (I've certainly enjoyed the ride!). Massive thanks goes to Henrik for his generous friendship, for always listening and helping out, for all the fun discussions, the wine, the long walks – and for helping me to increase my cultural capital. I am also indebted to Per whose generous help and razor-sharp advice (on SSE-related and other matters) have helped me a lot, and whose learned company I've always enjoyed. Björn, too, deserves a lot of credit for his enthusiastic and generous personality, as well as for sharing his reflections on society – sometimes provocative, often witty, never boring.

Finally, I wish to thank my parents, Sven and Anna-Karin, for their continuous love and support. Throughout the years, they have patiently supported me by all means possible. For that I am immensely grateful. I would like to thank my brother, Per, too – for being a true friend.

Stockholm, May 2008  
Ola Granström



## **Summary of Thesis**



## Introduction

This Ph.D. thesis consists of five papers that together cover a rather eclectic set of research topics. To the extent that there is a connecting thought in these papers, it spells empirical microeconomics. Each paper relies on empirical data to study a policy-relevant topic that has hitherto received rather scant attention from economic researchers.

The first three papers study the preferences of individuals making cross-border charitable donations. They aim at increasing our knowledge of how tied transfers and the identification of the recipient affect the willingness to give, as well as to allow for the improvement of foreign-aid policies. A subsequent paper deals with the performance of women in the informal sector in Senegal – a neglected topic although over 80% of female workers are found in the informal sector in sub-Saharan Africa (ILO 2002). The study compares occupational choices and wage outcomes of men and women in the formal and informal sectors. Finally, the remaining fifth paper examines the relationship between therapeutic innovation of drugs and their product cycles (sales). This topic has been overlooked in pharmaceutical economics, and provides valuable insights into to what extent drug firms are financially rewarded for innovative R&D.

Four papers in this thesis thus investigate the behavior of individuals, whereas the fifth and final paper focuses on the performance of a specific good – pharmaceuticals. The research topic at hand essentially determines what technique to use in the empirical analysis. For instance, experimental methods have proven particularly useful to evaluate theoretical predictions of donor behavior. In contrast to traditional empirical economics, which relies on observing decisions in natural environments, the idea here is to isolate the causal factors driving donor behavior in the "laboratory" with the aim of being able to better compare *ceteris paribus* situations.<sup>1</sup> By designing donation experiments that use real-world recipients and mimic cross-border charitable giving, and by varying one design parameter, we study what factors determine the willingness to give of individuals.

When comparing occupational choices and wage outcomes of men and women in the formal and informal sector, it would be exceedingly difficult to use a laboratory set-up.

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<sup>1</sup> For an introduction to the methodology of experimental economics, see Guala (2005).

Instead we rely on non-experimental data that describes the labor market. However, as our specific interest is the informal sector in Senegal, we base our empirical analysis on cross-sectional household survey data. In many developing countries, household surveys often constitute the only type of data available to social scientists. Moreover, analysts have recently become increasingly interested in exploring the ways in which household survey data may inform the policy process (Deaton 2000).

In contrast to the paper on women and informality in Senegal, the fifth and final paper deals with a topic – drug product cycles in Sweden – where we have access to a data set describing an entire population. We have data on all the New Chemical Entities (drugs) introduced in Sweden between 1987 and 2000. Moreover, the regulation of the Swedish pharmaceutical market with a state-owned monopoly retailer ensures that we have access to a unique data set containing panel data on all drug sales in Sweden for the 1987-2007 period.

The following section summarizes the five papers in more detail.

## Summary of Papers

### **Paper 1: Is Foreign Aid Paternalistic?** (with Anna Breman and Felix Masiye)

This paper experimentally investigates whether donors are paternalistically altruistic when contributing to foreign aid. A paternalist may be defined as someone who advances other people's interests, such as health or safety, at the expense of their liberty or autonomy. In economic theory, a donor is said to be paternalistically altruistic if he cares about a recipient's wellbeing, but does not fully respect the recipient's preferences (Pollak 1988, Jones-Lee 1991, 1992, Jacobsson et al. 2007).

In a double-blind experiment, a subject chooses whether to make a monetary or a tied transfer (mosquito nets) to an anonymous household in Zambia. Recipients have revealed preferences for money, as their willingness to pay for mosquito nets is positive but below the market price. A monetary transfer will therefore preserve the household's preferences while a tied transfer is paternalistic.

Health-focused paternalism is sufficiently strong for many donors to ignore the revealed preferences of recipients. The mean donation of mosquito nets (35%) differs significantly from zero. Paternalistic altruists constitute 65% of the total sample, whereas purely altruistic donors only constitute 15%. Our results are in line with Jacobsson et al. (2007) who find strong evidence of health-focused paternalism in within-country giving.

Health-focused paternalistic rather than purely altruistic preferences seem to dominate the foreign-aid giving of individuals. The questionnaire gives some insights into what drives paternalistic behavior and future research could deepen our understanding of this phenomenon. Our results may help explain the history of paternalistic policies in foreign development assistance. Moreover, they strengthen the case for health-related foreign aid.

### **Paper 2: Corruption and the Case for Tied Aid** (with Anna Breman)

Tied project aid is often said to suffer from allocative inefficiency. Yet project aid has historically been the dominant form of foreign aid (Kanbur 2003). Tying aid to specific projects may in fact be required to rally support for foreign development

assistance (Singer 1965). One reason may be that tied aid is perceived as less corrupt (i.e., less easy to divert due to its illiquid nature) than untied program aid.

We present a simple model that shows how perceived aid diversion can induce tied transfers. In a dictator game, we then compare the willingness to make a monetary contribution to Zambia's national health budget (CBoH) with the willingness to make a tied transfer (mosquito nets) to a health-care clinic (KC) in Lusaka. We also study to what extent the choice between project and program aid depends on the latter's perceived problems with corruption and misallocation.

Donors clearly prefer tied aid to untied program aid. First, the mean tied donation to KC (SEK 44) is highly positive. Second, it is significantly higher than the mean monetary transfer to CBoH (SEK 26). Third, the fraction of donors who give at least one net to KC (65%) is significantly higher than the share only giving money to the CBoH (16%). Exit questionnaires suggest that the reason is a fear of corruption and misallocation at the CBoH. Participants' opinions about the decisive factor for Swedish official development assistance – efficiency and influence over the use of aid funds – lend additional support to this interpretation.

Our results indicate that a fear of aid diversion, rather than a low valuation of foreigners' well-being, has a role to play in explaining the low level of cross-country transfers relative to within-country transfers in developed countries (see Kopczuk et al. 2005). Moreover, the experiment indicates that reducing developing country corruption could benefit aid recipient countries in two ways, increasing both allocative and productive aid efficiency.

### **Paper 3: Altruism without Borders?** (with Anna Breman)

Why do individuals contribute to foreign aid? Does the willingness to give increase the more we know about the recipients? Although there is some literature on the strategic interests of countries to provide foreign aid (e.g., Alesina and Dollar 2000), little is yet known about which preferences guide the foreign-aid giving of individual donors.

This paper experimentally tests altruism over borders. First, we test the *identification effect*, that is, whether the willingness to give increases with the information given about the recipients. Experimental studies of within-country altruism using dictator games have shown that such identification increases donations (Bohnet and Frey 1999, Charness and Gneezy 2003). We design a cross-country dictator game where the degree of identification of the recipient is varied in four treatments: (1) anonymity, (2) photo, (3) information and (4) photo and information.

The mean donation is 55%, which is considerably higher than in standard dictator games. In contrast to previous within-country experiments, we find no significant effect of identification on donations. This result is robust to testing levels as well as frequencies of donations. Our results are in line with experimental evidence on identifiable versus statistical victims. Small and Loewenstein (2003) demonstrate that determining the victim without providing particulars about him suffices to increase the willingness to help (see also Jenni and Loewenstein 1997).

We gather questionnaire data on donor characteristics as they have proven to be correlated with altruistic behavior in dictator games. Effectiveness is singled out as the most important factor in giving aid by the majority of subjects in the experiment. Women donate significantly more than men (64% compared to 50%) and those who state that aid is too large donate significantly less than those who state that aid is too small (24% compared to 67%). Apparently donations are directly related to the attitude to foreign aid.

#### **Paper 4: Women and Informality: Evidence from Senegal** (with Elena Bardasi)

The informal sector has long constituted a gap in the knowledge of women's labor. This paper seeks to fill a part of that knowledge gap using a 2002 household survey from Dakar, Senegal.

83% of working women are informal, compared to 50% of men. Multinomial logit analysis, controlling for education and other covariates, reveals that women are 3-4 times less likely to work formally (i.e., in the private formal sector or public sector) rather than informally. This may be due to the possibility provided by the informal sector of combining unpaid domestic work with paid work (World Bank 2007). Informal women spend significantly more time on household responsibilities than do women in the formal sector.

We also use interval regression techniques to estimate Mincer equations to assess whether there is a wage gap between men and women in each sector. We find that low education as well as a strong presence in relatively badly paid industries (e.g., trade) and professions (e.g., unskilled workers) explain a considerable part of the gender wage gap. Controlling for personal characteristics, profession and industry, there is no significant gender wage effect in the private formal sector.

In the informal sector, however, women experience a 28% lower wage on average. This result holds across specifications and robustness tests. One reason for this may be that low capital levels in female-run informal firms decrease their productivity. Indeed, we find female-run informal firms to be significantly less capital intense than male-run

informal firms. Women's productivity in the informal sector may also suffer from their considerable domestic work-loads, as has been pointed out by Blau (1998).

Our results suggest that in order to help women to fully break out of informal employment, one has to address multiple constraints: the low level of education and training among women; a high concentration of women in low-paid professions and industries; weak capital intensity in female-run firms; and a highly asymmetric allocation of domestic work tasks between men and women.

### **Paper 5: Does Innovation Pay? A Study of the Pharmaceutical Product Cycle**

Drug life cycles is a neglected topic in studies of pharmaceutical markets. This paper examines how pharmaceutical life cycles depend on a drug's degree of therapeutic innovation. A unique data set rates all the 414 New Chemical Entities (NCEs) introduced in Sweden between 1987 and 2000 into one of three FDA innovation classes: A (important therapeutic gains); B (modest gains); and C ("me-too" drugs with little gains). This data is combined with sales figures for the 1987-2007 period.

Regression analysis controlling for time effects and anatomical group shows that, over a 15-year life cycle, the average class A drug raises 15% higher revenues than B drugs and 114% higher revenues than C drugs (using a 4% discount rate). However, yearly sales for class A drugs are only significantly higher than for me-too drugs in year 14-17 after launch. Class B drugs, on the other hand, display significantly higher sales than C drugs in year 1-11 after launch. Sales of the most innovative drugs are initially weak and characterized by a high variance. When pooling A and B drugs to compare innovative and imitative (class C) drugs, we find 15-year life cycle revenues of the former to exceed those of imitative drugs by 100%. The sales difference is significant in 19 out of 20 years after launch. Finally, we find evidence of a first-mover advantage analyzing first and second-mover sales differences.

The late take-off in average sales for class A drugs stands in stark contrast to Pammolli and Riccaboni's (2004) claim that innovative drugs enjoy rapid growth after launch. Berndt et al. (2003) argue that the use of a drug may provide patients and physicians with valuable information about its efficacy or safety, so that a positive consumption externality materializes to increase demand and thus the diffusion of a drug. It is possible that these type of consumption externalities have significant effects on the diffusion of truly innovative drugs. Moreover, the high variance in sales for the most innovative drugs indicate that truly innovative R&D is a high-risk endeavour.



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# Papers



## Is Foreign Aid Paternalistic?

with Anna Breman and Felix Masiye

**ABSTRACT.** We experimentally investigate whether donors are paternalistically altruistic when contributing to foreign aid. In a double-blind experiment, a subject chooses whether to make a monetary or a tied transfer (mosquito nets) to an anonymous household in Zambia. Recipients have revealed preferences for money, as their willingness to pay for mosquito nets is positive but below the market price. A monetary transfer will therefore preserve the household's preferences while a tied transfer is paternalistic. The mean donation of mosquito nets differs significantly from zero, thereby implying paternalistic preferences among donors. Paternalistic donors constitute 65% of the total sample, whereas purely altruistic donors constitute 15%. We conclude that health-focused paternalistic rather than purely altruistic preferences dominate the foreign-aid giving of individuals.

Keywords: Foreign aid; paternalism; altruism.

JEL Classification: F35; A13; C72; C91.

### 1. Introduction

Paternalism is broadly defined as acting for the good of another person without that person's consent. It is controversial as its end is benevolent while its means are (arguably) coercive.<sup>1</sup> A paternalist may thus be defined as someone who advances other people's interests, such as life, health, or safety, at the expense of their liberty or autonomy. In economic theory, a donor is said to be paternalistically altruistic if he cares about a recipient's wellbeing, but does not fully respect the recipient's preferences (Pollak 1988, Jones-Lee 1991, 1992, Jacobsson et al. 2007).

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<sup>0</sup> We thank Jesper Sundewall for help with recruitment and distribution in Zambia, Claes Rehnberg for advice during the initial phase of the project, and Peter Gustafsson and Fredrik Wilander for assistance in carrying out the experiment. Comments from Ola Andersson, Magnus Johannesson, Erik Lindqvist, Sendhil Mullainathan, Elena Paltseva and Jeremy Tobacman, as well as from seminar participants at Harvard University, Universitat Pompeu Fabra, Stockholm School of Economics, Stockholm University and the 2006 ENTER Jamboree in Stockholm, are gratefully acknowledged. So is financial support from Jan Wallander and Tom Hedelius' Research Foundation.

<sup>1</sup> Suber (1999) provides a lucid introduction to the view on paternalism in philosophy. See also Dworkin (2002).

In the context of foreign aid, it is common that donors tie donations to specific causes, countries or victims. Kanbur (2003) notes that tied aid has been a key feature of foreign aid throughout history. U.S. development assistance began with food surpluses deployed as aid to Latin American countries in the nineteenth century. Moreover, donations to charitable organizations often include specifications as to how they may be used. While certain charities (e.g., Médecins Sans Frontières) discourage tied donations, judging that they have better information than donors as to where money is needed the most, many charities accept them in order not to forego possible donations.

This paper experimentally addresses the question as to what extent foreign aid is paternalistic. In a double-blind dictator game, subjects in Sweden can transfer money and/or mosquito nets to a real-life household in Zambia. The recipients have revealed preferences for money, as their willingness to pay for mosquito nets is positive but below the market price. A monetary transfer will therefore preserve the household's preferences while a tied transfer is paternalistic.

Although there exists a literature on the strategic interests of countries in providing foreign aid,<sup>2</sup> very little is yet known about which preferences guide the foreign-aid giving of individual donors. To what extent such donor preferences are paternalistically altruistic is important for theoretical as well as policy-related reasons.

Donor preferences are of importance to policy-makers since paternalistic altruism has a considerable impact on when and how individuals are willing to contribute to foreign aid. The current trend among governmental donor agencies is to move away from project aid where they directly control the use of aid funds to non-paternalistic budget support, where the recipient can choose how to best allocate the resources received (Sida 2008). This policy switch may find little support among tax payers if preferences are paternalistic.

According to traditional altruistic theory, donors only care about the utility of the recipient and not about his consumption pattern (Becker 1981). Hence, it would seem that a donor is never made worse off but might increase his utility by providing a cash transfer instead of a tied transfer, where the latter would put a constraint on the affordable market baskets of the recipient.

We propose an alternative approach, building on the work of Pollak (1988), Jones-Lee (1991, 1992) and Jacobsson et al. (2005). To give the intuition behind the experiment, we present simple theoretical definitions to identify selfish, altruistic and paternalistic preferences, respectively. These definitions are based on an augmented utility function where the utility of the recipient enters the donor's utility function.

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<sup>2</sup> See e.g., Alesina and Dollar (2000) for an overview.

They are intuitive and easily translate into actual behavior observed in the experiment.

We use a framework of development assistance in health to test for paternalistic altruism in foreign-aid giving.<sup>3</sup> A double-blind dictator game<sup>4</sup> is conducted with subjects (dictators) in Sweden and real-life recipients (households) in Zambia. We use a within-subject treatment where the subject must choose directly between a monetary and a tied transfer (mosquito nets). The recipients have revealed preferences for a monetary transfer and we can thus say that such a transfer is purely altruistic (i.e., a monetary transfer respects the preferences of the recipient) while the tied transfer is paternalistically altruistic. A follow-up questionnaire is added to the experiment, which allows us to identify the motives driving selfish, altruistic and paternalistic behavior, respectively.

We show there to be strong evidence of paternalistic behavior in foreign-aid giving. Many donors do not respect the preferences of recipients. Mean donations of the paternalistic (tied) transfer (35.4%) differ significantly from zero. Paternalistic altruists constitute 65% of the total sample, whereas only 15% are pure altruists. The probability is significantly higher that a donor is paternalistically altruistic (82%) than purely altruistic (18%).

These results are important for several reasons. First, they help explain the pattern of tied aid observed throughout the history of development assistance. Second, they show that it may be necessary to better inform taxpayers of the advantages of budget support, if donor agencies aim at continuing moving away from project aid towards budget support. Finally, health-focused paternalism strengthens the case for health-related foreign aid.

The rest of the paper is structured as follows. A following brief section reviews the related literature on paternalistic preferences. The third section theoretically defines various donor preferences, while the fourth explains the design of the experiment. Our results are presented in the fifth section and the sixth section concludes.

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<sup>3</sup> Health-related aid has been an important target for official development assistance. Throughout the 1990s, when overall foreign aid was declining, official development assistance to the health sector rose (World Bank 2004). The Gates Foundation, which, with its assets of approximately US\$ 28.8 billion, is a very important private provider of cross-country support, also primarily targets health aid.

<sup>4</sup> The game asks a dictator to unilaterally decide on the allocation of a fixed amount of money (previously received from the experimenter) between himself and the recipient. The double-blind design ensures that his decision is unknown to the other participants, including the experimenter.

## 2. A Review of Related Literature

The economic literature on paternalistic preferences developed in reaction to Becker's (1981) model of altruism within the household. In his model, altruistic parents always respect the preferences of their children. A weakness of the pure altruism model is its inability to explain the widespread use of tied transfers within the family (e.g., investment in college educations, down payments for house purchases) as well as by public institutions in developed countries (e.g., Medicaid).

Pollak (1988) demonstrates that tied transfers may be accounted for by incorporating paternalistic preferences into the donor's utility function.<sup>5</sup> Donors in his model are altruistic, but not in the Beckerian sense of respecting recipient preferences. They also care about the recipient's specific consumption pattern. There are two reasons why this may be the case. Donors may derive pleasure from the recipient's consumption of a particular good, independently of his preferences. Alternatively, donors may believe that they know the true, long-run interest of the recipient.<sup>6</sup>

Jones-Lee (1991, 1992) refines the study of paternalistic preferences. He introduces the concept of safety-focused paternalism, meaning that individuals care more about the safety of others than about other aspects of their well-being. Through the theoretical study of the value of a statistical life, Jones-Lee shows the willingness to pay for the safety of others to be higher with safety-focused paternalism than with pure altruism.

What Jones-Lee (1991, 1992) labels as safety-focused paternalism, others define as health-focused paternalism. Yet, the underlying idea is the same: altruism seems to be stronger for health care (or safety) than for the consumption of other goods (see e.g., Arrow 1963, Pauly 1971, Pollak, 1988). Such health-focused paternalism may explain the high degree of public subsidization of health care in developed countries (Jacobsson et al. 2007).<sup>7</sup>

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<sup>5</sup> Note that two alternative explanations for tied transfers do not apply to our experiment. Blackorby and Donaldson (1988) claim that tied transfers allow donors without information on recipient preferences to distinguish between intended and non-intended recipients. In our experiment, however, there are no non-intended recipients since all recipients are in need of both types of donations. Moreover, the recipients have revealed preferences for the cash transfer. Bruce and Waldman (1991), on the other hand, argue that tied transfers (as opposed to cash transfers) allow recipients who expect future transfers from a donor to stop self-imposing poverty (i.e., overspend in each period). There is no repeated interaction in our experiment, which is why strategic motives for tied transfers are not credible.

<sup>6</sup> Paternalistic preferences may thus derive from the assumption that a recipient suffers from self-control problems, as described by Laibson (1997) and O'Donoghue and Rabin (1999). It has been argued that such bounded rationality may justify paternalistic policies, even in the absence of altruism (see Thaler and Sunstein 2003, O'Donoghue and Rabin 2003, Camerer et al. 2003).

<sup>7</sup> Alternatively stated, paternalistic preferences for health may explain why health care qualifies as a *merit want*, a concept introduced by Musgrave (1959).



Jacobsson et al. (2007) experimentally test for health-focused paternalism and find strong evidence of such behavior. In their within-country design, a donor may transfer money or nicotine patches to an anonymous smoking diabetes patient whose willingness to pay for the nicotine patches is positive but below the market price. In the between-subject treatments, average donations are 40% greater in the paternalistic group as compared to the purely altruistic group. Moreover, in within-subject treatments, between 82% and 91% of the donations are given in kind rather than as money. The strong paternalistic behavior holds true in stability tests which vary the framing and goods used (e.g., when food stamps are used instead of money, and when donors can transfer money or physical training to a non-smoking diabetes patient).

Our experiment differs in design from that of Jacobsson et al. (2007). We conduct a between-country experiment with donors in Sweden and real-life recipients in Zambia. Moreover, the recipients in our study are poor. Our experiment thus reflects the choices facing individuals donating to poor recipients in developing countries.

Before presenting the experiment, we introduce a set of theoretical definitions accounting for different donor preferences.

### 3. Theoretical Definitions

We modify Pollak's (1988) definition of paternalistic altruism to comply with the context of foreign aid. Furthermore, we employ a definition of health-focused paternalistic altruism going back to Jones-Lee (1991, 1992) and Jacobsson et al. (2007).

There are two types of agents: donors,  $d$ , and recipients,  $r$ . Each donor is matched with a recipient. The utility of a donor is increasing in his own consumption of non-health goods  $c^d$  and his own consumption of health care  $h^d$ .<sup>8</sup> Moreover, the donor's utility is non-decreasing in the non-health consumption  $c^r$  and health-care consumption  $h^r$  of the recipient. The donor's utility function may be written as

$$(3.1) \quad U^d = U^d[c^d, h^d, c^r, h^r].$$

The recipient's utility is simply  $U^r [c^r, h^r]$  and does not depend on the utility of the donor.

A utility-maximizing donor will make a positive transfer (donation) to the recipient, provided that the marginal utility he obtains from the recipient's consumption is higher than the marginal utility he obtains from his own consumption. A donation may either be a monetary (cash) transfer, or a tied (in-kind) transfer. Below, we analyze how donor preferences influence this choice.

<sup>8</sup> Alternatively,  $h$  could be considered as health and health care to be used to produce health.

**3.1. Different Types of Donors.** Our simple theoretical framework for donor preferences allows for five different types of donors: selfish, purely altruistic, paternalistically altruistic, health-focused paternalistic, and purely health-focused paternalistic.<sup>9</sup> The charitable behavior of these five types of donors differs as to the type of donation chosen.

DEFINITION 1. *A donor is selfish if  $\partial U^d/\partial c^r = 0$  and  $\partial U^d/\partial h^r = 0$*

A selfish donor only derives utility from his own consumption  $c^d$  and own health care  $h^d$ . He receives no utility from the consumption and health of the recipient. Hence, a selfish donor will never make a positive transfer to the recipient in this setting.<sup>10</sup>

DEFINITION 2. *A donor is purely altruistic if he is not selfish, i.e.,  $\partial U^d/\partial c^r > 0$  and  $\partial U^d/\partial h^r > 0$ ; and, furthermore, if*

$$(3.2) \quad \frac{\partial U^d/\partial c^r}{\partial U^d/\partial h^r} = \frac{\partial U^r/\partial c^r}{\partial U^r/\partial h^r}.$$

For a pure altruist, the marginal rate of substitution (MRS) between the recipient's non-health consumption and health-care consumption equals the recipient's own MRS between non-health consumption and the consumption of health care. This is the case only if the donor derives no utility from the consumption pattern of the recipient. That is to say that the donor should not care about in what combination the recipient consumes the two goods, only about his total utility. A purely altruistic donor will thus make a transfer fully respecting the preferences of the recipient; that is, a pure altruist will always make a monetary transfer.

DEFINITION 3. *A donor is paternalistically altruistic if he is not selfish, i.e.,  $\partial U^d/\partial c^r > 0$  and  $\partial U^d/\partial h^r > 0$ ; and, furthermore, if*

$$(3.3) \quad \frac{\partial U^d/\partial c^r}{\partial U^d/\partial h^r} \neq \frac{\partial U^r/\partial c^r}{\partial U^r/\partial h^r}.$$

For the paternalistic altruist, the MRS between the recipient's consumption of non-health goods and health-care consumption differs from the recipient's own MRS between non-health consumption and the consumption of health care. A paternalistic altruist will hence not fully respect the preferences of the recipient. Instead, he will

<sup>9</sup> Where "paternalistic" is short for paternalistically altruistic.

<sup>10</sup> Note that a selfish donor could make a positive transfer in a setting where strategic concerns were involved. In the presence of reputation-building and reciprocity, a selfish donor might give money to the recipient in the name of enlightened self-interest.

have a tendency to tie his transfer to the good for which he has paternalistic preferences. The choice between the monetary and the tied transfer depends on the strength of the donor's paternalistic preferences (i.e., how much he values the recipient's consumption following a specific pattern) and his beliefs about the recipient's willingness to pay for the tied good. For example, a donor with paternalistic preferences will make a monetary transfer provided that he believes the recipient's willingness to pay for the tied good to be sufficiently low.

DEFINITION 4. *A donor is health-focused paternalistic if  $\partial U^d / \partial h^r > 0$ ; and, furthermore, if*

$$(3.4) \quad \frac{\partial U^d / \partial c^r}{\partial U^d / \partial h^r} < \frac{\partial U^r / \partial c^r}{\partial U^r / \partial h^r}.$$

For paternalistic altruism to be health-focused, the donor's marginal utility with respect to the recipient's consumption of health care should be positive and his MRS between the recipient's non-health consumption and health-care consumption should be inferior to the recipient's own MRS between non-health consumption and the consumption of health care. Alternatively stated, the donor derives relatively more utility from the recipient's consumption of the health-related good than from his consumption of the other good than does the recipient himself. A health-focused paternalist will thus always have a tendency to tie his transfer to health care. Whether he actually does so depends on the strength of his health-focused paternalism, versus his beliefs about the recipient's willingness to pay for health care.

DEFINITION 5. *A donor is purely health-focused paternalistic if  $\partial U^d / \partial h^r > 0$  and if  $\partial U^d / \partial c^r = 0$*

A health-focused paternalistic donor derives no utility from the recipient's consumption of non-health goods, only from his health-care consumption. In this special case, the only transfer that makes any sense is one tied to health care. Hence, a pure health-focused paternalist will always donate health care to the recipient.

Using the above definitions, we can predict how different donors will behave in an experimental setting. Selfish donors will neither donate money nor mosquito nets while purely altruistic donors will donate money to preserve the preferences of the recipients. Paternalistic altruists and health-focused paternalists will either donate money or mosquito nets depending on the strength of their paternalistic preferences and their beliefs about recipients' willingness to pay for mosquito nets. A purely health-focused paternalist will always donate mosquito nets. The experiment presented in the following section will test purely altruistic versus health-focused paternalistic preferences.

#### 4. Experimental Design

The experiment was a double-blind n-donor dictator game carried out in two separate sessions using a within-subject treatment design. In each of the two sessions, 25 donors were matched with a single real-life household in a rural village in Zambia. The dictators, recruited among the undergraduate students at The Stockholm Institute of Education<sup>11</sup>, were randomly selected into the two sessions. The recipient households were recruited by Felix Masiye and Jesper Sundewall.<sup>12</sup>

When subjects arrived for the experiment, they were given a SEK 50 show-up fee, and were asked to sit and read the instructions quietly without interacting with any of the other subjects. Once all subjects had arrived, the instructions were read out by the experiment leader and one subject was chosen to be the monitor.<sup>13</sup> The monitor's name and e-mail address were marked on the board in the classroom to allow all participants to check with the monitor afterwards that the instructions had been followed. The monitor handed out large opaque envelopes which, in all cases but one, contained two smaller envelopes, two SEK 50 bills (i.e., SEK 100)<sup>14</sup>, as well as four pieces of paper (of equal size as the money bills).<sup>15</sup> As is customary in double-blind dictator games, one of the envelopes contained no money bills, only six pieces of paper. This is to ensure complete anonymity between dictators and the experimenter.

Each subject was asked to choose how to divide the SEK 100 between themselves and the recipient household in Zambia. Donations in the form of money were to be put into the small envelope marked "money", while donations in the form of mosquito nets were to be put into the small envelope marked "malaria bed net". This donor choice was made behind a screen and by one subject at a time. SEK 50 bills were used in the experiment since one mosquito net costs just below SEK 50.

After having decided on the division of the SEK 100, each subject moved to a second screen behind which he anonymously filled out a questionnaire about the experiment. Thereafter the subject was free to leave.

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<sup>11</sup> Stockholm Institute of Education is a teaching college with approximately 15,000 students enrolled in bachelor's and master's programs.

<sup>12</sup> Jesper is Junior Professional Officer at the Swedish International Development Agency (Sida) in Lusaka, Zambia.

<sup>13</sup> The reading-out-loud of instructions allowed participants to verify that they had all received identical instructions. The monitor's task was to see to it that the experiment was executed exactly as stated in the instructions.

<sup>14</sup> 1 US\$  $\approx$  SEK 7. SEK 100  $\approx$  US\$ 14 (at the time of the experiment).

<sup>15</sup> The blank pieces of paper ensure that all envelopes are of equal thickness. A donor that keeps all or some money to himself will substitute the money with the pieces of paper so that the returned envelope is not empty.

When all subjects had made their decisions and filled out the questionnaire, the monitor opened each envelope together with the instructor and took note of the results. The monitor's name and e-mail address were noted by the experimenter. The money and bed nets were distributed to the recipient households in Zambia by Felix Masiye and Jesper Sundewall. A certificate showing that the money and bed nets had been delivered to the recipients was then sent by e-mail to the monitors.

The possible outcomes observed in the dictator game are described in Table 1. *Outcome* denotes the terminology used for different types of donors. The donors who chose not to make a transfer to the recipient are denoted *selfish*, while those only donating money are called *purely altruistic*. *Paternalistic* is short for health-focused paternalistically altruistic. A paternalistic donor made at least part of his transfer in mosquito nets. The distinction between weak and strong paternalists highlights the difference between those donating both money and a mosquito net (*weakly paternalistic*) and those donating only mosquito nets (*strongly paternalistic*).

Note that this terminology is a generalization used for tractability. For example, even an altruistic or paternalistic donor would make a SEK 0 transfer in case his willingness to give was above zero, but below the minimum positive donation in this experiment, i.e. SEK 50. The category *selfish* can thus be seen as an upper bound of the number of selfish donors. Furthermore, some paternalistic donors might not be paternalistic enough to give mosquito nets. The two categories *weakly* and *strongly paternalistic* donors taken together constitute a lower bound for the number of paternalistic donors.

TABLE 1. Possible outcomes in the dictator game

Total sum donated	Envelope marked "Money"	Envelope marked "Malaria bed net"	Outcome
0	0	0	Selfish
50	50	0	Purely altruistic
50	0	50	Strongly paternalistic
100	50	50	Weakly paternalistic
100	100	0	Purely altruistic
100	0	100	Strongly paternalistic

**4.1. Hypotheses.** The experiment was a within-subject treatment design where each subject (dictator) was observed making a choice between different alternatives.<sup>16</sup> A dictator had to decide how to divide SEK 100 between himself and the recipient.

<sup>16</sup> The within-subject design is discussed in more detail in the section on design concerns.

Each subject who chose to make a positive donation had to decide whether to make this donation in the form of (1) money, (2) mosquito nets, or (3) both money and mosquito nets.

We test whether we can find evidence of paternalistic behavior in giving aid. As explained above, we label the donors as selfish ( $s$ ), purely altruistic ( $a$ ), weakly paternalistic ( $wp$ ), and strongly paternalistic ( $sp$ ). These four groups are mutually exclusive. A fifth group of donors is the paternalistic group ( $p$ ), including both the weakly and the strongly paternalistic donors ( $p = wp + sp$ ).

Let  $\mu_j$  denote the mean donations of good  $j = \{m, n\}$ , where  $m =$  money and  $n =$  (mosquito) nets. Furthermore, let  $f_i$  denote the fraction of donors belonging to group  $i$ , where  $i = \{s, a, sp, wp, p\}$ . We consider the  $(1 - f_s)N$  experiment subjects<sup>17</sup> who are non-selfish (i.e., altruistic) and we let  $prob(p)$  denote the probability of such a donor being a paternalist ( $p$ ) and not purely altruistic ( $a$ ). Similarly, consider the  $(1 - (f_s + f_{wp}))N$  experiment subjects and let  $prob(sp)$  denote the probability of such a donor being a strong paternalist ( $sp$ ) and not purely altruistic ( $a$ ).

We have the following four hypotheses:

**Hypothesis 1:** Donors exhibit paternalistic preferences implying that mean donations of mosquito nets are positive. We test the null hypothesis that  $\mu_n = 0$ .

**Hypothesis 2:** Mean donations of mosquito nets are higher than mean donations of money. We test the null hypothesis that  $\mu_m = \mu_n$ .

**Hypothesis 3:** The probability is higher that a non-selfish donor is paternalistic rather than purely altruistic. We test the null hypothesis that  $prob(p) = 0.5$ .

**Hypothesis 4:** The probability is higher that a non-selfish donor is strongly paternalistic rather than purely altruistic. We test the null hypothesis that  $prob(sp) = 0.5$ .

Before presenting the results in section 5, we discuss specific features of the experimental design.

**4.2. Design Concerns.** Three key design features deserve to be highlighted: (i) the within-subject treatment design; (ii) the choice of the tied transfer; and (iii) the composition of the recipient households.

(i) We used a double-blind within-subject treatment design, which implies that a single subject is observed choosing between several alternatives. A first advantage of this design is that the subject serves as his own control group. Such a design is statistically more powerful than a between-subject design since it automatically controls for individual differences (Camerer 2003). A second advantage is that the within-subject design imposes a direct choice between a tied transfer and money. Thus, it makes

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<sup>17</sup>  $N =$  total number of observations ( $N = 48$ ).

it possible to categorize subjects according to their behavior in the experiment. The alternative would have been a between-subject design, where the subjects in treatment one were asked to donate money and subjects in treatment two were asked to donate mosquito nets. We would then have compared the mean donations in the two groups. However, in treatment two, mosquito nets would be the only possible donation and all altruistic subjects would have to make a tied transfer. Since they would not have had any choice, it would be difficult to label them as paternalistic.

(ii) To identify paternalistic preferences, the recipients need to have revealed preferences for money over the tied transfer. This is the case if we can find a tied transfer which is widely available but not bought by the recipients. In other words, the willingness to pay for the tied transfer should be positive but below the market price. Specifically, the tied transfer had to meet the following criteria:

- (1) Health-related;
- (2) Willingness to pay should be positive but below the market price;
- (3) Widely available and easily accessible (i.e., no prescription drugs);
- (4) No externalities (i.e., the chosen health-related good should be associated with a non-communicable disease): if the donated health good has positive external effects, a tied transfer might be better than donating the equivalent amount of money, since more than one household will benefit from the donation.

Insecticide treated nets (ITNs)<sup>18</sup> protecting individuals from malaria meet all these requirements. Studies show that the willingness to pay for mosquito nets is positive, but below the market price (Onwujenwe et al. 2000, 2003, Guyatt et al. 2002). Moreover, mosquito nets are widely available at local supermarkets and pharmacies in this part of Zambia. An insecticide treated mosquito net costs 30 000 kwacha, which is approximately US\$ 6.50. The households have chosen not to buy nets despite availability and a high prevalence of malaria. Thus, we can conclude that the households have revealed preferences for money. A monetary transfer ensures that a household's preferences are respected.

Furthermore, malaria is not directly communicable between humans: it is transmitted through a bite by the Anopheles mosquito. Treating patients suffering from malaria will reduce the prevalence of malaria-carrying mosquitoes in an area creating a positive external effect. Mosquito nets, on the other hand, prevent humans from catching the disease in the first place. Even if there were a small negative effect of mosquito nets on the number of malaria-carrying mosquitoes, it would be negligible in this setting where a maximum of 50 households receive nets in an area of 25 000 inhabitants.

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<sup>18</sup> What we hitherto have labeled, and will continue to label, "mosquito nets".

(iii) Participating households were recruited according to the following criteria:

- (1) They should not possess any mosquito nets prior to the experiment, and they had to commit to using any mosquito nets donated to them in the experiment.
- (2) Each household should consist of at least four individuals, to ensure that it would be reasonable to donate more than one net. (Note that two persons easily can sleep under one mosquito net.)

Permission to recruit households were sought and given by the village chief. Before consenting to participate, the households were informed about the study and the possible outcomes, including the possibility of receiving no donation at all.

**4.3. Questionnaire data.** A questionnaire allows us to observe donors' characteristics and motives for giving or not giving to foreign aid.<sup>19</sup> The questionnaire was filled out anonymously by the dictators after having chosen how to divide the money but before they left the room. (The full questionnaire is available in the appendix.)

The main purpose of the questionnaire was twofold. We wanted to address the relationship between donor characteristics and the choice of donation (i.e., the donated amount and the choice between transferring money and mosquito nets). Furthermore, our purpose was to assess whether subjects donated mosquito nets because they mistakenly believed there to be positive externalities associated with nets.

Those who only gave mosquito nets had the following four mutually exclusive alternatives to motivate their choice (where the third alternative was added to control for positive externalities):

- (1) I care more about the health of the household members than about other aspects of their situation;
- (2) By giving mosquito nets, the household receives a good it needs at the same time as I make sure that the money is not used to buy goods I believe might be harmful (such as tobacco and alcohol);
- (3) I believe that the mosquito nets can have positive effects for other persons than the ones using the nets; and
- (4) None of the above is consistent with my reasons for only donating money. Instead I motivate my choice in the following way... (to be filled out by the subject).

No subject chose the third alternative. The subjects seem to have accurately realized that giving mosquito nets to a very small fraction of the inhabitants in a village will not affect the overall prevalence of malaria-carrying mosquitoes in the area.

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<sup>19</sup> Breman and Granström (2008) provide an overview of donor characteristics and their effects on charitable giving (using a different yet similar data set).



**4.4. Statistical Tests.** Experimental bargaining data tends to be highly skewed, and our data is no exception. In these cases, the traditional parametric approach is not appropriate. Bootstrapping techniques have proven a powerful tool in dealing with this kind of data. They involve the creation of pseudoreplicate data sets by resampling. Thus, bootstrapping allows for testing without imposing normality on the data, that is, by inferring the underlying distribution that has generated the data (see Efron and Tibshirani 1993, Mooney and Duval 1993).

To test hypothesis 1 and hypothesis 2 regarding mean offers conditional on type of donation, we thus use bootstrapping techniques. Reported significance levels have been obtained using 5,099 resamples. Moreover, for comparison we provide results from the non-parametric Wilcoxon signed-ranks test for paired data and an ordinary t-test.

To investigate whether the probability that, for instance, a non-selfish donor displays paternalistic behavior differs from the probability that he displays purely altruistic behavior, we use a binomial probability test.<sup>20</sup> For non-selfish donors, the choice between paternalistic and purely altruistic behavior can be described as a Bernoulli trial: a donor is either a paternalist (a "success" or 1) or a pure altruist (a "failure" or 0). In this case, it is possible to use a binomial test to investigate whether the probability of being of a certain donor type significantly differs from the probability of being of another donor type (see e.g., Siegel and Castellan, Jr. 1988, ch. 4, Davis and Holt 1993, ch. 9). Thus, we use the binomial probability test on hypotheses 3 and 4.

## 5. Results

We conducted the experiment in January 2005 at the Stockholm Institute of Education. 52 subjects participated in the two sessions of which two received blank notes of paper and two were chosen to be monitors. The total number of observations was thus 48.

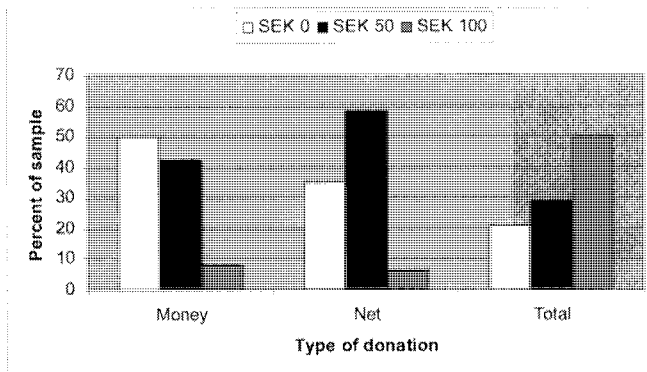
**5.1. Experimental results.** Figure 1 presents the distribution of donations in the experiment for the various types of donations. Table 2 shows experiment results (mean donations) depending on the type of donation while Table 3 presents results depending on donor type. Some descriptive statistical findings stand out.

Almost 80% of the subjects donated a positive amount, the majority of which donated the maximum amount of SEK 100. Hence, the mean donation for the total sample is high at 65%. Yet, of greater important to us here is the paternalistic behavior

<sup>20</sup> We do not test whether fractions of different types of donors (such as  $f_p$  and  $f_a$ ) significantly differ from each other. The reason is that we have paired data, whereas tests such as Pearson's chi-squared test and Fisher's exact test require two independent samples (see e.g., Siegel and Castellan, Jr. 1988, ch. 6).

of donors. The mean donation of mosquito nets (35%) points to the influence of paternalistic preferences on donor behavior. Indeed, the mean donation of mosquito nets is higher than the mean donation of money (29%).

FIGURE 1. Distribution of donations



Studying the shares of different donors in the experiment reinforces this picture. Paternalistic donors constitute 65% of all experiment subjects, whereas purely altruistic donors constitute 15% of the sample. In the sub-set of altruistic donors, 82% display paternalistic behavior and only 18% qualify as pure altruists. Finally, in the sub-set of paternalists, nearly half the donors (45%) behave as strong paternalists, that is, they only donate mosquito nets.

TABLE 2. Mean donations conditional on type of donation

	Type of donation		
	Money	Mosquito nets	
Number of observations	48	48	
Mean Donation	29.2	35.4	
STD of donation	32.3	29.1	
<b>H<sub>1</sub>: Mosquito nets versus zero</b>			
	Bootstrap test	t-test	Wilcoxon
p-value	<0.001	<0.001	<0.001
<b>H<sub>2</sub>: Mosquito nets versus money</b>			
	Bootstrap test	t-test	Wilcoxon
p-value	0.350	0.360	0.188

Note: All p-values are two-sided.

We test the four hypotheses presented in section 4.1. The results for hypothesis 1 and hypothesis 2 regarding mean offers conditional on type of donation are reported in Table 2 (all p-values are double-sided). The results for hypotheses 3 and 4 concerning the probability that a donor is of a certain type are reported in Table 3.

The mean donation of mosquito nets is significantly higher than zero. Using the bootstrap test on hypothesis 1, we can reject the null that the mean donation of mosquito nets equals zero ( $p < 0.001$ ).

Testing hypothesis 2 using bootstrapping, the null cannot be rejected ( $p = 0.350$ ). Hence, we cannot reject that the mean donations of money and mosquito nets are the same.

Using the binomial probability test on hypothesis 3, we can reject the null that it is equally likely for an altruistic donor to be a pure altruist as a paternalist. The probability of paternalistic behavior ( $\hat{prob}(p) = 0.816$ ) is significantly ( $p < 0.001$ ) higher than the probability of purely altruistic behavior ( $\hat{prob}(a) = 0.184$ ). When testing hypothesis 4, finally, we cannot reject ( $p = 0.189$ ) the null that the probability of being a strong paternalist ( $\hat{prob}(sp) = 0.667$ ) equals the probability of being a pure altruist ( $\hat{prob}(a) = 0.333$ ).

TABLE 3. Share of donors in different categories

Donor Type	Selfish	Pure altruist	Paternalist	Weak paternalist	Strong paternalist
No. of observations	10	7	31	17	14
% of total sample	20.8%	14.6%	64.6%	35.4%	29.2%
% of altruists	-	18.4%	81.6%	44.7%	36.9%
% of paternalists	-	-	-	54.8%	45.2%
<b>H<sub>3</sub>: Probability of being paternalistic</b>					
Binomial test	$prob(p) = 0.5$				
$\hat{prob}(p)$	0.816				
p-value	$< 0.001$				
<b>H<sub>4</sub>: Probability of being strongly paternalistic</b>					
Binomial test	$prob(sp) = 0.5$				
$\hat{prob}(sp)$	0.667				
p-value	0.189				

Note: All p-values are two-sided.

We conclude that there is strong evidence of paternalistic preferences in foreign-aid giving. Many donors do not only care about the overall well-being of recipients, but

also about their specific consumption pattern. That is, paternalistic donors provide recipients with mosquito nets, even if the recipients have revealed preferences for the monetary transfer.

**5.2. Questionnaire data.** Exit questionnaires were mainly used to address the following three issues. First, whether there are significant relationships between donor characteristics and the amount donated to the recipient. Second, whether mosquito nets were – mistakenly – associated with positive externalities. Third, what chief motivations participants gave for their choices of donation. Below, we consider each topic in turn.

TABLE 4. Summary of questionnaire data

Variable	Outcomes			
	Women	Men	Total	
Gender				
% of sample	68%	32%	100%	
Mean donation	69%	59%	66%	
Age	19-29	30-39	40-45	
% of sample	66%	20%	14%	
Mean donation	58%	70%	100%	
Frequency giving	Never	Sometimes	Regularly	
% of sample	28%	46%	26%	
Estimated aid share*	Mean	Median	Mode	True value
Percent of GDI	5.8%	3.0%	5.0%	0.88%
Most important factor for aid	Effective	Influence	Recipient Known	Proximity
% of sample	74%	24%	2%	2%

Base sample: n=50, (\*n=48)

Summary statistics for the questionnaire data on attitudes to foreign aid and donor characteristics are presented in Table 4. Note that donations, on average, are higher for women than for men and seem to increase with age. When we run OLS regressions with total donations as the dependent variable and donor characteristics as explanatory variables, it turns out, however, that the difference between female and male donors is

not statistically significant. Donations do not seem to be affected by the attitude to foreign aid either. Yet, age has a statistically significant effect on donations.<sup>21</sup>

TABLE 5. Self-reported motives for observed behavior

Donor Type	Questionnaire answer			
Pure Altruist	Freedom	Efficiency	Other Priorities	Other
% of category	71%	0%	29%	0%
Strong paternalist	Health	Give needed good & avoid harmful goods	Positive Externalities	Other
% of category <sup>22</sup>	13%	69%	0%	25%
Weak paternalist	No information	Equal importance	Other	
% of category	6%	71%	24%	
Selfish	Foreign aid skepticism	Need money themselves	Regular donor	Other
% of category	13%	38%	25%	25%

Note: Percentages may not sum to 100 due to round-off error.

Regarding the motives for giving mosquito nets versus money, our primary concern was to ensure that mosquito nets were not associated with positive externalities. As shown in Table 5, no subjects stated this as the reason for donating only mosquito nets. The remaining results are difficult to interpret, however, due to mutually exclusive response alternatives. Nevertheless, 11 subjects (69% of the strong paternalists) state that they want to contribute to something useful at the same time as they ensure that the money is not used for something harmful (such as tobacco or alcohol), while two (13%) state that they care more about health than other aspects of the recipient's welfare and four (25%) state other reasons.

How do purely altruistic donors motivate giving money only? A majority thinks it is important as a principle that households are free to choose how to use the donation (71% or 5 subjects), which can be seen as anti-paternalistic. Surprisingly, no one says that it is more efficient if the households can choose for themselves how to use the money, which is economists' main argument against paternalism. Finally, among those

<sup>21</sup> Across several specifications, average donations increase by fully SEK 2 per year of age ( $p < 0.01$ ). This result should be interpreted with caution, since we do not control for income (although in the population of Swedish students, it is reasonable to assume a fairly compressed income distribution). Nevertheless, altruism has been found to increase with age in other studies (see Camerer 2003).

donors who both give away money and a mosquito net, the preferred explanation is that the households need both money and mosquito nets (71% or 12 subjects). Only one person (6%) states that he/she did not have enough information to choose between the two alternatives.

## 6. Concluding Remarks

The experiment shows that paternalistic rather than purely altruistic preferences dominate foreign aid giving of individuals. While purely altruistic donors only care about recipients' utility and respect their preferences, paternalistic donors prefer recipients to consume a particular good, such as health care, to others. Health-focused paternalism is sufficiently strong for many donors to ignore the revealed preferences of recipients. The average tied donation (35.4%) differs significantly from zero. Paternalistic altruists constitute 65% of the total sample, whereas purely altruistic donors only constitute 15%.

Our results are in line with Jacobsson et al. (2007) who find strong evidence of health-focused paternalism in within-country giving. One difference is that the fraction of paternalistic donations is higher in their experiment (between 82% and 91%). There are two plausible reasons for this. In our experiment, the very low incomes of recipients made it reasonable to assume that cash transfers would be used to buy subsistence goods, i.e., goods that almost certainly have a positive impact on health. Second, many donors may have chosen not to donate two mosquito nets, since they believed the marginal utility of a second net to be low.

What do our results suggest for future research? The questionnaire gives some insights into what drives paternalistic behavior and future research could deepen our understanding of this phenomenon. Furthermore, this paper is limited to health-focused paternalistic altruism, and it would therefore be valuable to see if the results hold for other types of foreign aid such as education or food support.

What are the policy implications of paternalistic preferences in the context of foreign aid? First, they help explain the history of paternalistic policies, such as conditional aid and tied transfers, observed in foreign development assistance. Second, they suggest that some donors will only contribute to foreign aid conditional on being able to influence how donations are used. This may, in turn, affect the overall level of foreign aid in two opposing directions.

On the one hand, it may threaten public support for foreign aid and risk reducing its overall level as several countries are in the process of substituting project aid, which is driven by donor preferences, with program aid (e.g., general budget support), which gives the recipients more freedom to decide on resource allocation (Sida 2008). This

is a move away from traditional paternalistic policies towards more purely altruistic foreign-aid policies.

On the other hand, health-focused paternalism can facilitate the raising of funds for health-related aid projects.<sup>23</sup> A growing number of global initiatives in health, such as the Global Alliance for Vaccines and Immunization, the Global Fund to Fight AIDS, Tuberculosis and Malaria, and the Medicines for Malaria Venture, are already taking advantage of the high willingness to contribute to this type of foreign aid.

It has recently been argued that health improvements give rise to important positive externalities and, therefore, spur economic growth in developing countries (Arrow 2004, Bloom et al. 2004, UN Millennium Project 2005). If donors have paternalistic preferences for health, as suggested by our results, the case for health-related foreign aid is even stronger. Health-focused paternalism may hence justify public sector investment in research and the development of drugs targeting the diseases of the poor,<sup>24</sup> such as malaria.

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<sup>23</sup> Arrow (2004, p.21) notes that donors "...are clearly more willing to give to overcome disease than for other reasons."

<sup>24</sup> Such initiatives are advocated by Arrow (2004). Alternative related solutions, e.g., drug purchase commitments (see Kremer 2002), may be justified on the same grounds.

## Appendix A

### EXPERIMENT INSTRUCTIONS

#### **To the participants in an economics experiment:**

You have agreed to participate in this study which will take approximately 45 minutes to carry out. For your participation, you are paid SEK 50. You may also earn some additional money (at the maximum, another SEK 100).

Each and everyone in the room (except the monitor and one additional person, see below) will have to decide how to allocate SEK 100 between him/herself and an anonymous household in Zambia. The donation to the recipient household may either be given as money (which the recipient household may use for whatever it prefers) or as insecticide treated nets (against malaria mosquitoes). The total amount of money and/or mosquito bednets that you give away, will be given to a single household in Zambia which has agreed to participate in this study. Which of the anonymous households that will receive your possible donation will be randomly decided after the experiment. There is no possibility to trace a donation given to one of the participating households back to you.

In Zambia, gross domestic income (GDI) is US\$ 380 per person and year (in Sweden, GDI/person is US\$ 28,840 per year). The public health budget in Zambia corresponds to US\$ 10 per person and year. Life expectancy is 37 years. Infant mortality is 102 per 1000 live births. The most common infectious diseases are malaria, typhoid fever and HIV.

The recipient households have been recruited by Jesper Sundewall (bilateral deputy expert at Sida<sup>25</sup> in Zambia) and Felix Masiye (researcher at University of Zambia). The households consist of at least four individuals and they live in an area where malaria is common. These households have chosen not to buy malaria bed nets since they consider bed nets too expensive. They have agreed to use the mosquito nets donated to them in this study.

Malaria is a life threatening parasitical disease transmitted by the Anopheles mosquito. Insecticide treated mosquito nets are proven effective in preventing people from getting malaria. For example, a WHO study shows that insecticide treated mosquito nets reduce child mortality by 20%. Mosquito nets are purchasable in ordinary shops and pharmacies in Zambia. A mosquito net costs approximately 30,000 kwacha (Zambian currency) which is equivalent to SEK 44 according to the exchange rate as of January 10th, 2005. A donation of SEK 50 covers the cost of a mosquito net including

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<sup>25</sup> The Swedish International Development Agency.



the exchange rate fee. Similarly, each household receives 30 000 kwacha for each SEK 50 bill that is donated in the form of money.

One of you will be chosen to monitor the experiment. The monitor will be paid SEK 100 in addition to the SEK 50 he or she has already received. The monitor will be in charge of the envelopes mentioned below. In addition to that, the monitor shall verify that the instructions have been followed as they appear here.

The experiment is conducted as follows. Unmarked envelopes corresponding to the number of participants have been placed in a box. All of these except one contain two SEK 50 bills and four blank slips of paper of the same size. The remaining envelope contains six blank slips of paper. Moreover, all envelopes contain two smaller envelopes marked "money" and "mosquito nets", respectively. The monitor will call one person at a time and hand over an envelope from the box. The person will take the envelope and go behind screen number one. The envelope will then be opened behind the screen where no one else can see what happens.

When you have opened the envelope you have to decide how many bills and how many slips of paper to put in the two smaller envelopes marked "money" and "mosquito nets". The number of bills and slips of paper that are put into each of the two smaller envelopes must add up to two. You then pocket the remaining slips of paper and bills (they should total two). Example: (1) Put SEK 50 and one slip of paper in the envelope marked "money", put two slips of paper in the envelope marked "mosquito nets" and pocket SEK 50 and one slip of paper. (2) Put SEK 0 and two slips of paper in the envelope marked "money", put SEK 0 and two slips of paper in the envelope marked "mosquito nets" and pocket SEK 100 and zero slips of paper. These were nothing more than examples. The actual decision is up to you. No one else will know your decision.

Once you have made your decision, you shall seal the two small envelopes marked "money" and "mosquito bed nets" and put these two envelopes in the larger envelope which you also seal. Then, place this envelope in the box marked "returned envelopes". You then proceed to screen number two where you anonymously fill out a questionnaire with questions concerning the experiment. You then place the questionnaire in the box marked "questionnaires". The experiment is then over for you and you may leave the room.

After all envelopes have been returned, the monitor will open the envelopes in a random order and record the content of each envelope. Each household is only identified by a number from 1 and onwards. The donation in the first envelope to be opened is matched with household number one, the donation in the second envelope to be opened is matched with household number two, and so on, until all envelopes have been opened and each donation has been noted and matched with each and everyone

of the participating households. The donations are recorded on two identical lists. The monitor will keep one of the lists. The aim is to allow the monitor to verify that the total donated amount in form of mosquito nets and money to the respective households equals the amount stated in the certificate that will be sent out by Jesper Sundewall at Sida as soon as the donations have been transferred to the households.

The total donated amount in the experiment will be transferred to Jesper Sundewall in Zambia, who will change the money to Zambian kwacha. For each SEK 50 put in the envelope marked "mosquito nets" he will buy one mosquito net. Each SEK 50 put in the envelope marked "money" is transformed into 30 000 kwacha. Jesper Sundewall and Felix Masiye (University of Zambia) will then distribute the mosquito nets and the money to the respective households in the experiment. The amount of money that is given to the households from the envelopes marked "money", the households are free to use as they want. After the delivery (of money and mosquito nets), Jesper Sundewall will send a certificate via e-mail to the monitor where he accounts for how much money and how many mosquito nets that have been delivered to each household. The experiment is then over.

## Appendix B

### QUESTIONNAIRE

#### Some questions to you who participate in this experiment

We kindly ask you to answer some short questions regarding the experiment that you are participating in. As you have probably already understood, your answers are impossible to track. We therefore ask you kindly to answer the questions below truthfully. Thank you in advance.

1. First, state whether you are a man or a woman

Woman

Man

2. State your age:

3. Circle the sum of money you donated to the recipient in the preceding experiment  
a) in the form of money

0 SEK            50 SEK            100 SEK

b) in the form of malaria mosquito nets

0 SEK            50 SEK            100 SEK

4. How often do you donate money to a charitable organization?

Never         A few times per year         Regularly every month

5. Please estimate the share of Swedish gross domestic income (GDI) that goes to foreign aid each year: \_\_\_\_\_

6. What is your opinion on the share of the Swedish GDI that goes to foreign aid each year?

too small             about right             too large

7. Which single factor do you consider to be the most important for Swedish foreign aid to fulfill? (Choose one alternative)

that the aid is effective

that the aid goes to people that are geographically close to us

that the donor can influence what the money is used for (e.g., education, health care)

that the recipient's identity is known to the donor

Finally, if you have chosen to donate money and/or mosquito nets to the recipient in the experiment, we want you to answer question 8. If you have chosen not to give anything, we want you to instead answer question 9 below.

8. (Only to be answered if you did donate money and/or mosquito nets.)

If you only donated money you answer question a) below, if you only donated mosquito nets you answer question b), and if you donated both money and mosquito nets you answer question c). Each question contains a number of suggested motivations for your choice. Choose one alternative. If there are several alternatives that are in line with your motivation, pick the alternative that best describes how you were thinking at the time of your choice.

a) I donated only money because

I believe it gives the household the greatest possible freedom to use the donation the way it considers the best, which is important in principle.

I believe that it is more efficient if the household decides for itself how to use the money.

It gives the household the possibility to prioritize other things that I consider to be more important than fighting malaria.

None of the above is consistent with my reasons for donating money only. Instead I motivate my choice in the following way:

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b) I donated only mosquito nets because

I care more about the health of the household members than about other aspects of their situation.

By giving mosquito nets, the household receives a good it needs at the same time as I make sure that the money is not used to buy goods I believe might be harmful (such as tobacco and alcohol).

I believe that the mosquito nets can have positive effects for other persons than the ones using the nets.

None of the above is consistent with my reasons for only donating money. Instead I motivate my choice in the following way:

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c) I donated both money and mosquito nets because

I consider that I have too little information to be able to choose between the two alternatives.

I find that money and bed nets are equally important and I want to contribute in both cases.

None of the above is consistent with my reasons for only donating money. Instead I motivate my choice in the following way:

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9. I donated nothing because

I did not receive any money, only blank slips of paper. (double-blind treatment)

I do not believe in foreign aid.

I need the money myself.

I give regularly to charity through other organizations.

None of the above is consistent with my reasons for not donating money. Instead I motivate my choice in the following way:

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The experiment is now over. Thank you for participating.



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## PAPER 2

# Corruption and the Case for Tied Aid

with Anna Breman

**ABSTRACT.** Tied project aid is often said to suffer from allocative inefficiency, yet it seems to benefit from strong donor support. One reason may be that tied aid is perceived as less corrupt than untied program aid. We present a simple model where perceived aid diversion can induce tied transfers. In a dictator game, we then compare the willingness to make a monetary contribution to Zambia's national health budget (CBoH) with the willingness to make a tied transfer (mosquito nets) to a health-care clinic (KC) in Lusaka. Donors clearly prefer tied aid to untied program aid. First, the mean tied donation to KC (SEK 44) is highly positive. Second, it is significantly higher than the mean monetary transfer to CBoH (SEK 26). Third, the fraction of donors who give at least one net to KC (65%) is significantly higher than the share only giving money to the CBoH (16%). Exit questionnaires suggest that the reason is a fear of corruption and misallocation at the CBoH. Our experiment indicates that reducing developing country corruption could benefit aid recipient countries in two ways, increasing both allocative and productive aid efficiency.

Keywords: Foreign Aid; Aid efficiency; Project aid; Program aid; Dictator Game; Altruism.

JEL: C72; C91; D64; F35.

"... if we want the taxpayers of donor nations to be more generous with what they do, they need some convincing that the aid they give is used effectively, and the record there could be improved..."

– Paul Wolfowitz, Former president of the World bank, March 31, 2005, from *Newshour* on PBS

"... even hard-boiled cynics would agree that bed nets will not end up in offshore bank accounts, as can happen with cash assistance."

– Jeffrey D. Sachs (2005)

## 1. Introduction

Foreign development assistance typically comes as either project or program aid. Project aid involves the execution of a specific project: the building of a school or a bridge; the drilling of wells; or the fight against malaria. Program aid involves a financial transfer to the recipient, the allocation of which is entirely or partially left to the recipient (depending on whether general or sector budget support is provided).<sup>1</sup> Whereas project aid consists of tied transfers, program aid does not.<sup>2</sup>

Project aid is often frowned upon by economists and development assistance professionals. One early objection was that it may prove difficult to identify aid with any one project due to feedback effects among various aid projects (Singer 1965). More recent critiques concern high transaction costs (e.g., Quartey 2005) as well as foreign aid fungibility, which means that the discretionary power over the use of project funds often is illusionary (Hefeker 2005, Feyzioglu et al. 1996, Pack and Rothenberg Pack 1993). Yet, arguably the chief objection to project aid is that it is inefficient. Whereas tied aid puts a constraint on the affordable market baskets of the recipient, untied program aid should maximize allocative efficiency. Untied aid should thus be preferable to tied project aid.<sup>3</sup>

Despite this, project aid has historically been the dominant form of foreign aid (Kanbur 2003). Tying aid to specific projects may in fact be required to rally support for foreign development assistance (Singer 1965).<sup>4</sup> One explanation is that project aid is perceived as less corrupt than program aid.<sup>5</sup> Project aid is, as the above quote of Jeffrey Sachs implies, simply less easy to divert due to its illiquid nature.<sup>6</sup>

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<sup>0</sup> We thank Pär Eriksson, Felix Masiye and Jesper Sundewall for their help on the field in Zambia, and Peter Gustafsson and Fredrik Wilander for help in carrying out the experiment. Valuable comments from Ola Andersson, Erik Höglin, Magnus Johannesson, Sendhil Mullainathan, and Erik Wengström are appreciated, as well as from seminar participants at Harvard University, Lund University and the Stockholm School of Economics. We also thank Jan Wallander and Tom Hedelius Stiftelse for financial support.

<sup>1</sup> Program aid is sometimes referred to as horizontal foreign aid and project aid as vertical foreign aid.

<sup>2</sup> With *tied* transfers we imply foreign aid that is tied to a specific project or a specific good. We do not refer to the tying of, say, U.S. foreign aid to the recipient country's procurement of U.S. goods (see Quartey 2005, Radelet 2002). Neither do we imply conditional aid.

<sup>3</sup> Svensson (2000) provides a competing view, however. He shows that tied aid may be efficient if there exists problems with time-inconsistency.

<sup>4</sup> Project aid may well have other positive effects, such as strengthened local institutions and improved service delivery (World Bank 1998). See also Radelet (2005, 2002) and Singer (1965).

<sup>5</sup> Strong donor support for project aid may have other explanations. Breman and Granström (2008) show that donors who have paternalistically altruistic preferences prefer tied to untied foreign aid.

<sup>6</sup> This justification for project aid bears much resemblance to the rationale for providing in-kind finance. Hart (1995) fundamentally attributes the existence of in-kind finance to a risk for diversion

Untied budget support may thus be less efficient than economists generally assume, the reason being the risk that aid funds never reach the targeted recipients. In Cambodia, for example, health practitioners estimate that over 5% of the health budget is lost to corruption before even leaving central government (Transparency International 2006). Evidence from Kenya and Mexico shows that funds are often allocated to 'pet' projects – whether they are in line with official health policies or not. In Cameroon, Guinea, Tanzania and Uganda it has been estimated that 30% to 70% of government drugs disappear before reaching the patients (Easterly 2006, Ch. 7). As a consequence, one American study finds public support for foreign aid to be lukewarm due to perceived aid diversion by corrupt officials and aid inefficiency (PIPA 2001).<sup>7</sup>

Donor concerns with foreign-aid corruption and inefficiencies may affect the overall aid level as well as the choice between project and program aid. Yet, to our knowledge, there is no study of the preferences of individuals in this domain.<sup>8</sup> Systematic knowledge about donor concerns with program aid may help explain the widespread historical use of tied project aid. Also, as several donor agencies move away from project aid to program aid (Sida 2008, Quartey 2005), such knowledge should be highly policy-relevant. It may help improve foreign aid policies and raise voters' support for official development assistance.<sup>9</sup>

This paper experimentally examines the choice between project and program aid. We use a double-blind dictator game with a within-subject treatment design to investigate whether 47 Swedish subjects prefer to make a tied donation (mosquito nets) to a specified health-care clinic in Lusaka (the Kalingalinga Clinic, KC), rather than to make a monetary transfer to Zambia's national health-care budget as administered by the Central Board of Health (CBoH). Furthermore, we study to what extent the choice between project and program aid depends on the latter's perceived problems with corruption and misallocation.

Our experiment design resembles other dictator games on altruistic giving, such as Bohnet and Frey (1999), Hoffman et al. (1996) and Jacobsson et al. (2007). Yet a few design characteristics stand out. Our experiment concerns cross-country altruism as opposed to within-country altruism. Moreover, the recipients in this experiment are

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of funds. Burkart and Ellingsen (2004) show that when bank (cash) and in-kind (production input) credit are available and there is risk for credit diversion, creditors will provide in-kind finance. In-kind finance is illiquid by definition and therefore less easy to divert.

<sup>7</sup> Economist (2004, 2001) and Lloyd (2004) also provide evidence that donors care about foreign-aid inefficiency and corruption. See Kopczuk et al. (2005), too, who present a model where the fear of aid diversion plays an important role in explaining why cross-country altruism is so much weaker than within-country altruism.

<sup>8</sup> At the country level, however, Alesina and Dollar (2000) and Hook and Taylor (1998), among others, have investigated donor preferences in the domain of foreign aid.

<sup>9</sup> This support has been falling in recent years in, for instance, Sweden (Sida 2006).

institutions – not individuals (see Eckel and Grossman 1996). Finally, the experiment mimics real-life foreign-aid giving in two ways. The experimental design is realistic as all official Swedish health-related aid to Zambia is channelled to the CBoH budget. The way potential concerns with corruption enter the experiment also adds to its realism. Whereas we see to that donated mosquito nets are delivered to KC, monetary donations are transferred to CBoH’s account without any guarantee as to how the funds will be used. What is important here is the risk for aid corruption and inefficiency as perceived by donors.

We present a simple theoretical model showing how perceived aid diversion may influence the choice between tied and untied aid. Furthermore, the use of exit surveys permits us to better understand how donors motivate their choices.

Project aid clearly enjoys stronger donor support than program aid. The average tied donation to KC is SEK 44, which is significantly higher than the average monetary donation to the CBoH (SEK 26).<sup>10</sup> Moreover, the fraction of subjects who donate at least one mosquito net to KC significantly exceeds the share of donors who only make a cash transfer to CBoH. Exit surveys suggest that the reason why donors prefer tied aid to untied aid is a concern with corruption, misallocation and inefficiency associated with program aid.

The paper proceeds as follows. The following section presents a simple model to analyze donor behavior in the presence of perceived aid diversion. A third section presents the design of the experiment while the fourth gives the results. Conclusions are presented in the fifth and final section.

## 2. Theory: Donor Behavior under Perceived Aid Diversion

We present a simple theoretical framework for analyzing donor behavior in a foreign-aid setting characterized by (partial) perceived aid diversion. Whereas our model is highly stylized, it nevertheless allows us to identify three donor types and predict their behavior in the experiment.

There are two types of agents: donors,  $d$ , and recipients,  $r$ . Each donor is paired with a recipient, to which he may make a transfer; either a monetary or a tied transfer. A donor potentially gets utility from two sources: his own and the recipient’s consumption. The donor’s utility equals the sum of a concave function  $U^d$  of his consumption of a bundle of  $n$  goods,  $c^d$ , and  $\alpha \in [0, 1]$  times the concave function  $U^r$  of the recipient’s consumption of any transfer from the donor. The parameter  $\alpha$  captures the donor’s degree of altruism so that  $\alpha = 0$  characterizes a selfish donor.

We may state a donor’s utility maximization problem as

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<sup>10</sup> US\$ 1  $\approx$  SEK 7. SEK 100  $\approx$  US\$ 14 (at the time of the experiment).

$$(2.1) \quad \max_{c^d, g_i, \{m, t\}} U = \sqrt{c^d} + \alpha \sqrt{(1 - \delta_i) \beta_i g_i}$$

subject to the budget constraint  $w^d \geq p^d c^d + g_i$  where  $p^d$  is the price of the bundle of consumption goods,  $w^d$  is the wealth of the donor, and  $g_i \in [0, w^d]$  is the donor's gift (transfer) to the recipient.

Any gift  $g_i$  from the donor to the recipient comes in either tied or untied (monetary) form. This is captured by the index  $i = \{t, m\}$ , where  $t$  represents a tied donation and  $m$  represents money. A tied donation is a transfer of *one* specific consumption good in the bundle (e.g.,  $c_3$  or  $c_n$ ). Hence a donor may transfer either tied (project) aid or untied (program) aid.

Tied transfers constrain the recipient's consumption choice. Compared to monetary transfers, they may give rise to allocative inefficiency. The utility the recipient receives from a tied transfer is thus weakly inferior to the utility he receives from a monetary transfer.<sup>11</sup> We capture this by multiplying the gift with a coefficient  $\beta_i$  for  $i = \{t, m\}$ , where  $0 \leq \beta_t \leq \beta_m = 1$ .<sup>12</sup>

Any gift from the donor to the recipient is assured by a transfer technology which may or may not be perceived as secure. We model this by multiplying the gift  $g_i$  with the expression  $(1 - \delta_i)$  where  $\delta_i$  is a parameter of perceived aid diversion:  $\delta_i \in [0, 1]$  for  $i = \{t, m\}$ . If there is no perceived aid diversion,  $\delta_i = 0$ . A transfer technology that is seen as insecure, on the other hand, is characterized by  $\delta_i > 0$ . In this case a fraction of the transfer is perceived to be diverted by some third party (due to corruption or misallocation) and never to reach the targeted recipient. For simplicity, we assume that  $\delta_m \geq \delta_t = 0$ , so that a monetary transfer may be perceived as insecure (characterized by aid diversion) while a tied transfer is not. The reason is that a tied transfer is illiquid by nature and hence less easy (or appealing) to divert.<sup>13</sup>

Obviously the utility of the recipient depends positively on the transfer. A donor, however, is both positively and negatively affected by any transfer  $g_i$  made to the

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<sup>11</sup> The concave utility function guarantees that  $\frac{\partial^2 U}{\partial (c_1^d)^2} < 0$  where  $c_1^d$  represents a specific good in the bundle of consumption goods  $c^d$ . Utility is maximized by not only consuming good  $c_1^d$  but by diversifying the consumption. A monetary transfer allows for this, whereas a tied transfer, which is illiquid by nature, does not.

<sup>12</sup> This is of course a simplified way of expressing that the utility from the tied gift is weakly inferior to that of the monetary transfer. One may think of this as it being possible to transform a tied transfer into money – but only at a cost. That is, the resale price of  $g_t$  is weakly inferior to that of the equivalent money donation:  $\beta_t g_t \leq g_t$ .

<sup>13</sup> In a paper on the provision of in-kind versus bank credit, Burkart and Ellingsen (2004) make the same type of assumption: the two sources of external funding differ in their exposure to diversion of funds. One fundamental reason for this is the illiquid nature of in-kind credit (i.e., a tied transfer).

recipient. On the one hand, a transfer decreases the donor's utility as the gift decreases his own consumption. On the other hand, the transfer has a positive effect on the donor's utility, as it increases the recipient's utility.

The donor faces three simultaneous choices: what type of transfer to make (tied or untied), the level of his own consumption, and the level of the transfer. As the donor can make either a tied or an untied transfer, it is possible to separate these simultaneous choices and instead study two sequential choices. First the donor chooses whether to make a tied or a monetary transfer. Thereafter he chooses the level of the optimal transfer.<sup>14</sup> Below we study these choices in turn.

Consider the choice between the tied and the monetary transfer. This choice may be evaluated at a fixed level of transfer,  $\bar{g}_t = \bar{g}_m = \bar{g}$ . Clearly, the type of transfer chosen influences donor utility. A utility-maximizing donor will hence choose to make a tied transfer under the condition that

$$(2.2) \quad U^t - U^m = \sqrt{c^d} + \alpha\sqrt{(1-\delta_t)\beta_t\bar{g}_t} - \sqrt{c^d} - \alpha\sqrt{(1-\delta_m)\beta_m\bar{g}_m} \geq 0$$

which may be rewritten as  $\frac{(1-\delta_t)\beta_t\bar{g}_t}{(1-\delta_m)\beta_m\bar{g}_m} \geq 1$ . Now, since  $\bar{g}_t = \bar{g}_m$ , this simplifies to  $\frac{(1-\delta_t)\beta_t}{(1-\delta_m)\beta_m} \geq 1$ . Given that  $\delta_t = 0$  and  $\beta_m = 1$  by assumption, we may simplify the condition under which the donor makes a tied transfer further so as to have:

$$(2.3) \quad \beta_t \geq 1 - \delta_m$$

The donor chooses a tied transfer over the monetary transfer provided that the recipient's loss of value from a tied transfer is less severe than the amount of diversion caused by the monetary transfer. Hence, whenever the allocative inefficiency of a tied transfer is smaller than the productive inefficiency of a monetary transfer (i.e., the fraction of a monetary gift that is diverted), it is optimal to make a tied transfer.

In order to illustrate how this binary choice of transfer type is affected by various levels of aid diversion, we fix the allocative efficiency associated with the tied transfer as  $\beta_t = \bar{\beta}_t < 1$ . Consider first the case where  $\delta_m = \delta_t = 0$ . In this case an altruistic donor will always make a monetary transfer, since it is utility-maximizing. Also for positive but low levels of  $\delta_m$  the monetary transfer provides a higher utility to the recipient, and thus to the donor. Therefore the donor will still choose the monetary transfer over the tied transfer.

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<sup>14</sup> Note that the donor's choice of optimal transfer then fully determines his choice of own consumption.



For levels of perceived aid diversion above a certain threshold level,  $\delta_m^T$ , however, the utility-maximizing donor suddenly shifts from making a monetary transfer to making a tied transfer. For such high levels of aid diversion, the productive inefficiency of the monetary transfer overshadows its allocative efficiency, and a tied transfer becomes utility maximizing. Formally,  $\forall \delta_m > \delta_m^T$  we have that  $\bar{\beta}_t > 1 - \delta_m$ .

We now turn to determining the optimal transfer. It is possible to restate the utility-maximization problem in equation 2.1 as

$$(2.4) \quad \max_{c^d, g_i} U = \sqrt{c^d} + \alpha \sqrt{(1 - \delta_i) \beta_i g_i}$$

subject to the budget constraint  $w^d \geq p^d c^d + g_i$  for  $i = \{t, m\}$ .

Solving the maximization problem, we get the optimal transfer as

$$(2.5) \quad g_i^* = \frac{p^d \alpha (1 - \delta_i) \beta_i}{1 + p^d \alpha (1 - \delta_i) \beta_i} w^d$$

which means that the optimal transfer is some fraction of the donor's wealth. For what concerns comparative statics, we note that  $\frac{\partial g_i}{\partial \alpha} > 0$  and  $\frac{\partial g_i}{\partial w^d} > 0$  so that the transfer increases in altruism as well as in wealth. Furthermore, we have that  $\frac{\partial g_i}{\partial \delta_i} < 0$ , meaning that the transfer is decreasing in the level of aid diversion. Finally we have  $\frac{\partial g_i}{\partial \beta_i} > 0$ , so that a transfer increases when the allocative efficiency of the transfer rises.

The model allows for three different types of donors. Each type gives rise to a particular outcome. From equation 2.5 it is clear that a selfish donor will never make a positive transfer to the recipient. A positive transfer would decrease his own consumption. This would only diminish his overall utility, since he receives no positive utility from the recipient's consumption of the gift (i.e.,  $\alpha = 0$ ).

An altruistic donor, on the other hand, will make a positive donation to the recipient. Specifically, an altruistic donor who is not (sufficiently) concerned with aid diversion (i.e., a donor characterized by  $\delta_m \leq \delta_m^T$ ), chooses to make a monetary transfer. An altruistic donor who is (sufficiently) concerned with aid diversion (i.e., for which  $\delta_m > \delta_m^T$ ), on the other hand, makes a tied transfer.

Let us now turn to the experiment to see how this simple theoretical framework translates into actual donor behavior.

### 3. Experimental Design

The experiment was a double-blind n-donor dictator game carried out using a within-subject treatment design. Two separate sessions were conducted with around

25 participants respectively. In each of these two sessions, the donors were matched with the following two recipient institutions: Central Board of Health (CBoH) and Kalingalinga Clinic (KC) in Lusaka. The dictators, recruited among the undergraduate students at the Stockholm Institute of Education<sup>15</sup>, were randomly selected into the two sessions.

When subjects arrived to the experiment, they were given a SEK 50 show-up fee, and were asked to sit and read the instructions quietly without interacting with any of the other subjects. When all subjects had arrived, the instructions were read out by the experiment leader and one student was chosen to be the monitor.<sup>16</sup> The monitor handed out opaque envelopes which, in all but one case, contained two SEK 50 bills (i.e., SEK 100)<sup>17</sup>, as well as four pieces of paper (of equal size as the money bills).<sup>18</sup> The last envelope contained no money bills, only six pieces of paper as customary in double-blind dictator games. One subject at a time went behind a screen to make a choice on how to divide the money between himself/herself and the recipient institution. The subject then moved to a second screen behind which he/she anonymously filled out a questionnaire about the experiment. Then the subject was free to leave.

When all subjects had made their decisions and filled out the questionnaire, the monitor opened each envelope together with the instructor and took note of the results on two different forms. On these forms were also recorded the total amount donated to CBoH as well as KC, and the name and e-mail address of the monitor. One of the two forms was kept by the monitor in order for him/her to be able to verify that the donated amounts were actually transferred to the two respective recipients (verification was done based on a certificate issued after delivery, see below).

The money donated to KC was transferred to the account of Jesper Sundewall, Junior Professional Officer at the Swedish International Development Agency (Sida) in Lusaka, Zambia. He withdrew the sum in kwacha and purchased mosquito nets which he personally delivered to KC in Lusaka. After the delivery, Jesper Sundewall sent an electronic certificate to the monitors of each session, stating what amount had been received from the experiment and testifying that all the purchased mosquito nets had

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<sup>15</sup> Stockholm Institute of Education is a teaching college with approximately 15,000 students enrolled in bachelor's and master's programs.

<sup>16</sup> By reading the instructions out loud, the participants were able to verify that they had all received identical instructions. The task of the monitor was to see to that the experiment was executed exactly as stated in the instructions.

<sup>17</sup> US\$ 1  $\approx$  SEK 7. SEK 100  $\approx$  US\$ 14 (at the time of the experiment).

<sup>18</sup> The blank pieces of paper ensure that all envelopes are of equal thickness. A donor that keeps all or some money to himself will substitute the money with the pieces of paper so that the returned envelope is not empty.

been delivered to KC. All this was clearly stated in the instructions so that the subjects would not have any doubts about the accuracy of the experiment.

The entire amount of money donated to CBoH was transferred to the CBoH account via Pär Eriksson at Sida in Lusaka, to add up to the national health budget in Zambia. CBoH's chief accountant certified that the donated amount had been registered on their account, and this certificate was e-mailed to the monitors in the experiment.

Subjects were all exposed to the same treatment. Each dictator faced two consecutive decisions. First, how much out of the SEK 100 to keep for himself and how much to donate to the recipient(s). Thereafter, in case of a positive transfer, whether to donate 1) money to CBoH, 2) mosquito nets to KC or 3) both money to CBoH and mosquito nets to KC. (The complete instructions for the experiment are found in the Appendix). Hence, a within-subject design was used for the experiment.<sup>19</sup>

**3.1. Hypotheses.** We test whether donors prefer giving project aid to program aid. Whereas project aid is tied to mosquito nets donated to KC, program aid consists of an untied monetary transfer to the CBoH budget (i.e., budget support).

We label donors who make a zero donation *selfish* ( $s$ ). All other donors are considered altruistic. Yet altruistic donors differ as to how they make their donation. There is the group of donors who make at least part of the donation in the form of mosquito nets to KC. We say that such donors make a *tied* ( $t$ ) transfer. Other donors only make a monetary or *untied* ( $u$ ) transfer to CBoH. These two groups are mutually exclusive. Finally, there exist two sub-groups among the donors who make a tied transfer. The first sub-group is made up of the donors who transfer *only nets* ( $on$ ) to KC (and no money to CBoH). The second sub-group consists of those who make a *mixed* ( $m$ ) transfer, that is, who give one mosquito net to KC and SEK 50 to CBoH.

Let  $\mu_j$  denote mean donations to  $j = \{CBoH, KC\}$  where  $CBoH$  = Central Board of Health (money) and  $KC$  = Kalingalinga clinic (mosquito nets). Furthermore, let  $f_i$  denote the fraction of donors that belong to group  $i$ , where  $i = \{s, t, u, m, on\}$ .<sup>20</sup> We consider the  $(1 - f_s)N$  experiment subjects who are altruistic and we let  $Prob(tied)$  denote the probability that such a donor makes a tied donation to KC.<sup>21</sup> Similarly, consider the  $(1 - (f_s + f_m))N$  experiment subjects and let  $Prob(onlynets)$  denote the probability that such a donor only makes a tied donation to KC and not an untied transfer to CBoH only.

Let us consider the following four hypotheses.

<sup>19</sup> The within-subject design is discussed in more detail in the section on design concerns.

<sup>20</sup> Note that  $f_t = f_m + f_{on}$ .

<sup>21</sup>  $N$  is the total number of observations ( $N = 43$ ).

**Hypothesis 1:** The mean donation of project aid to KC is positive. We test the null hypothesis that  $\mu_{KC} = 0$ .

**Hypothesis 2:** The mean donation of project aid to KC is higher than the mean donation of untied aid to CBoH. We test the null that  $\mu_{CBoH} = \mu_{KC}$

**Hypothesis 3:** The probability is higher that an altruistic donor makes a tied transfer to KC than an untied transfer to CBoH only. We test the null that  $Prob(tied) = 0.5$ .

**Hypothesis 4:** The probability of an altruistic donor transferring only nets to KC is higher than the donor making an untied transfer to CBoH only. We test the null that  $Prob(only\ nets) = 0.5$ .

**3.2. Design Concerns.** It is worth highlighting four experiment design considerations: (i) the mimicking of real-world foreign-aid giving; (ii) the within-subject treatment design; (iii) the negligibility of any paternalistic preferences for health; and (iv) the choice of institutions as recipients.

(i) We mimic real-world foreign-aid giving at the individual level in this experiment.<sup>22</sup> As the experiment is designed, donors do not know whether aid is actually diverted at CBoH, and if so, to what extent. It is typically impossible to know the exact extent of aid diversion *ex ante*. What guides real-world donor behavior is thus perceived aid diversion – not necessarily actual aid diversion. Hence it would be misleading to use treatment groups where, say, 10%, 20%, and 30% of aid resources were diverted, respectively. Such a design would fail to teach us a lot about preferences of individual donors under real circumstances, while our experiment succeeds to do so. A recipient does not actually have to be more corrupt than another recipient for donor behavior to be affected, as long as donors believe this to be the case.

(ii) We use a double-blind within-subject treatment design, which implies that a single subject is observed choosing between several alternatives. A first advantage with this design is that the subject serves as his own control group. Such a design is statistically more powerful than a between-subject design because it automatically controls for individual differences (see Camerer, 2003). A second advantage is that the within-subject design imposes a direct choice between a tied transfer to KC and a monetary transfer to CBoH. It thus makes it possible to categorize the subjects according to their behavior in the experiment. The alternative would have been a between-subject design where the subjects in treatment one were asked to donate money to CBoH and subjects in treatment two were asked to donate mosquito nets to KC. We would then have compared mean donations in the two groups. However, in

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<sup>22</sup> Compare to e.g., Andreoni and Petrie (2004) who mimic the behavior of charitable organizations in a study of within-country giving.

treatment two, an altruistic donor would have had no choice but to donate mosquito nets to KC, even if he would have actually preferred to donate money to CBoH. It would have been difficult to say that such a donor displays a preference for tied aid.

(iii) It has been argued that donors may have paternalistically altruistic preferences, meaning that they care not only about the recipient's utility but also about his/her consumption pattern (see Pollak 1988). Jones-Lee (1990, 1991) introduced the concept of safety-focused paternalism meaning that individuals care about the safety of others more than other aspects of their well-being. Experiments have shown that paternalistic preferences for health are important in within-country giving (Jacobsson et al. 2007) as well as in foreign-aid giving (Breman and Granström 2008). To be able to say that tied transfers in this experiment are motivated by a preference for project aid over program aid due to a fear of aid diversion and misallocation, it was crucial to design the experiment so as to reduce the influence of any health-focused paternalistic preferences to a minimum.

Since donations to both recipients are earmarked for health-care consumption, we argue that potential health-focused paternalistic preferences will not affect the experiment results. It is impossible to deduce whether a donor will donate cash to CBoH or mosquito nets to KC just by knowing that he has health-focused paternalistic preferences. Specifically, there are no reasons to assume that health-focused paternalistic donors systematically care more or less about malaria prevention at a particular health clinic than about, say, child vaccination and the fight against HIV/AIDS in Zambia as a whole, to which CBoH allocates parts of its budget. Hence we may disregard paternalistic preferences in our experiment.

(iv) Our recipients are health-care institutions. Eckel and Grossman (1996) also use an institutional recipient, namely the American Red Cross.<sup>23</sup> In our case, however, the two institutions – the Central Board of Health (CBoH) and Kalingalinga Clinic (KC) in Lusaka – are located in Zambia while the donors are located in Sweden. Felix Masiye, Pär Eriksson and Jesper Sundewall assisted in identifying the above two institutions and obtaining their acceptance to participate in the study. CBoH is the governmental institution in Zambia that is in charge of the national health budget. All official Swedish health-related foreign aid is channelled to the CBoH budget. While Sida and CBoH have agreed on general principles for the use of health-related Swedish aid, CBoH has full autonomy to allocate funds to specific health-related uses in the short run.

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<sup>23</sup> Moreover, in our experiment as well as in that of Eckel and Grossman (1996) the recipient could, arguably, be described as "deserving". See also Fong (2007) who uses deserving individuals as recipients.

**3.3. Questionnaire design and measurements.** An double-blind exit questionnaire allows us to observe donor characteristics (e.g., gender, age, frequency of giving to charitable organizations) as well as donors' motives for their choice of donation.<sup>24</sup> Subjects anonymously filled out the questionnaire after the choice of donation but prior to leaving the room. (The full questionnaire is available in the Appendix.)

Of particular importance were the motivations provided by the subjects who only donated mosquito nets to KC. Specifically, we were interested in knowing to what extent their decision was motivated by a perceived risk for aid diversion and misallocation at CBoH. These donors were provided with the following (mutually exclusive) alternatives to motivate their decision:

1. I am afraid that the money disappears due to corruption etc. if they are transferred to the Central Board of Health's account.

2. By giving mosquito nets to Kalingalinga Clinic I know with certainty to what purpose the donation is used, which I don't know in the case of the Central Board of Health.

3. I believe that the mosquito nets can have positive effects for other persons than the ones using the nets.

4. None of the above is consistent with my reasons for only donating money. Instead I motivate my choice in the following way... (to be filled out by the subject).

Furthermore, subjects who only made a money transfer to the CBoH and those who made both a money transfer to CBoH and a tied transfer to KC, were asked to provide motivations for doing so, using alternatives provided in the questionnaire. Finally subjects who did not donate were asked to provide their reasons (open answer).

**3.4. Statistical Tests.** Experimental bargaining data tends to be highly skewed. Our data is no exception. In these cases the traditional parametric approach often fails. Bootstrapping techniques have proven a powerful tool in dealing with this kind of data. They involve the creation of pseudoreplicate data sets by resampling. By doing so, bootstrapping allows for parametric testing without imposing normality on the data, that is, by inferring the underlying distribution that has generated the data (see Efron and Tibshirani 1993, Mooney and Duval 1993).

To test hypothesis 1 and hypothesis 2 regarding mean offers conditional on type of donation, we thus use bootstrapping techniques. Reported significance levels have been obtained using 5,099 resamples. Moreover, for comparison we provide results from the non-parametric Wilcoxon signed-ranks test for paired data and an ordinary t-test.

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<sup>24</sup> Breman and Granström (2008) provide an overview of how donor characteristics affect foreign-aid giving.

In order to investigate whether the probability that a non-selfish donor ties his transfer to KC differs from the probability that he makes an untied transfer to CBoH, we use a binomial probability test.<sup>25</sup> The choice whether to make a tied transfer to KC or to make a monetary transfer to CBoH only, may be described as a Bernoulli trial. That is, either the donor partially or entirely ties the transfer to KC (a "success" or 1) or he makes the entire transfer as money to CBoH (a "failure" or 0). In this case, it is possible to use a binomial test to investigate whether the probability of making a certain type of transfer differs significantly from the probability of making another type of transfer (see e.g., Siegel and Castellan, Jr. 1988, ch. 4, Davis and Holt 1993, ch. 9). We thus use the binomial probability test on hypotheses 3 and 4.

#### 4. Results

We conducted the experiment in January 2005 at the Stockholm Institute of Education. 47 subjects participated in the two sessions of which two received blank notes of paper and two were chosen to serve as monitors. The total number of observations was thus 43 of which 22 subjects were in the first session and 21 in the second.

**4.1. Treatment effects.** Table 1 presents summary statistics for the experiment.

TABLE 1. Summary statistics

Mean donations conditional on type					
Type of donation	Money to CBoH		Nets to KC		
Mean Donation	25.6		44.2		
Standard error	33.4		38.1		
Number of obs.	43		43		
Fraction of donors making various types of transfer					
Transfer	No	Untied	Tied	Only nets	Mixed
Number of obs.	8	7	28	17	11
Percent					
- in total sample	18.6%	16.3%	65.1%	39.5%	25.6%
- of positive transfers	-	20%	80%	48.6%	31.4%
- of tied transfers	-	-	-	60.7%	39.3%

<sup>25</sup> One may perhaps wonder why we do not test whether fractions of different types of donors (such as  $f_{untied}$  and  $f_{tied}$ ) significantly differ from each other. The reason is that we have paired data whereas tests such as Pearson's chi-squared test and Fisher's exact test require two independent samples (see e.g., Siegel and Castellan, Jr. 1988, ch. 6).

While the average monetary contribution to CBoH is SEK 25.6, the mean tied donation to KC is considerably higher at 44.2 SEK.<sup>26</sup> No more than 16% of the total sample makes an untied transfer to the CBoH only. Compare this to the 65% who, entirely or partially, transfers mosquito nets to KC. When considering only the positive donations in the sample, the result comes out even sharper. Whereas 80% of the participants who make a positive donation tie it to KC to some extent, a mere 20% make a monetary transfer to CBoH only. Also, nearly half of the donors who make a positive donation, transfer mosquito nets to KC only. These findings suggest that donors prefer tied project aid to untied program aid. We investigate this claim further below, while evaluating our four hypotheses from section 3.1.

The statistical tests of the four hypotheses are found in Table 2. We first test hypothesis 1, whether the average donation of mosquito nets to KC is positive. Clearly, we may reject the null that the mean donation of mosquito nets to KC equals zero ( $p < .001$ ).

TABLE 2. Statistical tests

<b>H<sub>1</sub>: Mosquito nets to KC versus zero</b>			
Statistical test	Bootstrap	t-test	Wilcoxon
p-value	< 0.001	< 0.001	< 0.001
<b>H<sub>2</sub>: Mosquito nets to KC versus money to CBoH</b>			
Statistical test	Bootstrap	t-test	Wilcoxon
p-value	0.04903	0.0476	0.0435
<b>H<sub>3</sub>: Probability of a tied transfer to KC versus only untied to CBoH</b>			
Binomial test	$Prob(tied) = 0.5$		
$\hat{Prob}(tied)$	0.800		
p-value	0.00051		
<b>H<sub>4</sub>: Probability of only nets to KC versus only untied to CBoH</b>			
Binomial test	$Prob(only\ nets) = 0.5$		
$\hat{Prob}(only\ nets)$	0.708		
p-value	0.0639		
Note: all p-values are two-sided			

<sup>26</sup> We may incidentally note that the average total donation is SEK 69.8, a very large contribution compared to other dictator games (see Camerer 2003). This is true also in comparison to Fong (2007) and Eckel and Grossman (1996) who, as we do, use "deserving" recipients.



When testing our second hypothesis, we may again reject the null. Specifically, we reject the null that the mean donation of mosquito nets to KC equals the mean donation of money to CBoH ( $p=0.049$ ). The average tied transfer to KC is significantly higher than the average money transfer to the CBoH.

Hypothesis 3 deals with the probability that an altruistic donor makes a tied transfer to KC versus an untied transfer to CBoH only. We reject the null that the probability for the donor to make a tied transfer to KC equals 0.5. The probability for the donor to make a tied transfer to KC ( $\hat{prob}(only\ nets) = 0.80$ ) is significantly ( $p < .001$ ) higher than the probability to make a monetary donation to CBoH only ( $\hat{prob}(untied) = 0.20$ ).

Also for hypothesis 4, we may reject the null that the probability for a donor to transfer only nets to KC equals 0.5, however only at  $p=0.064$ . The probability for an altruistic donor to transfer only nets to KC ( $\hat{prob}(only\ nets) = 0.708$ ) is thus significantly higher (at the 10% level) than the probability for such a donor to make a monetary donation to CBoH only ( $\hat{prob}(untied) = 0.292$ ).

In conclusion, we find compelling evidence that donors prefer tied project transfers as compared to untied program transfers. Average donations are significantly higher in the form of mosquito nets to a the Kalingalinga clinic than in the form of budget support to the Central Board of Health. Also, the probability is significantly higher that an altruistic donor makes a tied transfer to KC than an untied transfer to CBoH only. The same goes for a tied transfer to KC only (at the 10% significance level).

**4.2. Questionnaire data.** Exit questionnaires were used to address the following two issues. First, whether there are significant relationships between donor characteristics and the transfer made to the recipient. Second, what chief motivations participants gave for their choices of donation. We consider each topic in turn.

A summary of the questionnaire data is found in Table 3. It is clear that the average donation is higher for women than for men and that it increases with age in this experiment. OLS regression analysis reveal that these differences are not statistically significant, however.<sup>27</sup> Furthermore, there are no significant differences in contributions between subjects who contribute to charity at least occasionally and those who never do, neither between those who believe that the Swedish foreign aid budget is too small and those who do not. Given the small simple size, this is not surprising.

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<sup>27</sup> Results are available upon request.

TABLE 3. Summary of questionnaire data

Question variable	Outcomes			
Gender	Women	Men	Total	
% of sample	71%	29%	100%	
Mean donations	69%	62%	67%	
Age	20-29	30-39	40-49	
% of sample	62%	20%	18%	
Mean donations	64%	61%	81%	
Frequency giving	Never	Sometimes	Regularly	
% of sample	18%	58%	24%	
Estimated aid share*	Mean	Median	Mode	True value
% of GDI	8.1%	4.5%	5.0%	0.88%
Most important factor†	Effective	Influence	Recipient Known	Proximity
% of sample	67%	20%	13%	0%

n=45 (except for \* where n=30) † = Mutually exclusive alternatives.

Table 3 also displays what participants perceive as the decisive factor for Swedish foreign aid. We see that 67% of participants state aid effectiveness whereas another 20% state influence (i.e., influence over how aid funds are used). This suggests that many subjects are concerned with aid inefficiency due to sub-optimal allocation and outright diversion of aid funds.

When we examine the individual motives – shown in Table 4 – for the subjects who only donated mosquito nets to KC, we find additional support for the above interpretation. Ten (56%) subjects stated that they only donated mosquito nets to KC because they wanted to be sure what the contribution was used for. Arguably this result should be seen in the light of evidence from the developing world where national health funds are sometimes allocated to officials' pet projects (Transparency International 2006) and often not in accordance with burden of disease figures (World Bank 2004). Moreover, nine (50%) of these donors said that they were afraid of corruption at the CBoH. The individual motivations of the donors who only transfer mosquito nets to KC thus point to untied budget support as being associated with aid inefficiency due to corruption and misallocation.

TABLE 4. Self-reported motives for choice of donation

Type of transfer	Questionnaire answer			
Untied	Freedom	Efficiency	Other Priorities	Other
% of category	33%	50%	0%	17%
Only nets	Influence use of aid	Corruption at CBoH	Positive Externalities	Other
% of category	56%	50%	6%	6%
Mixed	No information	Equal importance	Other	
% of category	36%	55%	9%	
No	Foreign aid skepticism	Need money themselves	Regular donor	Other
% of category	0%	63%	25%	25%

Percentages may not sum to 100 due to round-off error and some subjects giving multiple motivations.

Note finally that, among the six subjects who only donated money to the CBoH, three (50%) stated that the reason was that it is more efficient if CBoH could decide to which part of the health-care sector the money should be allocated. This is the traditional economic argument for monetary transfers.

## 5. Concluding Remarks

Individual donors prefer tied project aid to untied program aid. Subjects in our experiment chose how much to donate to one or both of two health care institutions in Zambia: mosquito nets to the Kalingalinga Clinic or a monetary transfer to the Central Board of Health. The mean project aid transfer to KC (SEK 44) is significantly higher than the average monetary transfer to CBoH (SEK 26). Moreover, the probability that an altruistic donor makes some of his donation as project aid to KC is significantly higher than the probability that he makes it as program aid to CBoH only. This also holds for the probability that a donor only transfers nets to KC (at the 10% significance level).

Exit questionnaires reveal that subjects who donate tied project aid to KC only are concerned with inefficiencies associated with untied program aid due to misallocation and corruption. Participants' opinions about the decisive factor for Swedish official development assistance – efficiency and influence over the use of aid funds – lend additional support to this interpretation.

Our results indicate that a fear of aid diversion, rather than a low valuation of foreigners' well-being, has a role to play in explaining the low level of cross-country transfers relative to within-country transfers in developed countries (see Kopczuk et al. 2005). The more so since Alesina and Weder (2002) show that more corrupt governments do not receive less foreign aid than other governments. Donor concerns with aid diversion may also help explain why tied project aid has historically dominated untied program aid.

Donor tendencies to tie aid in response to perceived aid misallocation and diversion have theoretical as well as policy-related implications. Foreign-aid theory has hitherto largely focused on the superiority of monetary transfers to tied transfers as the former maximize the allocative efficiency of aid. Program (budget) support allows for flexibility in allocation of aid funds and thus for utility maximization. Yet our results show that tied transfers may be perceived as a means to reduce the risk for aid diversion. This increases productive aid efficiency. In cases of severe aid diversion, tied project aid may thus increase overall aid efficiency. Theories on foreign-aid giving and charitable behavior should take this into account.

The implications for foreign aid policy are equally important. In recent years several donors have moved away from tied project aid to untied program aid (Sida 2008, Quartey 2005). Our results indicate that such policy changes threaten to hurt donor (and voter) support for foreign aid. Future levels of foreign aid may thus be lower than today's, or at least the aid increases called for by the UN Millennium Project (2005), for example, may fail to materialize. Sachs (2005, p.65) seems concerned with this risk as he recommends aid increases to be distributed "...directly to villages and towns to minimize the chances of their getting diverted by central governments".

Finally, our experiment indicates that reducing developing country corruption could benefit aid recipient countries in two ways. First, productive aid efficiency will go up as corruption goes down. A higher fraction of the aid provided simply reaches the targeted recipients. Second, when corruption goes down, the support for untied program aid (e.g., budget support) should increase, pushing up allocative aid efficiency. The potential benefits of donors' increased focus on reducing corruption are thus considerable.<sup>28</sup>

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<sup>28</sup> One example is the U.S. anticorruption strategy (USAID 2005).

## Appendix A

### EXPERIMENT INSTRUCTIONS

#### **To the participants in an economics experiment:**

You have agreed to participate in this study which will take approximately 45 minutes to carry out. For your participation, you are paid SEK 50. You may also earn some additional money (at the maximum, another SEK 100).

Each and everyone in the room (except the monitor and one additional person, see below) will have to decide how to allocate SEK 100 between him/herself and recipients in Zambia. The money may either be given to *Central Board of Health* or to *Kalingalinga Clinic* in Lusaka (the capital of Zambia), or to both these recipients. The Central Board of Health is the public authority in Zambia that decides how to use the health budget. If you choose to donate money to Central Board of Health, they will decide where the money is needed the most. The alternative is to donate the money directly to Kalingalinga Clinic in Lusaka. The money will then be donated in the form of mosquito nets that are used to protect the hospital's in-house patients from malaria.

Swedish foreign development assistance to Zambia is organized in the following way. Sida<sup>29</sup> has a general agreement with Zambia on bilateral health-related aid that is channeled via the Central Board of Health. Sweden and Zambia have agreed on the general priorities for the Swedish development assistance, but it is the Central Board of Health that ultimately decides how to use the money. Pär Eriksson, who is the one responsible for this cooperation at Sida, is our contact person to the Central Board of Health. We also collaborate with Jesper Sundewall (bilateral deputy expert at Sida in Zambia) and Felix Masiye (researcher at University of Zambia) to carry out this experiment. Through them we have obtained permission from Zambian authorities to donate mosquito nets to Kalingalinga Clinic.

In Zambia, gross domestic income (GDI) is US\$ 380 per person and year (in Sweden, GDI/person is US\$ 28,840 per year). The public health budget in Zambia corresponds to US\$ 10 per person and year. Life expectancy is 37 years. Infant mortality is 102 per 1000 live births. The most common infectious diseases are malaria, typhoid fever and HIV. In countries such as Zambia, where malaria is common, it is estimated that around 40% of the public health expenses are related to malaria. Malaria is also estimated to represent 50% of hospital visits, and 30-50% of the in-house patients in hospitals have malaria.

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<sup>29</sup> The Swedish International Development Agency.

Insecticide treated mosquito nets are proven effective in preventing people from getting malaria. For example, a WHO study shows that insecticide treated mosquito nets reduce child mortality by 20%. Mosquito nets are purchasable in ordinary shops and pharmacies in Zambia. A mosquito net costs approximately 30,000 kwacha (Zambian currency) which is equivalent to SEK 44 according to the exchange rate as of January 10th, 2005. A donation of SEK 50 covers the cost of a mosquito net including the exchange rate fee. Similarly, Central Board of Health receives 30 000 kwacha for each SEK 50 bill that is donated in the form of money.

One of you will be chosen to monitor the experiment. The monitor will be paid SEK 100 in addition to the SEK 50 he or she has already received. The monitor will be in charge of the envelopes mentioned below. In addition to that, the monitor shall verify that the instructions have been followed as they appear here.

The experiment is conducted as follows. Unmarked envelopes corresponding to the number of participants have been placed in a box. All of these except one contain two SEK 50 bills and four blank slips of paper of the same size. The remaining envelope contains six blank slips of paper. Moreover, all envelopes contain two smaller envelopes marked "Central Board of Health" and "Kalingalinga Clinic", respectively. The monitor will call one person at a time and hand over an envelope from the box. The person will take the envelope and go behind screen number one. The envelope will then be opened behind the screen where no one else can see what happens.

When you have opened the envelope you have to decide how many bills and how many slips of paper to put in the two smaller envelopes marked "Central Board of Health" and "Kalingalinga Clinic". The number of bills and slips of paper that are put into each of the two smaller envelopes must add up to two. You then pocket the remaining slips of paper and bills (they should total two). Example: (1) Put SEK 50 and one slip of paper in the envelope marked "Central Board of Health", put two slips of paper in the envelope marked "Kalingalinga Clinic" and pocket SEK 50 and one slip of paper. (2) Put SEK 0 and two slips of paper in the envelope marked "Central Board of Health", put SEK 0 and two slips of paper in the envelope marked "Kalingalinga Clinic" and pocket SEK 100 and zero slips of paper. These were nothing more than examples. The actual decision is up to you. **No one else** will know your decision.

Once you have made your decision, you shall seal the two small envelopes marked "Central Board of Health" and "Kalingalinga Clinic" and put these two envelopes in the larger envelope which you also seal. Then, place this envelope in the box marked "returned envelopes". You then proceed to screen number two where you anonymously fill out a questionnaire with questions concerning the experiment. You then place the

questionnaire in the box marked "questionnaires". The experiment is then over for you and you may leave the room.

After all envelopes have been returned, the monitor will open the envelopes in a random order and record the content of each envelope on two identical lists. The monitor will keep one of the lists. The aim is to allow the monitor to verify that the total amount donated in form of mosquito nets to Kalingalinga Clinic and money to Central Board of Health equals the amount stated in the certificate that will be sent out by Jesper Sundewall (for Kalingalinga Clinic) and Pär Eriksson (for Central Board of Health), both at Sida in Zambia, as soon as the donations have been transferred to the recipients.

The money in the envelopes marked "Kalingalinga Clinic" will be transferred to Jesper Sundewall in Zambia, who will change the money to Zambian kwacha. For each SEK 50 bill put in these envelopes, he buys a mosquito net. Jesper Sundewall and Felix Masiye (University of Zambia) will distribute the mosquito nets to Kalingalinga Clinic. Each SEK 50 bill put in the envelope marked "Central Board of Health" is transformed into 30 000 kwacha and is transferred to the Central Board of Health's bank account in the Standard Chartered Bank in Lusaka, Zambia. As indicated above, the money will be used in the way deemed most appropriate by the authority. When the money and mosquito nets have been transferred, the monitor will receive a certificate per e-mail from Jesper Sundewall (for the mosquito nets to Kalingalinga Clinic) and from Pär Eriksson (for the money to the Central Board of Health). The experiment is then over.

## Appendix B

### QUESTIONNAIRE

#### Some questions to you who participate in this experiment

We kindly ask you to answer some short questions regarding the experiment that you are participating in. As you have probably already understood, your answers are impossible to track. We therefore ask you kindly to answer the questions below truthfully. Thank you in advance.

1. First, state whether you are a man or a woman

Woman

Man

2. State your age:

3. Circle the sum of money you donated to the recipient in the preceding experiment

a) in the form of money to Central Board of Health

0 SEK            50 SEK            100 SEK

b) in the form of malaria mosquito nets to Kalingalinga Clinic

0 SEK            50 SEK            100 SEK

4. How often do you donate money to a charitable organization?

Never             A few times per year             Regularly every month

5. Please estimate the share of Swedish gross domestic income (GDI) that goes to foreign aid each year: \_\_\_\_\_

6. What is your opinion on the share of the Swedish GDI that goes to foreign aid each year?

too small             about right             too large

7. Which single factor do you consider to be the most important for Swedish foreign aid to fulfill? (Choose one alternative)

that the aid is effective

that the aid goes to people that are geographically close to us

that the donor can influence what the money is used for (e.g., education, health care)

that the recipient's identity is known to the donor



Finally, if you have chosen to donate money and/or mosquito nets to the recipient in the experiment, we want you to answer question 8. If you have chosen not to give anything, we want you to instead answer question 9 below.

8. (Only to be answered if you donated money to Central Board of Health and/or mosquito nets to Kalingalinga Clinic.)

If you only donated money to Central Board of Health you should answer question a) below, if you only donated mosquito nets to Kalingalinga Clinic you should answer question b), and in the case you donated to both these recipients you should answer question c). Each question contains a number of suggested motivations for your choice. Pick one alternative. If there are several alternatives that are in line with your motivation, pick the alternative that best describes how you were thinking when you chose to donate money and/or mosquito nets.

a) I donated only money to Central Board of Health because

I believe it gives Central Board of Health the greatest possible *freedom* to use the donation the way it considers the best, which is important in principle.

I believe that it is more *efficient* if Central Board of Health decides for themselves how to use the money.

I believe that there are more important things for Central Board of Health to prioritize than fighting malaria.

None of the above is consistent with my reasons for donating money only. Instead I motivate my choice in the following way:

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b) I donated only mosquito nets to Kalingalinga Clinic because

I am afraid that the money disappears due to corruption etc. if they are transferred to the Central Board of Health's account.

By giving mosquito nets to Kalingalinga Clinic I know with certainty to what purpose the donation is used, which I don't know in the case of the Central Board of Health.

I believe that the mosquito nets can have positive effects for other persons than the ones using the nets.

None of the above is consistent with my reasons for only donating money. Instead I motivate my choice in the following way:

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c) I donated both money to Central Board of Health and mosquito nets to Kalingalinga Clinic because

I consider that I have too little information to be able to choose between the two alternatives.

I find that money to Central Board of Health and mosquito nets to Kalingalinga Clinic are equally important and I want to contribute in both cases.

None of the above is consistent with my reasons for only donating money. Instead I motivate my choice in the following way:

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9. I donated nothing because

I did not receive any money, only blank slips of paper (double-blind treatment).

I do not believe in foreign aid.

I need the money myself.

I give regularly to charity through other organizations.

None of the above is consistent with my reasons for not donating money. Instead I motivate my choice in the following way:

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The experiment is now over. Thank you for participating.

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## Altruism without Borders?

with Anna Breman

**ABSTRACT.** Why do individuals contribute to foreign aid? Does the willingness to give increase the more we know about the recipients? This paper experimentally tests altruism over borders. We design a cross-country dictator game where the degree of identification of the recipient is varied in four treatments: (1) anonymity, (2) photo, (3) information and (4) photo and information. In addition, questionnaire data on donor characteristics is gathered. The mean donation is 55%, which is considerably higher than in standard dictator games. In contrast to previous within-country experiments, we find no significant effect of identification on donations. Furthermore, we find that women donate significantly more than men (64% compared to 50%) and that those who state that aid is too large donate significantly less than those who state that aid is too small (24% compared to 67%).

Keywords: Altruism; Dictator Game; Foreign Aid; Identifiable Victim Effect.

JEL: A13; C72; C91; F35.

*"... Bono's next target is the American people: he expects to have an army of 10 million activists signed up for the One Campaign by 2008. He believes – he knows – that the American people would demand action on Africa if only someone would tell them the facts."*

(New York Times, September 18, 2005)

### 1. Introduction

Calls for increased foreign aid to developing countries have been legion in recent years. Such calls have come from celebrities like Bono the rock star, actress Angelina Jolie (O'Brian 2005), Prime Minister Tony Blair and Professor Jeffrey Sachs (2002).

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<sup>0</sup> We thank the SOS Children's Villages Sweden for cooperating in making this experiment possible and Erik Mohlin, Henrik Lundvall and Robert Östling for help in carrying out the experiment. Moreover, we are grateful to Milo Bianchi, Magnus Johannesson, Sendhil Mullainathan, Elena Paltseva, Karl Schlag, Robert Östling and participants at the Harvard Development Workshop, the Stockholm School of Economics Lunch Workshop and the 20th Annual Congress of the European Economic Association for helpful comments and discussions, as well as to Jan Wallander and Tom Hedelius' Research Foundation for financial support.

Eleven of America's most well-known non-profit organizations have founded the campaign "ONE". Inspired by The United Nations' Millennium Development Goals, it demands that the U.S. devote an additional one percent of the federal budget to foreign aid. Despite the inefficiency of foreign aid being high on the agenda, private donations to foreign aid seem to be on the rise. In Sweden, 40% of all registered charities now target foreign recipients (Bremner 2006). In the U.S., private contributions to international development have increased by two-digit numbers in 2001, 2002 and 2003 (Giving USA 2005).<sup>1</sup>

Why do individuals contribute to private charities that help people in poor countries? Why would voters support government levying taxes for foreign aid? While there is a vast literature on foreign aid effectiveness<sup>2</sup>, and some literature on government incentives behind foreign aid (see Alesina and Dollar 2000 for an overview)<sup>3</sup>, we have found no literature on individual donors' motives for giving aid. Whether foreign aid is believed to be too high or too small, effective or detrimental, the question still remains as to what induces people to contribute to foreign aid.

This is the first paper, to our knowledge, to experimentally test cross-country altruism. First, we test the *identification effect*; whether the willingness to give increases with the information given about the recipients.<sup>4</sup> Experimental studies of within-country altruism using dictator games have shown that such identification increases donations (Bohnet and Frey 1999, Burnham 2003, Charness and Gneezy 2003). We design a double-blind dictator game in line with this literature. The key difference from previous studies is that our recipient is a poor person in a developing country. To keep the experiment as close as possible to the real world features of charitable giving, the recipient was recruited in collaboration with SOS Children's Villages. The subjects were divided into four treatments where the degree of anonymity of the recipient varied.

Furthermore, exit surveys were conducted to obtain characteristics of the individual donors and their motives for giving or not giving foreign aid. Donor characteristics are correlated with altruistic behavior in dictator games (see Camerer 2003 for an overview). Testing donor characteristics may therefore give important insights into what affects the level of foreign aid.

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<sup>1</sup> The exact numbers are 13%, 11.6% and 14.8% for 2001, 2002, and 2003, respectively.

<sup>2</sup> For an introduction to this literature, see World Bank (1998)

<sup>3</sup> See also Lumsdaine (1993), Maizels and Nissanke (1984), Schreder, Hook and Taylor (1998) and Boschini and Olofsgård (2007).

<sup>4</sup> A related concept is the identifiable victim effect, which is discussed in e.g., Schelling (1968), Jenni and Loewenstein (1997), Small and Loewenstein (2003), and Small, Loewenstein and Slovic (2005).



It has been argued that cross-country altruism is weaker than within-country altruism. Kopczuk et al. (2005) compute the level of U.S. foreign aid to be consistent with Americans valuing the welfare of citizens of the poorest countries at 1/2000 the welfare of fellow Americans, or with an overwhelming part of foreign aid actually being wasted. In another U.S. study, Americans consider the level of foreign aid to be too high and want to see it reduced. It turns out, however, that they greatly overestimate the amount of money given to foreign aid. The amount considered to be reasonable is much higher than the actual U.S. foreign aid budget (PIPA 2001).

The experiment finds strong evidence of cross-border altruism. The mean donation for the entire sample was 55%. Not only is this level considerably higher than what has been observed in ordinary dictator games where both dictators and recipients are students (Johannesson and Persson 2000, Mohlin and Johannesson 2007), it also exceeds the levels obtained in previous within-country dictator games conducted with deserving recipients (Eckel and Grossman 1996, Fong 2007).<sup>5</sup>

We show that there is no identification effect in cross-border giving. Mean donations do not differ significantly between the four treatment groups. This result is robust to testing levels as well as frequencies of donations. The results in Bohnet and Frey (1999), Burnham (2003) and Charness and Gneezy (2003) do not carry over to a cross-country setting. The reasons for this result are discussed in the concluding remarks.

Furthermore, the survey questions give us important information about the key determinants in giving aid. Regardless of the characteristics of the dictators, the majority (63%) consider effectiveness to be the decisive factor in giving aid while a mere 9% say that knowing the identity of the recipient is important. Furthermore, the amount donated in the experiment is highly determined by donor characteristics and the attitude towards foreign aid. Women donate significantly more than men (64% as compared to 50%). Answering that foreign aid is "too small" is significantly associated with an increase in donation from 24% to 76%, as compared to answering that foreign aid is "too large".

Based on the results, we can thus identify two main criteria that influence the public's support for foreign aid. First, the effectiveness is singled out as the most important factor in giving aid by the majority of subjects in the experiment. When aid is guaranteed to reach the recipients, as in this experiment, mean donations are high. Second, donations are directly related to the attitude to foreign aid. The negative attitude in countries like the U.S. is associated with grossly overestimating the amount of money devoted to development assistance. Increasing the knowledge about the

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<sup>5</sup> Note that Johannesson and Persson (2000) and Johannesson and Mohlin (2005) were conducted on the same population of students. Both experiments yield average donations of 13%. Eckel and Grossman (1996) and Fong (2007) both yield average donations of 30%.

actual level of aid could therefore positively influence the willingness to contribute to foreign aid.

The paper proceeds as follows. The subsequent section presents the design of the experiment while the third gives the results and presents several robustness tests. The fourth section discusses the results and concludes.

## 2. Experimental Design

The experiment was a double-blind n-donor dictator game with four separate treatments. Each treatment was carried out in two separate sessions. In each of the eight sessions, about 20 donors were matched with a single real-life recipient in the SOS Children's Village in Port Elizabeth, South Africa. The dictators, recruited among the undergraduate students at Stockholm School of Economics and Stockholm University, were randomly selected into the four treatments. The recipient, a 12-year old boy, was recruited through the Swedish branch of SOS Children's Villages. As stated in the instructions (see Appendix), the agreement was that any money donated to the child should go to everyday expenses for food, clothes, education and health care minus an administrative fee of 8% taken by the charitable organization.

When subjects arrived at the experiment, they were given the SEK 50 show-up fee<sup>6</sup> and were asked to sit and read the instructions quietly without interacting with any of the other subjects. When all subjects had arrived, the instructions were read out by the experiment leader and one student was chosen to be the monitor. The monitor handed out opaque envelopes which, in all but one case, contained six SEK 20 bills (i.e., SEK 120), as well as six pieces of paper (of equal size as the money bills).<sup>7</sup> The last envelope contained no money bills, only twelve pieces of paper as is customary in double-blind dictator games. One subject at a time went behind a screen<sup>8</sup> to make his/her choice on how to divide the money between himself/herself and the recipient child. The subject then moved to a second screen behind which he/she anonymously filled out a questionnaire about the experiment. After that the subject was free to leave.

When all subjects had made their decisions and filled out the questionnaire, the monitor opened each envelope together with the instructor and took note of the results. All the money together with a follow-up note from the session was then put in a brown envelope addressed to the local office of SOS Children's Villages. The envelope was

<sup>6</sup> US\$ 1  $\approx$  SEK 7 (at the time of the experiment).

<sup>7</sup> The sum SEK 120 was chosen so as to allow for the equal division of SEK 60 – SEK 60 (note that SEK 10 bills do not exist).

<sup>8</sup> The screens were the same as those used during elections in Sweden and borrowed from the local government.

sealed and the supervisor and the instructor went together to the closest mail box and mailed the envelope. The SOS Children's Villages is a well known charitable organization in Sweden and it was clear from the instructions that the money would be sent directly there. The subjects could therefore not doubt the accuracy of the experiment.

**2.1. Treatment groups and hypotheses.** The subjects were randomly selected into one of four treatments. The degree of recipient identification, i.e., the amount of information about the recipient that was provided to the participants, was varied between the treatments in the following way:<sup>9</sup>

**Treatment 1: Recipient anonymous.** The recipient is an anonymous child in the SOS Children's village Port Elizabeth in South Africa.

**Treatment 2: One-way visual identification (photo).** The recipient is a child in the SOS Children's village Port Elizabeth in South Africa. A photo of the child is included at the end of the instructions.

**Treatment 3: One-way written identification (written information).** The recipient is a child in the SOS Children's village Port Elizabeth in South Africa. Some information about the child is included at the end of the instructions.

**Treatment 4: One-way visual identification and one-way written identification (photo and written information):** The recipient is a child in the SOS Children's village Port Elizabeth in South Africa. A photo and some information about the child are included at the end of the instructions.

In the experiment, the true identity of the child was revealed, but in this paper the name and the date of birth are concealed from the reader. The information given about the child in treatments 3 and 4 was the following:

*Name: XXXX*

*Born: YYYY, 19ZZ*

*XXXX, or "XX" as he is mostly called, came to our children's village in October 2002 where he now attends third grade in school. In his spare time, XX prefers playing cricket or pool. The boy is described as very civil and shy and to begin with, it was difficult for him to get to know the other children. Nowadays, he gets along very well with his SOS brothers and sisters, and even though he is somewhat introvert, he is well*

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<sup>9</sup> The complete instructions for the four treatment groups can be found in the Appendix.

*settled in his new environment. The boy is trustworthy and responsible and helps with the household work.*

*Since XX was a street child, we have no information about his family background. XX was homeless when a social worker noticed him on a street in Motherwell. At that time, the boy was already ten years old and without any adult supervision. The police tried without any success to identify the parents and thereafter, the authorities chose to place him in our Children's Village. Here, XX can grow up in a safe, stable and caring environment and he has the possibility to go to school and get an education.*

We test the general assumption that identification increases offers against the alternative that there is no identification effect. Let  $D_i$  denote the distribution of offers in treatment  $i$  ( $i = 1, \dots, 4$ ). Then, we test the following three main hypotheses about dictator behavior.

**Hypothesis 1:** The willingness to give is higher in the case of one-way visual identification (i.e., when the donor sees a photo of the recipient) than otherwise. The average offer should be higher in treatment 2 (photo) than in treatment 1 (anonymous), and higher in treatment 4 (photo and written information) than in treatment 3 (written information). Hence, we get the following two null hypotheses:  $D_2 = D_1$  and that  $D_4 = D_3$ .

**Hypothesis 2:** The willingness to give is higher in the case of one-way written identification (i.e., when the donor is provided with written information about the recipient) than otherwise. That is, the average offer should be higher in treatment 3 (written information) than in treatment 1 (anonymous), and higher in treatment 4 (photo and written information) than in treatment 2 (photo). In this case, our two null hypotheses are:  $D_3 = D_1$  and that  $D_4 = D_2$ .

**Hypothesis 3:** The willingness to give is higher in the case with both one-way visual and one-way written identification (i.e., when the donor is provided with a recipient photo and written information) than when the recipient remains anonymous. Our final null is therefore:  $D_4 = D_1$ .

If, as hypothesized above, mean offers are higher when the recipient is identified – that is, if we can reject the null that the underlying distribution of offers is independent of the treatment – we may conclude that there is such a thing as an identification effect

increasing the willingness to give. Before turning to the results, however, we discuss some design concerns related to the experiment as well as the exit surveys.

**2.2. Design Concerns.** Three considerations were of particular importance to us when designing this experiment; the connection to previous experiments, the mimicking of real-world framing, and fairness.

First, we aimed at using the design in previous literature focusing on within-country altruism. This experiment therefore closely follows the design in Hoffman et al. (1996), Bohnet and Frey (1999) and Burnham (2003) with separate treatment groups for each step of identification. We had to forego one of the standard designs used in dictator games, namely that each dictator makes an offer to one recipient. Here, the dictators were informed that everyone participating in one session was giving to the same child. This design has been used in previous dictator games when the recipient is not a student (see Eckel and Grossman 1996, Fong 2007, Jacobsson et al. 2007).

Second, we aimed at mimicking the real-life behavior of charitable organizations as closely as possible. Charitable organizations often use photos and written information about the recipients to induce altruistic behavior among donors (Andreoni and Petrie 2004). The photo and the description of the child are therefore identical to the information ordinarily given to foster families supporting a child in an SOS Children's Village.

Third, fairness has been shown to play a crucial role in ultimatum and dictator games (see Camerer 2003). Therefore, we wanted to allow for an equal distribution between dictators and recipients. Since there are no SEK 10 bills in Sweden – only coins – we were left with SEK 20 bills and the total sum was therefore SEK 120, allowing for a 60-60 split.

**2.3. Questionnaire design and measurements.** Since this is the first experimental study of micro-level donor preferences over foreign aid, we were interested in donors' characteristics and their motives for giving foreign aid or not providing aid. Dictators therefore had to fill out an anonymous questionnaire after having chosen how to divide the money but before leaving the room. In particular, we wanted to test if there were any differences in behavior between women and men and whether the attitude to foreign aid influenced donor behavior.

There is evidence that women and men behave differently in dictator and ultimatum games (see Camerer 2003 for an overview). Andreoni and Vesterlund (2001) find no clear evidence that women should generally be more generous than men in dictator games. Instead, gender seems to interact with many other variables (e.g., prices, beliefs

about the recipient). Eckel and Grossman (1998) test gender differences in a double-blind dictator game controlling for risk, gender-related subject interactions, and the experimenter effect. They find a significant gender difference; women, on average, donate twice as much as men. Therefore, it was important to keep the share between men and women approximately equal in the treatment groups, but also to follow up in the questionnaire to see whether we could identify a difference between the sexes.

In studies on attitudes to foreign aid, the American public tends to overestimate the amount of money devoted to foreign aid (see e.g., PIPA 2001). The level it finds acceptable is noticeably higher than the actual budget for foreign aid. For that reason, the subjects were asked to estimate the size of the Swedish budget for foreign aid (as a percentage of GDI). It has been well-known that Swedish governments have targeted a foreign aid budget at 1.0% of GDI. The UN recommended level is 0.7% and aid budget in Sweden at the time of the experiment was 0.87%. Answers around 1% were therefore expected. The subsequent question in the survey asked the subjects to state whether they believed the current level of foreign aid to be too small, about right, or too large.

We also asked the subjects to choose which of the following four alternatives they considered the most important for foreign aid to fulfill in general:

- (1) that the aid is effective (efficiency)
- (2) that the aid reaches people that are geographically close to us (proximity)
- (3) that the donor can influence what the money is used for (for example education, health care), (influence)
- (4) that the recipient identity is known to the donor (recipient known)

Finally, we invited the subjects to motivate why they had given/not given any money in the experiment. Those who did not donate were asked to provide their reasons, but we did not suggest any answers. Those who did donate were given the following five options (not mutually exclusive): (1) empathy, (2) fairness, (3) warm-glow, (4) reciprocity, and (5) other (open-ended).<sup>10</sup>

### 3. Results

We conducted the experiment in September 2004 at the Stockholm School of Economics. 181 subjects participated in the eight sessions (two sessions per treatment) eight of which received blank notes of paper and eight were chosen to be monitors. The total number of observations was thus 165 subjects, 46 of which were in the first treatment, 40 in the second, 38 in the third and 41 in the fourth treatment.<sup>11</sup>

<sup>10</sup> See Appendix for the exact formulation of the questionnaire.

<sup>11</sup> The reason why the sessions were of unequal size is that some students did not show up at their designated session.

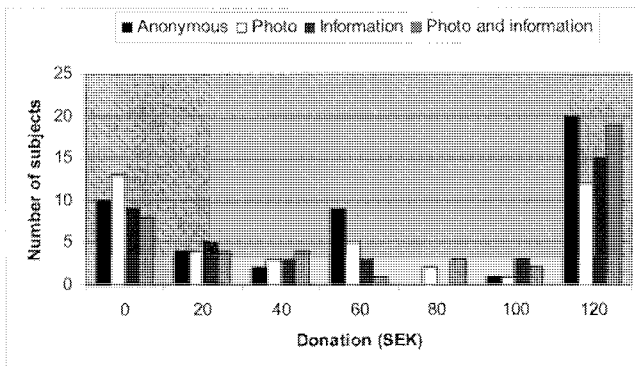
**3.1. Treatment effects.** Table 1 presents summary statistics for the four treatment groups. The first thing to observe is the high mean offers in all four treatments groups; 58%, 46%, 55% and 61%, respectively. This is considerably higher than in previous double-blind dictator games using the same student population, but where both dictators and recipients are students within the same country. Both in studies by Johannesson and Persson (2000) and Mohlin and Johannesson (2008), the experiments yield average donations of 13%. It is also noticeably higher than previous double-blind experiments in the US, where the average donation has ranged from 8% to 16% of the endowment (Hoffman et al. 1996, Eckel and Grossman 1996, 1998, Burnham 2003). Clearly, foreigners are not valued at 1/2000 as compared to fellow citizens as suggested in Kopczuk et al. (2005).

TABLE 1. Summary statistics

	Treatment 1	Treatment 2	Treatment 3	Treatment 4
<b>Degree of identification</b>	Anonymous child	Photo	Written information	Photo and written information
Mean donations, SEK (percentage)	69.57 (58%)	55 (46%)	65.79 (55%)	73.66 (61%)
Standard deviation	50.02	50.38	51.76	50.49
N	46	40	38	41
Mean donations conditional on giving, SEK (percentage)	88.89 (74%)	81.48 (68%)	86.21 (72%)	91.52 (76%)
Standard deviation	38.18	39.59	41.44	38.74
N	36	27	29	33

The second thing to note is the high standard deviations, which reflect the broad distribution of offers (as shown in Figure 1). The offers have peaks on SEK 0 and SEK 120 and the share of offers in between the minimum and maximum are highly similar between the four treatments (see Table 2). The offers do not seem to be normally distributed. Using the Kolmogorov-Smirnov test for normality, we can reject the null hypothesis that offers are normally distributed with  $p < 0.05$  for treatments 1, 3 and 4. In the second treatment, we have that  $p = 0.078$ .

FIGURE 1. Distribution of donations



Since the offers are not normally distributed, a standard t-test to compare average offers across the four treatment groups is not appropriate. Instead, we use the non-parametric Wilcoxon rank test for non-paired data (also known as the Mann-Whitney test).<sup>12</sup> The Mann-Whitney tests the null that the distributions are equal between two treatments. The results are reported in Table 3 (all p-values are double-sided). Our three main hypotheses are discussed in detail in section 2.1.

TABLE 2. Distribution of donations

	Offers $X=0$	Offers $0 < X < 120$	Offers $X=120$
Treatment 1 (anonymous)	22%	35%	43%
Treatment 2 (photo)	33%	37%	30%
Treatment 3 (information)	24%	37%	39%
Treatment 4 (photo and information)	20%	34%	46%

Hypothesis 1 that the distribution of offers is unaffected by photo identification cannot be rejected in a Mann-Whitney test, both comparing treatment 1 (anonymity)

<sup>12</sup> However, all results presented here also hold under a two-sample t-test with unequal variances.



with treatment 2 (photo) ( $p=0.17$ ) and comparing treatment 3 (information) with treatment 4 (photo and information) ( $p=0.50$ ).

Neither can we reject the second hypothesis that the distribution of offers should be unaffected by written information. The Mann-Whitney test is not significant at the 5% level for treatment 1 (anonymity) compared with treatment 3 (information) ( $p=0.67$ ) nor comparing treatment 2 (photo) with treatment 4 (photo and information) ( $p=0.0998$ ).<sup>13</sup>

TABLE 3. Mann-Whitney and Pearson's chi2 tests

	One-way visual identification (photo)		One-way identification by information		One-way identification by photo and information
<b>Null hypothesis</b>	$D_1 = D_2$	$D_3 = D_4$	$D_1 = D_3$	$D_2 = D_4$	$D_1 = D_4$
<i>Mann-Whitney, mean donations</i>					
z-scores	1.37	-0.68	0.433	-1.65	-0.32
(p-value)	(0.17)	(0.50)	(0.67)	(0.0998)	(0.75)
Number of observations	86	79	84	81	87
<i>Mann-Whitney, mean donations conditional on giving</i>					
z-scores	0.80	-0.52	0.42	-0.98	-0.19
(p-value)	(0.43)	(0.60)	(0.68)	(0.33)	(0.85)
Number of observations	63	62	65	60	69
<i>Pearson's chi2 test, the fraction of positive donations</i>					
Chi2(1)	1.26	0.20	0.05	1.78	0.066
(p-value)	(0.26)	(0.65)	(0.83)	(0.18)	(0.80)
Number of observations	86	79	84	81	87

Note: All p-values are two-sided

Finally, hypothesis 3 that the distribution of offers is the same for treatment 1 (anonymity) and treatment 4 (photo and written information) cannot be rejected in a Mann-Whitney test ( $p=0.75$ ).

<sup>13</sup> The difference between treatments 2 and 4 is significant at the 10% level. This could be a weak sign of information having an effect on donations. However, average donations in treatment 3 (information) are lower than in treatment 1 (anonymity) and the difference is not significant. This is inconsistent with the comparison of treatments 2 and 4.

Furthermore, we perform an additional Mann-Whitney test for mean donations, conditional on giving and a Pearson's chi-squared test for the share of positive donations. The results are reported in Table 3.

The Mann-Whitney conditional on giving tests our three hypotheses that the distribution of positive donations is the same in the four treatments. As shown in Table 3, we cannot reject that the distributions of donations are the same. This strengthens the result that identification has no effect on donations.

The Pearson's chi-squared tests the null that the fraction of positive donations is the same across treatments.<sup>14</sup> Once more, the null cannot be rejected. The fraction of positive donations is unaffected by (1) identification by photo, (2) identification by written information, and (3) identification by photo and written information.

Hence, the evidence indicates that identification is not equally important in cross-country altruism as in within-country altruism. The next section shows some results from the exit surveys that move us closer to an explanation for this result.

**3.2. Overview of questionnaire results.** Table 4 presents summary statistics for the answers to the exit questionnaire. We first discuss the results related to the attitude to foreign aid, and second the characteristics of the donors and how that, in turn, is related to the attitudes and motives for giving.

Several questions in the questionnaire are related to the subjects' attitude towards foreign aid. In line with surveys in the U.S., the subjects in the experiment overestimate the share of GDI devoted to foreign aid. The sample mean is 3.5% and the median is 2.0%. The 1% government target is not as widely known as expected. When asked about the magnitude of aid, 45% think it is too small, 46% find it about right and merely 9% state that it is too large. Hence, the subjects overstate the magnitude of foreign aid, but the vast majority (91%) finds it about right or too small.

To further test for the identification effect, we asked what the subjects considered to be (1) the most important factor for foreign aid in general and (2), their motives for giving in this particular case. On general foreign aid, 63% state effectiveness as the key determinant and 25% value the possibility of influencing what the aid is used for (e.g., health care, education). Knowing the identity of the recipient finds very small support (9%), and proximity to the recipient even less (2%). Hence, being able to identify the recipient is not listed as a key decisive factor for giving foreign aid in general. This

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<sup>14</sup> See D'Agostino (1988) for a motivation as to why Pearson's chi-squared test is to be preferred to e.g., Fischer's exact test, when testing the equality of two population fractions.

TABLE 4. Summary of questionnaire data

Question variable	Outcomes					
	Women	Men	Total			
<b>Gender</b>						
Number of observations (percentage)	74 (45%)	91 (55%)	165 (100%)			
Mean donations conditional on gender	64%	50%	55%			
<b>Estimated aid share</b> (percent of GDI)	Mean	Median	Mode			
	3.5%	2.0%	1.0%			
<b>Opinion on current level of aid</b>	Too small	About right	Too large			
Fraction of sample	45%	46%	9%			
Mean donation conditional on opinion	67%	50%	24%			
<b>Most important factor for foreign aid</b>	Efficiency	Influence	Recipient known	Proximity		
Fraction of sample	63%	25%	9%	2%		
Mean donation conditional on factor	60%	50%	50%	50%		
<b>Motive for giving (non exclusive)</b>	Empathy	Fairness	Warm-glow	Reciprocity	Proximity	Other
Fraction of sample	34%	15%	13%	5%	2%	36%
Mean donations conditional on motive	71%	64%	71%	44%	83%	83%

is further strengthened by the motives for giving in this particular case. A mere 6% state reciprocity<sup>15</sup> as the cause. This seems reasonable, considering that the donor is completely anonymous to the recipient. Instead, feeling empathy for the child (43%), fairness (19%), and warm-glow<sup>16</sup> (17%) are the self-reported motives for giving in this particular experiment.

<sup>15</sup> Hoffman et al. (1996) argued that reciprocity and identification are "inextricably intertwined" as explanations for pro-social behavior in dictator games.

<sup>16</sup> See Andreoni (1990) for a longer discussion on warm-glow as a motive for altruistic behavior.

Regarding individual donor characteristics, we see that mean donations by women (64%) are considerably higher than mean donations by men (50%). This result is in line with some previous experimental evidence, which shows that women are more generous than men in dictator and ultimatum games (see Camerer 2003).

We test whether donor characteristics and/or attitudes to foreign aid have any significant effect on mean donations. This is done by regressing the actual donations on dummy variables for women/men, the attitude to aid, and motives for giving. Table 5 (see Appendix B) presents the results.

In all regressions, treatment dummies are included and treatment 1 (anonymity) is the baseline. As shown in Table 5, and in line with the Mann-Whitney test, the treatment dummies are never significant. In other words, none of the treatments significantly affects average donations compared to the baseline.

In OLS(2), we see that women give significantly more than men controlling for the treatments. The average woman gives 13.4 percentage units more than the average man. Another significant effect is the attitude to foreign aid. Stating that foreign aid is "too small" compared to stating that it is "too large" is significantly associated with a 44 percentage unit difference in average donation (OLS(3)). However, when we control for attitude to aid (OLS(4)), the higher donation by women is no longer significant. Being a woman therefore seems to be highly correlated with finding foreign aid to be "too small".

OLS(5) shows that the variable "most important factor when giving aid" divided into efficiency, influence and recipient known, does not have any significant impact on average donations. As we have seen, 63% stated that effectiveness was the most important factor for foreign aid, which seems to be true, regardless of the amount donated.

OLS (6) shows the individual motives for giving aid in this particular experiment. The regression is based on positive donations ( $N = 129$ ). Reciprocity is significant at the 5% level ( $p=0.037$ ). The coefficient is negative, indicating that those who stated reciprocity as a motive for giving, on average offer less than the mean donations among positive donations. "Other" is positive and significant and it is an open-ended question used by most subjects to clarify their motivations. Since the alternatives were not mutually exclusive, many of those who chose "other" also chose one of the other alternatives. Therefore, there is no conclusion to be drawn about that variable.

Furthermore, we run double-sided Tobit regressions since the data is censored from below at zero and from above at 120. The Tobit regressions are presented in Table 6 (see Appendix B). The results from this robustness test are essentially the same as

those in the OLS regressions. The minor differences are that the variable "sex" is significant at  $p=0.053$  in Tobit(2), "aidlarge" is significant at  $p=0.057$  in Tobit(4), and "reciprocity" is significant at  $p=0.094$  in Tobit(6).

The questionnaire data reinforces the experimental evidence that identification does not significantly increase mean donations. Few people state that it is important to know the identity of the recipient (9%). Instead, the questionnaire points to effectiveness as the most important factor for foreign aid (63%). Effectiveness is chosen by donors regardless of gender and the amount donated. The second most important factor in giving aid is to be able to influence the use of the donations (25%), which can be seen as a sign of paternalistic altruism.

#### 4. Concluding Remarks

Altruism does not stop at the border. On the contrary, this first experiment to investigate donor behavior in a foreign-aid setting indicates that cross-country altruism exists. Donors in our experiment displayed a considerable willingness to give. The mean donation for the entire sample was surprisingly high at 55%.

However, in this cross-country dictator game, we cannot replicate the result of Bohnet and Frey (1999), Burnham (2003), and Charness and Gneezy (2003) that donations increase with recipient identification.<sup>17</sup> How can we explain the discrepancy in results between those studies and ours? Is there some unexpected difference in our experimental design or is the identification effect not robust between experiments? Several facts point to the latter explanation.

First, our experiment is close in design to those of Bruno and Frey (1999), and Burnham (2003). The two key differences are that our recipient is (1) poor and (2) living in a developing country. The poverty aspect, "the perceived need" may certainly explain the observed higher mean donations in all our treatment groups. The difference in mean donations between treatment groups, however, should only be affected by the degree of identification.

Second, even though a large share of donors offers the maximum amount already in the anonymous treatment, 60% of the dictators can still raise their donations as the

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<sup>17</sup> Bohnet and Frey (1999) found a significant identification effect from one-way visual identification with information about the recipient, but no significant effect from one-way visual identification without information. Burnham (2003) did find a significant effect from one-way visual identification using photos (no information). Charness and Gneezy (2003) found a significant effect of revealing the family names of the recipients to subjects in a dictator game.

amount of information about the recipient increases.<sup>18</sup> No such increase occurs. The fraction of positive donations does not differ significantly between treatments.

Third, in Bohnet and Frey (1999), Burnham (2003), and Charness and Gneezy (2003), the identification effect can be seen as minimizing the social distance between donors and recipients, thus increasing pro-social behavior. While increasing identification in a dictator game between students might trigger reciprocity concerns (see Hoffman et al. 1996, 1999), our cross-country setting enabled us to isolate the potential identification effect and thus, to eliminate any reciprocity concerns. Instead, our experiment triggered – according to the questionnaire – empathy and fairness as the key reasons for giving.

Moreover, our results are in line with experimental evidence on identifiable versus statistical victims. While Jenni and Loewenstein (1997) show that an emotional description of the victim does not increase the willingness to help, Small and Loewenstein (2003) demonstrate that determining the victim without providing particulars about him suffices to increase the willingness to help. Both these features are captured in our experiment.

On a general level, aid efficiency seems crucial for the willingness to give.<sup>19</sup> In a world with considerable uncertainty concerning the efficiency of foreign aid, earmarking aid for identified recipients presumably complicates the embezzlement of funds and hence, a way of alleviating donor concerns with foreign aid waste. Recipient identification may also be a way for a charity of signalling that aid allocation is based on the perceived need of recipients.

Furthermore, identifying the recipient may be a means for a charitable organization of raising donor commitment. It is emotionally more challenging to cut off funding for a recipient whom you "know" than for one who has remained anonymous to you, since personal information creates emotional ties. Having an identified recipient for each donor might be a way for the charitable organization of engaging its donors in repeated funding. If charitable organizations face credit market restrictions, such long-term commitment may provide a means of smoothing fluctuations in private donations, reducing risk and thereby increasing the efficiency of charitable funding (compare to e.g., Andreoni and Petrie 2004).

Relating back to the Kopczuk et al. (2005) study, we can conclude that it is not likely that a foreigner is valued at 1/2000 as compared to a person within the same

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<sup>18</sup> The experiment has an in-between subject design and it is not the same donors in the treatments following the anonymous treatment.

<sup>19</sup> 63% of the participants in the experiment stated "efficiency" as the decisive factor for giving foreign aid. Moreover, efficiency ranked as the most important factor, regardless of donor characteristics and the amount donated.

country. As shown by this study, their alternative explanation, i.e., the perceived effectiveness hypothesis, seems more plausible. The low level of cross-country income redistribution compared to within-country redistribution, may be explained by the fact that donors expect a significant fraction of cross-border transfers to be wasted. Breman and Granström (2008) show that fears of aid diversion significantly reduce donations as compared to the case where aid reaches the targeted recipients with certainty.

This paper offers a first glance at the behavioral foundations for foreign aid related altruism. What induces cross-border donations? We have shown that it is not recipient identification. Instead, donor characteristics such as gender and beliefs and attitudes to foreign aid are important predictors of the willingness to give. The key determinant, however, seems to be perceived effectiveness. When aid is guaranteed to reach recipients in need, as in this experiment, the willingness to give is remarkably high.

## Appendix A

### EXPERIMENT INSTRUCTIONS

The original instructions were in Swedish. This appendix reprints a translation of the instructions used in the four experimental treatments. The instructions below are those of the baseline group, i.e. the anonymous treatment group. The second section (in italics) is the only one changed in between the four treatments. Therefore, we only provide the second paragraph of the instructions for treatments two, three and four.

### INSTRUCTIONS IN THE ANONYMOUS TREATMENT

#### **To the participants in an economics experiment**

You have agreed to participate in this study which will take about half an hour to carry out. You have been paid SEK 50 for your participation. You may also earn an additional amount of money (at most SEK 120).

*Everyone in the room (except the monitor and one more person, see below) will decide how to allocate SEK 120 between himself/herself and an anonymous child in the SOS Children's Village Port Elizabeth in South Africa. The total sum of money that is given away by all in this room will be given to a the child in the Village mentioned above, except for an administrative fee of 8 percent that is taken by SOS Children's Villages. The donated money to the child will go to everyday expenses for food, clothes, education and health care.*

SOS Children's Villages is an organization founded in 1949 in Austria and it aims at giving orphaned and abandoned children a home, a family and education. SOS Children's Villages belongs to SFI, the Swedish Foundation for Fund-raising Control.<sup>20</sup> SFI regularly monitors the organization and controls that the money is used in the appropriate way, which gives SOS Children's Villages Sweden the right to use a so-called 90-account.

One of you will be chosen to be the monitor for the experiment. The monitor will be paid SEK 120 in addition to the SEK 50 already paid. The monitor will be in charge of the envelopes as explained below. In addition, the monitor will verify that the instructions have been followed as they appear here.

<sup>20</sup> See <http://www.insamlingskontroll.se/>. The Swedish name is "Stiftelsen för Insamlingskontroll". This non-profit organisation is financed by contributions from the charitable organisations that are entitled to use a "90-account". A 90-account is a special bank account only to be used by officially monitored charitable organizations.



The experiment is conducted as follows: unmarked envelopes corresponding to the number of participants have been placed in a box. All these except one contain six SEK 20 bills and six blank slips of paper of the same size. The remaining envelope contains twelve blank slips of paper. The monitor will call one person at a time and hand each person an envelope from the box. The person will take the envelope and go behind screen number one. The envelope will then be opened privately behind the screen.

When you have opened the envelope you have to decide how many bills and how many slips of paper to leave in the envelope. The number of bills and the number of slips of paper must add up to six. You then pocket the remaining SEK bills and slips of paper. Example: (1) Leave SEK 20 and five slips of paper in the envelope and pocket SEK 100 and one slip of paper. (2) Leave SEK 80 and two slips of paper in the envelope and pocket SEK 40 and four slips of paper. These are examples only. The actual decision is up to you. No one else will know your decision.

Once you have made your decision, you will seal the envelope and then place it in the box marked "returned envelopes". You then proceed to screen number two where you anonymously fill out a questionnaire with questions concerning the experiment. You then place the questionnaire in the box marked "questionnaires". The experiment is then over for you and you may leave the room.

After all envelopes have been returned, the monitor opens the envelopes and records the content of each envelope. The monitor then puts all SEK 20 bills in a stamped envelope addressed to the SOS Children's Villages, Sweden (the envelope also contains a letter that refers to the experiment, which the monitor reads through). When the money has been put in the envelope, the envelope is sealed and the monitor and the experimenter go to the closest mailbox and mail the envelope. SOS Children's Villages will transfer the total sum minus the administrative fee of 8 percent to the child in the village in Port Elizabeth, and a certificate that this has happened will be sent by e-mail to the monitor. The experiment is then over.

#### **INSTRUCTIONS IN THE PHOTO TREATMENT (Second paragraph)**

*Everyone in the room (except the monitor and one more person, see below) will decide how to allocate SEK 120 between himself/herself and an anonymous child in the SOS Children's Village Port Elizabeth in South Africa. A photo of the child is attached at the end of these instructions. The total sum of money that is given away by all in this room will be given to a the child in the Village mentioned above, except for an administrative fee of 8 percent that is taken by SOS Children's Villages. The donated*

*money to the child will go to everyday expenses for food, clothes, education and health care.*

**INSTRUCTIONS IN THE WRITTEN INFORMATION TREATMENT  
(Second paragraph)**

*Everyone in the room (except the monitor and one more person, see below) will decide how to allocate SEK 120 between himself/herself and an anonymous child in the SOS Children's Village Port Elizabeth in South Africa. Some information about the child is attached at the end of these instructions. The total sum of money that is given away by all in this room will be given to a the child in the Village mentioned above, except for an administrative fee of 8 percent that is taken by SOS Children's Villages. The donated money to the child will go to everyday expenses for food, clothes, education and health care.*

**INSTRUCTIONS IN THE PHOTO AND WRITTEN INFORMATION  
TREATMENT (Second paragraph)**

*Everyone in the room (except the monitor and one more person, see below) will decide how to allocate SEK 120 between himself/herself and an anonymous child in the SOS Children's Village Port Elizabeth in South Africa. A photo and some information about the child are attached at the end of these instructions. The total sum of money that is given away by all in this room will be given to a the child in the Village mentioned above, except for an administrative fee of 8 percent that is taken by SOS Children's Villages. The donated money to the child will go to everyday expenses for food, clothes, education and health care.*

## Appendix B

### QUESTIONNAIRE

#### Some questions to you who participate in this experiment

We kindly ask you to answer some short questions regarding the experiment you are participating in. As you have probably already understood, your answers are impossible to track. We therefore ask you kindly to answer the questions below truthfully. Thank you in advance.

1. First, state whether you are a man or a woman

Woman

Man

2. Below circle the sum of money you donated to the child in the preceding experiment

**0 SEK   20 SEK   40 SEK   60 SEK   80 SEK   100 SEK   120 SEK**

3. Please estimate the share of Swedish gross domestic income (GDI) that goes to foreign aid each year: \_\_\_\_\_

4. What is your opinion on the share of Swedish GDI that goes to foreign aid each year?

too small     about right     too large

5. What agent in the recipient country do you think should be the principal recipient of Swedish foreign aid?

the State     private agents

6. Which **single** factor do you consider to be the most important for Swedish foreign aid to fulfill? (Choose one alternative)

that the aid is effective (efficiency)

that the aid goes to people that are geographically close to us (proximity)

that the donor can influence what the money is used for (e.g., education, health care), (influence)

that the recipient’s identity is known to the donor (recipient known)

Finally, if you have chosen to donate money to the child in the experiment, we want you to answer question 7 below. If you have chosen not to give anything, we want you to instead answer question 8, also below.

7. We are interested in why you chose to donate money, when you could have kept the money yourself without losing anything from it. Below, you find a couple of suggested alternatives on what made you donate money and how you may have reasoned when you took this decision. Mark the alternative/alternatives that **best** corresponds/correspond to how you were reasoning when you made the decision to donate money.

I feel empathy/compassion with the child and therefore I want to give up money to the child.

I chose to give up the money to the child in the experiment for reasons of fairness since the allocation of the SEK 120 becomes fairer if I give up part to the child.

I chose to give up the money to the child in the experiment since the act of giving in itself makes me feel good. What is most important to me is that I have made a gift.

I chose to give up the money to the child in the experiment, since I hope that this means that I can get help myself if I get in trouble in the future.

none of the above alternatives is consistent with my thoughts and feelings when I chose to donate money. Instead I motivate my choice in the following way:

-----  
-----  
-----

8. In the case you did not donate any money, tell us why you made that decision:

-----  
-----  
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The experiment is now over. Thank you for participating.

TABLE 5. Relationship between donations and survey answers, OLS

<b>All treatments</b>						
	OLS(1)	OLS(2)	OLS(3)	OLS(4)	OLS(5)	OLS(6)
<i>Dependent variable:</i>						
<i>Share donated out of SEK 120</i>						
Constant	<b>.587</b> (.060)	<b>.532</b> (.068)	<b>.522</b> (.073)	<b>.500</b> (.078)	<b>.554</b> (.227)	<b>.608</b> (.094)
Treatment dummy (treatment 2)	-.099 (.089)	-.094 (.089)	-.084 (.088)	-.083 (.088)	-.108 (.090)	-.037 (.080)
Treatment dummy (treatment 3)	-.043 (.093)	-.055 (.091)	-.001 (.087)	-.008 (.086)	-.055 (.092)	-.009 (.083)
Treatment dummy (treatment 4)	.031 (.089)	.018 (.088)	.020 (.087)	.086 (.087)	.021 (.087)	.042 (.078)
Sex (d=1 if woman, 0 otherwise)		<b>.134</b> (.065)		.068 (.066)		
Aid too small			<b>.435</b> (.094)	<b>.152</b> (.068)		
Aid too large			<b>-.271</b> (.096)	<b>-.253</b> (.096)		
Effectiveness					.078 (.225)	
Influence					-.020 (2.30)	
Recipient known					-.042 (.246)	
Empathy						.082 (.072)
Warm-glow						.079 (.078)
Fairness						-.016 (.079)
Reciprocity						<b>-.211</b> (.100)
Other						<b>.212</b> (.078)
$R^2$	.014	.039	.103	.109	.028	.119
F-test (p-value)	.77 (.515)	1.81 (.130)	5.26 (.000)	4.95 (.000)	.72 (.635)	2.65 (.010)
Number of observations	165	165	164	164	165	129

Robust standard errors in parenthesis. A bold coefficient is significant at  $p < 0.05$ .

TABLE 6. Relationship between donations and survey answers, Tobit

<b>All treatments</b>						
	TOB(1)	TOB(2)	TOB(3)	TOB(4)	TOB(5)	TOB(6)
<i>Dependent variable:</i>						
<i>Share donated out of SEK 120</i>						
Constant	<b>.783</b> (.159)	<b>.645</b> (.170)	<b>.589</b> (.174)	<b>.535</b> (.181)	.678 (.529)	<b>.689</b> (.255)
Treatment dummy (treatment 2)	-.279 (.229)	-.260 (.226)	-.232 (.216)	-.225 (.215)	-.309 (.231)	-.120 (.219)
Treatment dummy (treatment 3)	-.113 (.233)	-.135 (.230)	-.000 (.223)	-.018 (.223)	-.158 (.234)	-.055 (.217)
Treatment dummy (treatment 4)	.079 (.229)	.047 (.226)	.059 (.218)	.046 (.217)	.052 (.230)	.081 (.211)
Sex (d=1 if woman, 0 otherwise)		.325* (.167)*		.157 (.163)		
Aid too small			<b>.445</b> (.169)	<b>.415</b> (.170)		
Aid too large			<b>-.597</b> (.292)	<b>-.562*</b> (.293)*		
Effectiveness					.244 (.530)	
Influence					-.059 (.543)	
Recipient known					-.096 (.585)	
Empathy						.251 (.207)
Warm-glow						.083 (.225)
Fairness						-.010 (.208)
Reciprocity						-.533* (.316)*
Other						<b>.593</b> (.239)
Pseudo-R <sup>2</sup>	.008	.018	.051	.054	.017	.064
LR chi2(m) (Prob>chi2)	2.65 (.449)	6.50 (.165)	17.93 (.003)	18.87 (.004)	5.98 (.426)	15.32 (.053)
N	165	165	164	164	165	129

Robust standard errors in parenthesis. A bold coefficient is significant at  $p < 0.05$ , while a coefficient followed by an asterisk (\*) is significant at  $p < 0.10$ . m=number of explanatory variables.

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## Women and Informality: Evidence from Senegal

with Elena Bardasi

**ABSTRACT.** The informal sector has long constituted a gap in the knowledge of women's labor. This paper seeks to fill a part of that knowledge gap using a 2002 household survey from Dakar, Senegal. 83% of working women are informal, compared to 50% of men. Multinomial logit analysis, controlling for education and other covariates, reveals that women are 3-4 times less likely to work formally (i.e., in the private formal sector or public sector) rather than informally. This may be due to the possibility provided by the informal sector of combining unpaid domestic work with paid work: informal women devote significantly more time to unpaid work than do women in the formal sector. We also use interval regression techniques to estimate Mincer equations to assess whether there is a wage gap between men and women in each sector. Controlling for personal characteristics, profession and industry, there is no significant gender wage effect in the private formal sector. Yet in the informal sector, women experience a 28% lower wage on average. This result holds across specifications and robustness tests. One reason for this may be that female informal entrepreneurs are found in smaller and less capital intense firms than men.

**Keywords:** Informal sector; Occupational choice; Self-employment; Wage discrimination; Women's work.

**JEL:** J24; J31; J71; L25; L26; O17.

### 1. Introduction

Labor markets in many developing countries are characterized by informality. Also when disregarding agricultural labor, more people in the developing world work in the informal sector – the part of the economy that does not fall under the purview of

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<sup>0</sup> We are grateful for valuable comments and suggestions from Magnus Johannesson, as well as from Per-Anders Edin, Per Engström, Bertil Holmlund, Henrik Huitfeldt, Erik Höglin, Mikael Lindahl, Erik Lindqvist, Henrik Lundvall, Björn Tyrefors and seminar participants at Sida, SSE and Uppsala University. Any remaining errors are our responsibility. Granström is indebted to the Jan Wallanders och Tom Hedelius stiftelse (J02-27) for financing. The findings, interpretations and conclusions expressed in this paper are those of the authors and should not be attributed in any manner to the World Bank, to its affiliated organizations, or to the members of its Board of Executive Directors or the countries they represent.

organized economic activities – than in the formal sector. In Sub-Saharan Africa, an estimated 72% of people are employed in the informal economy (ILO 2002).

A majority of the informal workers are women. In sub-Saharan Africa, a staggering 84% of female workers are found in the informal sector where they work as street vendors or home-based workers (ILO 2002). Across the developing world the informal sector offers more jobs for women, and more consistently, than the formal sector (Mehra and Gammage 1999).<sup>1</sup>

Despite this, labor market studies in developing countries have had a tendency to deal only with the formal sector. In an introduction to the study of developing country labor markets, Harrison and Leamer (1997) regret the exclusion of the informal sector. When the informal sector has been at the center of the attention, such as in Maloney (2004, 1999), the focus has almost exclusively been on male – not female – workers and entrepreneurs. The informal sector thus constitutes a gap in the knowledge of women's labor, as has been pointed out by Mehra and Gammage (1999) and WIEGO<sup>2</sup>. In fact, women in the informal economy have been referred to as "the invisible workforce".<sup>3</sup>

Women and informality is the focus of this study of the labor market in Dakar, Senegal. We use a rich cross-sectional data set with information on 11,772 individuals aged 15 to 65 (based on the Enquête 1-2-3 household survey from 2002), to address the following issues:

- Are women more likely than men to work in the informal sector?
- Are women – especially informal women – experiencing wage discrimination?
- Do women's informal firms differ from men's in size and capital intensity?

A frequent claim is that women are more likely than men to work in the informal sector (ILO 2002, Mammen and Paxson 2000, UNIFEM 2005) – also when controlling for other covariates such as education. One reason for why women would prefer the informal sector is that it allows them greater flexibility in combining non-remunerated household responsibilities with paid work (World Bank 2007, Cunningham 2001). Using multinomial logit analysis we study, in line with Keane and Wolpin (1997) and Constant and Zimmermann (2003), the occupational choice – that is, the choice among public, private formal and private informal sectors, as well as unemployment and inactivity – of men and women. Furthermore, we scrutinize descriptive data on time spent on unpaid household activities by women across sectors.

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<sup>1</sup> See Mammen and Paxson (2000) for an introduction to women and labor markets in developing countries.

<sup>2</sup> Women in Informal Employment: Globalizing and Organizing, <http://www.wiego.org> (September 4, 2007).

<sup>3</sup> Global Development Research Center, <http://www.gdrc.org> (September 5, 2007).

It is common to assert that wage disparities between men and women are particularly pronounced in the informal sector. According to a common critique of the Becker (1975) human capital theory, the existence of dual or segmented labor markets would confine less educated workers and women to secondary (i.e., informal) labor markets where different factors determine earnings (Mammen and Paxson 2000, Woodhall 1987). Wage disparities and discrimination based on gender have been studied in developed countries since the seminal work of Oaxaca (1973, 1977) and Mincer (1976).<sup>4</sup> Using Mincer wage regressions we analyze the factors driving wages in the public, private formal and private informal sectors. We investigate to what extent there is evidence of discrimination on the basis of gender – in particular, in the informal sector.

Finally we take interest in features such as the size and capital stock of informal firms managed by men and women – do they differ in any systematic way? One theory says that, due to credit constraints the informal firms of women are smaller in size and operate with lower capital stocks than those operated by men (World Bank 2007).

We find that women largely are confined to the informal sector. 83% of working women are informal, compared to 50% of men. Multinomial logit analysis reveals that, controlling for education and other covariates, a female is 3-4 times less likely to work formally (i.e., in the private formal sector or public sector) rather than in the private informal sector. This may be due to the possibility provided by the informal sector of combining unpaid domestic work with paid work. Informal women devote significantly more time to unpaid work than women in the formal sector.

Interval regressions estimations of Mincer wage equations for each sector reveal that, when controlling for personal characteristics, profession and industry, there is no significant effect of gender on wage in the private formal sector (neither in the public sector, for most specifications). Yet in the informal sector, women experience a 28% lower wage on average. This result holds across specifications and robustness tests. This does not necessarily mean that women are victims of direct wage discrimination in the informal sector, however. One reason for their lower wages is probably that female informal entrepreneurs are found in smaller and less capital intense firms than men.

The paper is structured as follows. Section 2 defines the informal sector and sections 3 discusses our data set and general methodology. We provide some descriptive statistics on the education, work and wages of women in Dakar in section 4. Section 5 analyses occupational choice and presents suggestive evidence that household responsibilities in part influence this choice for women. Wage analysis in the public, private

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<sup>4</sup> A brief overview is provided by Oaxaca (1987); see also Woodhall (1987). Moreover, the highly related topic of wage discrimination based on race (ethnicity) is surveyed in Chiswick (1987).

formal and private informal sectors follows in section 6. A seventh section briefly examines the differences between the informal firms managed by men and women. Section 8 concludes.

## 2. Informality – definition and link to gender

The term informality was first introduced by Hart (1973). Yet to this day, there is no agreed upon definition of the informal sector. As pointed out by the World Bank (2007), however, it almost exclusively has a negative connotation, signifying tax evasion, absence of employment contract, self-employment, reliance on family aides, exceptionally poor working conditions, to give only a few examples (see Henley et al. 2006, Prata and Quintin 2006, and Gërkhani 2004 for overviews).

Traditionally the informal sector has been viewed as caused by a dual, or segmented, labor market. According to that view, the (urban) informal sector is characterized by involuntary, transitory and unproductive employment providing meager earnings – it is mainly populated by the "reserve army of the underemployed" (Hart 1973, p.68). Arguably this is the picture of informality most often painted by the International Labor Organization (e.g., ILO 2002) and UNIFEM (2005). Recently, however, this view has been challenged as too simplistic (World Bank 2007, Maloney 2004, 1999, and Yamada 1996). Many workers or entrepreneurs choose to operate informally, and seem to fare rather well. Where the traditional view saw informality as a question of necessity, the challenging view talks of informality by choice. Using an alternative terminology coined by the World Bank (2007), we may refer to informality by exclusion or by exit.

Proponents of the informality-as-exclusion (or necessity) view tend to be principally concerned with the informal or unsalaried worker, who may work in an unregistered micro-firm as well as in bigger, registered firm. Exclusion means that informal workers are excluded from state benefits or the circuits of the modern economy. As such, this view of informality relates to two distinct, though overlapping questions. First, being informal increases the risk to which the individual is exposed. This risk is related to uncertain or variable incomes, but also to the absence of formal mechanisms to mitigate adverse shocks such as loss of job, sickness, or natural calamity (World Bank 2007, ILO 2002). The accent is thus placed on the risk related to informality as well as on poverty. According to this view it is important to adopt policies that allow a greater number of individuals to reach the state of formally (and regularly) paid work – a policy which creates "good" jobs. Second, there is the question of opportunities for certain vulnerable individuals, such as those who lack education, and the women which must combine work with household responsibilities. Where would they work if

not in the informal sector? Informal self-employment can certainly bring benefits for the individual (flexibility, profits, et cetera) but it also constitutes, to a large degree, a last resort for individuals who do not find work elsewhere. It is thus necessary to address the multiple constraints that leave certain individuals with no choice other than to work informally.

The informality-as-exit view focuses on the entrepreneur (or worker) who, after a rational cost-benefit analysis chooses to opt out of formality (or to remain in the informal sector). The legal aspect is at the center of the attention here: an entrepreneur chooses whether to register his or her firm and the employee whether to accept an "irregular" position. This view is linked to the seminal work of De Soto (2000, 1989). He insists that, for the state to broaden its tax base and the economy to experience sustained growth and job-creation, it must simplify firm regulation and bureaucratic costs and extend property rights. As the cost of operating formally goes down, more micro-entrepreneurs will opt for formalization of their firms which, in turn, will reduce poverty.

In reality the informal sector is far from being a monolithic entity. The above two views of informality are thus by no means exclusive – instead they complement each other. World Bank (2007), Maloney (1999) and Yamada (1996), for instance, study a group of Latin American, male micro-entrepreneurs who choose to operate informally in order to maximize utility (income) and fare rather well. It is not rare, however, that the lowest levels in the informal universe are inhabited by women. UNIFEM (2005) speaks about the stratification of the informal sector; a stratification in which women often seem to lose out. Many women work informally by tradition or by necessity (i.e., as a coping strategy) – not by choice. Critics of the informality-as-exit view thus claim that it is necessary to address several constraints (not just firm regulation constraints) that hinder individuals from moving out of informality. Examples of such constraints are a lack of education, crowding in unprofitable professions and industries that lend themselves easily to informal activities, and the allocation of power and work tasks within the household.

In our study, we define as pertaining to the informal sector individuals who work:

- in a private or associative firm as a manager or self-employed and who is not formally registered according to the Enquête 1-2-3 criteria, that is, who either does not hold written accounts, or who holds written accounts but is not registered (i.e., does not have a NINEA<sup>5</sup> or tax code);
- in a household (as e.g., a housemaid or gardener);

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<sup>5</sup> NINEA stands for “Numéro d’Identification National des Entreprises et Associations” and is the administrative code used in Senegal for firm registration.

- as a family aide (e.g., to a spouse in his or her business).

By defining an informal agent as above, we capture the homogeneity of the informal sector: those who are largely informal by choice (often self-employed) and those who are informal by necessity.

### 3. Data and general methodology

The 2002 Enquête 1-2-3 household survey, initiated in December 2001 and finalized in December 2004, was conducted in Dakar by the Government of Senegal together with AFRISTAT<sup>6</sup> and DIAL<sup>7</sup>. It consisted of three sequential survey phases, each executed on the field during a month's time. Survey phase 1 collected information on personal characteristics and work-related variables (from the formal or informal sector). Phase 2 gathered firm-level data for a sub-set of those individuals found (during phase 1) to manage an informal firm, and phase 3 dealt with household consumption data. The Enquête 1-2-3 household survey has been used to this aim in several Francophone African capitals with only minor adaptations as to the questionnaire design.

2,500 households were included in the survey. In order to assure geographic and demographic representativity, these households were randomly selected from a list with 125 different city segments. These segments were, in turn, randomly chosen from the entire set of districts that make up the agglomeration of Dakar according to the third Senegalese census (Recensement Général de la Population et de l'Habitat du Sénégal) in 2002. All individuals in each household were, to the extent possible, surveyed in person by the interviewer.

We have modified the Enquête 1-2-3 data set in order to carry out the analysis of this study. Our data set contains cross-sectional data on 11,772 individuals aged 15 to 65. This is how we, in line with the International Labor Organization (ILO), define the working age. For each individual we have access to a whole range of personal characteristics: education, sex, age, ethnic group, religion, marital status, and relation in the household such as household head, for instance. We also have work-related characteristics, such as hours spent on paid and unpaid work, profession, industry, sector, and wage (which allows us to construct the hourly wage). For the self-employed (or managers) in informal firms we also have a set of firm characteristics, for example registration and tax data, size, use of physical capital, sales, and inputs goods.

Our analysis of the Enquête 1-2-3 data follows the guidelines provided by Deaton (2000), who discusses the microeconomic analysis of household surveys. To account

<sup>6</sup> Economic and Statistical Observatory of Sub-Saharan Africa, <http://www.afriostat.org> (September 16, 2007).

<sup>7</sup> Développement Institutions & Analyses de Long terme, a development economics consultancy, <http://www.dial.prd.fr> (September 16, 2007).



for the sampling technique used in the survey design, we use analytical weights throughout the analysis of point estimates of means and other statistics. Yet we do not use weights in the regression analysis (see discussion in Deaton 2000).<sup>8</sup>

#### 4. Women's work – descriptive statistics

Among women (aged 15 to 65) in Dakar, 42% work, 15% are unemployed and 42% are not in the labor force (inactive). This is in line with the average figures for developing countries (UNIFEM 2005, Mammen and Paxson 2000). For men, the picture is the following: 68% work, 10% are unemployed and 22% are not in the labor force.

The lion's share of working women in Dakar are found in informality. 83% work in the in the private informal sector, 12% in the private formal sector and only 6% in the public sector. Compare this to the working men of whom 50% work informally, 38% work in the private formal sector and 12% in the public sector. This picture holds true also for alternative measures of informality (see Table 1 in the Appendix<sup>9</sup>).

Education levels for the women in Dakar are low. 39% of women have not been to school at all, compared to 25% of men. This could explain the strong female presence in the informal sector (see Woodhall 1987). Bigsten et al. (2004) show that, in Kenya, the probability of operating informally goes down as the level of education increases. Still for a given level of education there are sizeable differences between men and women. Among those who have never been to school, 21% of men work in the private formal sector whereas, for women, only 3% do. Across education levels the number of women relative to men is higher in the informal sector. It seems that education alone cannot explain women's strong informal presence.

Female wages are considerably lower than male wages in Dakar. The median monthly wage is 18,000 FCFA for women and 45,000 FCFA for men. Large differences persist also for a given education level (see Table 2). One explanation for this is that women tend to cluster in certain professions and industries (as well as in the informal sector) where wages are low. These factors seem to reinforce one another. As seen in Figure 1, the median wage of men in the informal sector (45,000 FCFA) is at 75% of the median wage in the private formal sector. With the median wage for informal women at 15,000 FCFA, they do not earn more than 38% of the private formal sector median wage. This may be explained by the fact that women constitute 81% of the unskilled workers who tend to get the lowest wages in the informal sector (see

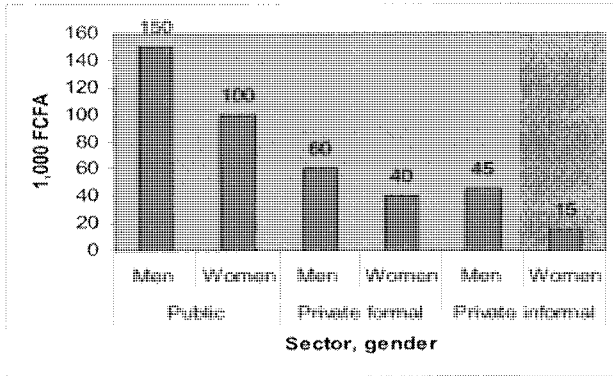
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<sup>8</sup> The use of weights does not change any important results, however. Weighted regression results are available upon request.

<sup>9</sup> Due to space limitations, all tables are found in the Appendix.

Table 3). Finally, as seen in Table 4, women are concentrated in the particular industries where mean wages are the lowest. 69% of those who work in personal services are women. The median monthly wage in this industry is 17,000 FCFA. Compare this to the median wage in the transport industry – where only 7% of the active are women – of 50,000 FCFA.

FIGURE 1. Median wages for men and women across sectors



## 5. Occupational choice

Women's low education levels alone cannot explain their tendency to work in the informal rather than the formal sector. For a given education level, women are relatively more numerous in the informal and less numerous in the formal sector. To investigate this issue in depth, we estimate an individual's occupational choice in line with e.g., Keane and Wolpin (1997), Wooldridge (2002), Constant and Zimmerman (2003) and Hill (1983).

**5.1. Methodology.** We utilize a multinomial logit model (McFadden 1974) with the occupational states as dependant factors and a set of personal characteristics as explanatory variables. Let  $y$  denote the variable capturing occupational state, so that  $y = \{0, 1, 2, 3, 4\} = \{\text{public, private formal, private informal, unemployment, inactivity}\}$ .  $x$  denotes the vector of conditioning variables (enumerated below). Since the response probabilities for the five sectors must sum to unity, the multinomial logit model sets the probability of being, for instance, in the public sector to (see Wooldridge

2002):

$$(5.1) \quad \Pr(y_i = \text{public} | x_i) = \frac{1}{1 + \sum_{j=1}^4 \exp(x_i \beta_j)}$$

for individual  $i$ , where  $j = \{1, 2, 3, 4\}$  denotes the remaining occupational states (i.e., private formal, private informal, unemployment, and inactivity).

In our main specification, the vector of independent variables,  $x$ , consists of age, age squared, number of children (in the household), matrimonial status, relation with the household head (household head, spouse, and other), sex, and education level (no schooling is the baseline, with a dummy each for primary education, and secondary education and above). Our results are based on this specification, whereas alternative specifications are discussed in the subsection on robustness tests.

We obtain predicted probabilities (based on the multinomial logit regressions) for men and women to be in a particular occupational state. We do so for five typical individuals with varying age and education level; for each type we see how the predicted probability of being in one sector changes with the discrete change of gender from man to woman.<sup>10</sup> Each type is married and lives in a household with the average number of children (4), unless otherwise stated in Table 6. Education and age vary across types as follows: 1) age 25 with primary school; 2) age 25 with secondary school and unmarried; 3) age 40 with no school and household head; 4) age 40 with university and household head; and 5) age 50 with secondary school and household head.

**5.2. Results.** The multinomial logit regression results indicate that education alone cannot explain the occupational choice of the individual – there is also a gender effect (see Table 5 where inactivity is the base outcome). It is true that the likelihood to operate in the public sector, as well as in the private formal sector, goes up with the education level. Conversely, the probability of working in the informal sector falls with rising education (compare to Woodhall 1987). Yet when controlling for education, women are still less likely to be found in the two formal sectors and more likely to work informally.

Table 6 presents the predicted probabilities (based on the multinomial logit) that a man or a woman is found in the public, private formal and private informal sector, respectively. Moreover, the ratios between the probability to work in the private formal versus the private informal sector are presented for each type in its last column.

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<sup>10</sup> As education and age have a large impact on occupational choice, the gender differences are better illustrated by the use of these five types of individuals than they would have been if we estimated them at the average parameter value for each explanatory variable.

First, notice that, across all types (i.e., for a given age and education level), women have a lower probability than men of working in the public sector and the private formal sector. The difference is particularly pronounced for the private formal sector. For instance, the probability that a man, 25 years of age and with primary education will be in the private formal sector is estimated to 20%; it is estimated to only 5% for a woman with the same characteristics.

Second, women are more likely than men to work in the informal sector. This becomes clearer still when we consider the ratio between the probability to work in the private formal sector and the probability of working in the private informal sector. For all types of individuals, this ratio is 3-4 times lower for women than for men. Consider a 40 year old household head without education. For men, the probability that this individual is in the private formal sector divided by the probability that he is in the private informal sector equals 0.52. It is around four times smaller for women (0.14). Similarly, for a 50 year old household head with secondary education, the probability of being in the private formal sector divided by the probability of being in the private informal sector is 1.53 for men but only 0.40 for women.

**5.3. Robustness tests<sup>11</sup>.** We perform various robustness tests. First, we use various specifications for the multinomial logit analysis. Alternative specifications account for potential interaction effects between gender and education, introduce variables such as migratory status and father's occupation, and leave out the variables capturing an individual's status within the household (household head, spouse etc.). This does not affect the fundamental results. We also estimate an individual's occupational choice using multinomial probit regression, again with the essential results unchanged.

Finally we restrict our analysis to the sub-sample of individuals who work. Using Logit and Probit regression, we study their binary choice between work in the formal sector (i.e., the public sector and the private formal sector pooled) and the informal sector. The logit analysis corroborates our multinomial regression results above (see Table 7). The female dummy is highly significant and negative in both cases.

**5.4. Domestic responsibilities and informality.** It has been suggested that women with heavy household responsibilities, such as domestic work or caring for children and elderly, choose to work in the informal sector as it allows them to optimally combine remunerated work with these non-remunerated domestic activities (see World Bank 2007, Maloney 2004, 1999, UNIFEM 2005 and Cunningham 2001). The nature of work, hours and location in the more rigid formal sector would not give women this opportunity. By examining information on the number of hours that individuals

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<sup>11</sup> Robustness test results for the occupational choice analysis are available upon request.

in various sectors devote to non-remunerated domestic activities, we obtain a first indication as to whether this theory holds up to scrutiny.

Information on the number of hours devoted to various domestic activities is found in Table 8. It is difficult not to notice the strong divergence in behavior between men and women. 84% of the men in the private formal sector and 76% in the private informal sector never engage in non-remunerated household work. For women, the corresponding figures are 41% and 27%, respectively. Notice that the women who work formally differ considerably from women who work informally. Considerably fewer women in the formal than in the informal sector engage in unpaid household work.<sup>12</sup>

The average number of hours per week devoted to domestic activities by women in the public and the private formal sectors, 7.1 and 9.3 hours respectively, are significantly lower than the 16.6 hours on average devoted by private informal women (t-test,  $p < 0.001$  in both cases). When we consider only those women who actually perform unpaid house work, the average number of hours is 14.1 in the public sector and 15.8 in the private formal sector; both significantly lower than the 22.8 hours devoted on average by private informal women (t-test,  $p < 0.001$  in both cases). The results are similar, though less marked for the activity of fetching water, firewood, or going to the market.<sup>13</sup> These findings lend some credence to the hypothesis that informal work (e.g., self-employment) may be associated, for women, with a higher degree of flexibility in combining paid and unpaid work.

## 6. Wage analysis

Our goal here is to investigate what determines the earnings in the public, private formal and private informal sectors in order to see if there is any evidence of unexplained wage gaps between men and women in these sectors. We thus estimate Mincer (1974) equations to seize the effect of various explanatory variables on the logarithm of the hourly wage.<sup>14</sup>

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<sup>12</sup> Using the two-sample Wilcoxon rank-sum (Mann-Whitney) test, the difference between women in the private formal and informal sector is highly significant ( $Prob > |z| = 0.0000$ ).

<sup>13</sup> There are no big differences between women who are employed by a registered rather than an unregistered firm (results available upon request). This indicates that the dynamics between informality and constraints linked to domestic duties are not determined by informality in a legalistic sense (i.e., by the registration status of a firm), but rather by the type of informality associated with self-employment. Self-employment may thus be chosen so as to increase flexibility in carrying out various unpaid household responsibilities. In fact, self-employed women consecrate significantly fewer hours per week to paid work than both other women and self-employed men.

<sup>14</sup> On earnings functions, see also Cahuc and Zylberberg (2004) and Psacharopoulos (1987).

**6.1. Methodology.** We use interval regression techniques to estimate the Mincer wage equations. The reason is that the Enquête 1-2-3 survey provide exact wage data for only approximately half of the working individuals. For the remaining working individuals we do not know the exact wage,  $w_i^*$  – only the wage bracket. Our wage data is thus interval-coded, that is, interval censored as well as censored in the upper tail. Interval regression techniques allow for analysis of such data. Interval regression is exactly ordered probit with the cut points fixed and with  $\beta$  and  $\sigma^2$  estimated by maximum likelihood (see Wooldridge 2002). Its chief advantage is that, by applying the ordered probit to interval regression, the  $\beta$ -parameters become interpretable as if we had observed the exact wage,  $w_i^*$ , for each individual  $i$  and estimated  $E(w_i^*|x) = x\beta$  by Ordinary Least Squares (OLS).<sup>15</sup>

We estimate interval regressions for all the individuals in the sample based on the wage bracket information. Having assigned the first 2,398 individuals for whom we have exact wage information to the corresponding wage brackets, we regress the logarithm of the lower and upper bounds of the wage brackets using interval regression technique for all the 4,411 individuals.

For each of the three sectors – the public, private formal and private informal sector – we estimate a Mincer wage equation. We use three different specifications that control for: 1) personal characteristics; 2) personal characteristics and profession; and 3) personal characteristics, profession and industry. Specification 3 is at the center of our attention. It uses as its explanatory variables: age (a proxy for experience; see Cunningham 2001 and Woodhall 1987 ); age squared; gender (with a dummy variable taking the value 1 for females and 0 for males); marital status; household head; education level (with dummies for primary and higher education and no school as the baseline); profession (with dummies for managers and professionals, clerks, service personnel and unskilled workers, respectively, and artisans as the baseline); and industry (with dummies for trade, personal services and other services, respectively, and manufacturing as the baseline). We use Huber-White robust standard errors.

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<sup>15</sup> Interval regression analysis is preferable to two alternative methods for wage regression in this case: OLS on the midpoints of the wage brackets and ordered logit regression on the likelihood of being in a specific wage bracket. In the first case, OLS regression would neither take into account our uncertainty as to the nature of the exact values within each interval, nor would it constitute an adequate response to the censoring in the tail. In the second case, one could conceptualize this model as an ordered logistic regression with seven ordered categories representing the wage brackets. This approach requires the data to meet the proportional odds assumption, however. This is not necessary the case as we convert this data into ordinal categories. More importantly, perhaps, the interval regression results are considerably easier to interpret. Nevertheless, we have estimated ordered logit regressions too and the results are discussed in the subsection on Robustness tests.

**6.2. Results.** Tables 9-11 present the interval regression results for the public, private formal, and private informal sector, respectively. In the following discussion, except where otherwise indicated, any reference to specific coefficients relates to specification 3 for each sector.

Except in the public sector, wage increases with age in the usual concave manner. There is also a clear wage premium associated with education in all sectors. It is highest in the public sector, 52% for primary and 83% for higher education, followed by the private formal sector, 24% and 48%, respectively, and the private informal sector, 20% and 57%, respectively.<sup>16</sup> (In all these cases the p-value is below 0.01. In what follows, we always have that  $p < 0.01$  unless otherwise indicated.) Considering that approximately 73% of the women only have primary education or less, this is of course an important explanation for women's low wages.

Turning to other personal characteristics, we find that, across sectors, whether an individual is married or not does not significantly affect his or her wage. In the private formal and private informal sectors, a household head earns 28% and 22% more, *ceteris paribus*.

Professions have strong effects on the wage – especially in the private formal and private informal sectors. In the public sector, only the manager/professional earns significantly more on average (60%) than an artisan (the baseline). In the private formal sector, the manager/professional and the clerk on average earns 60% and 26% more, respectively, the service personnel earn 30% less and the unskilled workers 16% less ( $p=0.078$ ). In the informal sector, a manager/professional on average earns 39% more than an artisan, while a clerk earns 36% less, and the service personnel and unskilled worker 28% and 83% less, respectively. Given that women are unlikely to be managers and professionals but very likely to work as service personnel or unskilled workers – especially in the informal sector – this plays an important part in explaining the low wages of women.

Industry also affects the wage, at least in the private formal and private informal sectors. In the former, work in personal services increases the wage by 32% and in "other" industries (agriculture, construction, transport, and real estate) is associated with a wage premium of 19% compared to the baseline (manufacturing). In the informal sector, the mean wage is 17% ( $p=0.044$ ) higher in the trade industry and 31% higher in other industries. Very few women work in these "other" industries, however.

Sector, finally, is a decisive factor for women's wages relative to those of men. In the public and private formal sectors, the parameter capturing the effect of gender on wage

<sup>16</sup> An alternative specification capturing no, primary, secondary and high school as well as university education shows that, on average, each education level raises the wage significantly (results available upon request). This specification does not change our fundamental results, however.

does not significantly differ from zero. This holds true across all specifications. When controlling for education and other personal characteristics, as well as for profession and industry, no wage gap remains between men and women in the private formal sector. The same is true for the public sector (although in the public sector, this does not hold in all cases, as discussed in the section on robustness tests below).

In the informal sector, however, the wage gap between men and women remains significant. In the minimalist first specification, when we do not control for profession or industry, a female earns 54% less than a man. When controlling for profession in specification 2, this wage gap goes down to 34%. In specification 3, when controlling for industry, the wage penalty for women is 28%. Unsurprisingly, t-tests reveal that the estimated gender parameter differs significantly between the public sector and the private informal sector, as well as between the private formal sector and the private informal sector.

**6.3. Interpreting the results: Potential selection bias.** Essential for how we interpret the above results are our beliefs about the relationship between wages and selection into a specific occupational state. Both occupational choice and wage are clearly determined by ability, which is unobservable.

First, there exist traditional constraints to women's work in many developing countries. Also in Senegal relatively more women than men are inactive and unemployed. Mammen and Paxson (2000) show that, across the developing world, numerous costs are associated with women's work outside the household. Customs or social norms limit women's possibility to take paid (especially manual) jobs. Paid jobs may be less compatible with bringing up children. There are even examples of laws against female wage work (e.g., the Taliban in Afghanistan). It is thus not unlikely that women who decide – and succeed – to engage in wage work are, on average, more determined and have higher (unobservable) ability than those who remain inactive (or unemployed). Hence it is not unreasonable to assume that the average working woman has higher ability than the average working man. In this case, after controlling for observables such as education and industry we should actually observe that women have a higher average wage than men. We may thus underestimate women's wage penalty in all sectors.

On the other hand, one may argue that the choice to work in a specific sector is linked to (unobservable) ability. Women may be more likely to work informally by necessity – exclusion from the formal sector – whereas men may be more likely to do so by choice – exit from the formal sector. Sánchez and Pagán (2001) point out that if women face difficulties in finding formal wage work, then also women with little entrepreneurial talent may have to go into (informal) self-employment. This



would push down the mean wage for female entrepreneurs. Moreover, the need to balance domestic and market responsibilities constrains productivity (see Blau 1998, and Sánchez and Pagán 2001). In Dakar, women with large domestic responsibilities work disproportionately in the informal sector. Heavy unpaid workloads may thus decrease the productivity of these women vis-à-vis the men in the informal sector. This could explain the gender wage gap observed in the informal sector. As a consequence we may overestimate the gender wage gap here. Should we be able to control for ability (or productivity), the wage gap would have been lower or non-existing.

Arguably women are not disfavored as much in terms of wages as in terms of access. In the public and the private formal sector wage regressions, the parameter capturing gender is insignificant. Yet women seem to suffer from a multiple lack of access – to education, certain professions, industries, and the formal sectors. Clearly this has a strong negative effect on women’s wages.

In the informal sector, also when controlling for the above covariates, there remains a wage gap between men and women. Yet this should not automatically be interpreted as evidence of direct wage discrimination. Among informal entrepreneurs, for example, gender-related differences that are unobservable to us could potentially explain the wage gap. Sánchez and Pagán (2001) argue that many women in developing countries become entrepreneurs to supplement family income and thus engage in business activities with low risk (volatility) and low returns. As we shall see below, the wage gap between male and female informal entrepreneurs may also be linked to differences in physical capital.

**6.4. Robustness tests<sup>17</sup>.** We perform several robustness tests. First, we use alternative specifications of the interval regression. We control for additional personal characteristics: migratory status (recent migrant, not recent migrant, and no migrant); ethnic group other than Wolof; and religion other than Islam. We also allow for five education levels (no school, primary, secondary, high school, and university, with no school as baseline). These variables do not change our fundamental wage regression results.

One important alternative specification excludes the household head variable. Only 26% of household heads in Dakar are female. We want to make sure that this fact does not drive the result where the female dummy turns out insignificant in the wage regressions for the public and private formal sector. That is clearly not the case in the private formal sector where the dummy for female remains largely insignificant. In the public sector, however, the picture changes – at least in part – as we drop the household head dummy. When we exclude household head from specification 3 above,

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<sup>17</sup> Robustness test results for the wage regression analysis are available upon request.

women in the public sector experience a wage penalty at 21% ( $p=0.004$ ). Yet if five education levels are used (no school, primary, secondary, high school, and university, with no school as baseline), the wage penalty for women decreases to 13% and is only significant at the 10-percent level ( $p=0.08$ ).

Finally, two additional robustness tests are carried out as we replace the interval regression wage analysis with other techniques. We perform OLS wage regression using the 2,398 individuals for whom we have exact wage data. This sub-sample is comparable to the entire sample of working individuals in terms of several characteristics.<sup>18</sup> Furthermore, we use ordered logit regression analysis estimating the likelihood to be in a specific wage bracket for the entire sample of working individuals. Our fundamental interval regression results are confirmed in both cases, although the ordered logit results are not as easily interpretable.

## 7. Men and women's informal firms

We briefly investigate whether there are any systematic differences in characteristics between the informal firms managed by men and women that could potentially explain the earnings gaps in the informal sector.

**7.1. Methodology.** Descriptive statistics on the size (number of employees) and type of premises associated with male and female-run informal firms are presented. We also measure the variation in capital intensity between male and female entrepreneurs to evaluate whether there is a gender effect. We control for other factors which are likely to affect the capital intensity in economic activities, such as firm size and the sector in which the firm operates. We regress the logarithm of capital intensity on sector, firm size, and gender. We also include interactions between gender and firm size as well as gender and sector.

**7.2. Results.** There are stark differences between the informal firms managed by men and those managed by women. Firm size is a first difference. As Sánchez and Pagán (2001) find for microentrepreneurs in Mexico, the informal firms operated by women are on average smaller than those run by men. While 41% of the firms managed by men have employees, only 14% of those managed by women do. Among the firms that have employees, the median number of employees is 2 for firms managed by women and 3 for those operated by men (Pearson's  $\chi^2$  test,  $p=0.039$ ).

In line with ILO (2002) and Mehra and Gammage (1999), we find that women are less likely to carry out their entrepreneurial activities in fixed premises. 15% of women

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<sup>18</sup> Comparing averages of several personal characteristics, we find few differences between the two groups.

work in the street using an improvised work station whereas 26% work in their own house without any particular installation; the corresponding figures for men are 3% and 7%.<sup>19</sup>

From the multivariate capital stock regression, we find that women in the informal sector use less physical capital than men do. This is partly due to the fact that women have a strong presence in industries with low capital intensity, such as trade and personal services. Yet the regression results<sup>20</sup> indicate that there are marked differences between firms managed by women and men also within a specific sector. The capital intensity disparity between women and men for a one-man business was estimated at 40%, 77%, and 85%, respectively, in manufacturing, trade, and personal services – sectors where 85% of the women are active.

These results suggest that women's access to capital may be limited, for example because women: have more difficulties in obtaining loans or to invest; have less own funds; benefit less from inheritances; and are not in possession of land title (or similar property rights) that may serve as collateral when taking up a loan from a bank.<sup>21</sup> Whatever the reason for the low capital intensity in female-run informal firms, it makes the marginal productivity of labor lower for female than male entrepreneurs – which could explain their lower earnings.

## 8. Conclusion

The lion's share (83%) of Dakar's working women are found in the informal sector. A lack of education alone cannot explain their strong informal presence, as evidenced by our multinomial logit analysis of occupational choice. For an individual with a given age and education level, the ratio between the probability to work in the private formal sector and the probability to work informally is 3-4 times lower for women than for men. We find indicative evidence that unpaid domestic responsibilities constitute an element of explanation for this. Informal women spend significantly more time on household responsibilities than women in other sectors. A choice to remain informal would increase their flexibility in combining their different responsibilities. This potential link between informal sector work (e.g., self-employment) and a desire for flexibility in combining paid and unpaid work should be an interesting area for future research.

Wage analysis using interval regression techniques show that low education as well as a strong presence in relatively badly paid industries (e.g., trade and personal services)

<sup>19</sup> The gender difference is highly significant in a Mann-Whitney test ( $Prob > |z| = 0.0000$ ).

<sup>20</sup> Available upon request.

<sup>21</sup> Yet female informal entrepreneurs do not view a lack of access to capital as a much bigger problem than their male counterparts. 54% of females see lack of access to capital as a problem, compared to 49% of males (the difference is not significant in a Mann-Whitney test,  $Prob > |z| = 0.1326$ ).

and professions (e.g., unskilled workers) explain a considerable part of the gender wage gap. Controlling for these and other covariates, we find no significant wage differences between men and women in the private formal sector. In the public sector, the picture is more mixed.<sup>22</sup>

In the informal sector, however, women experience a wage penalty across all specifications and robustness tests. Our main specification finds the wage gap between men and women to be 28%, *ceteris paribus*. This does not necessarily mean that informal women are victims of direct wage discrimination. One explanation could be that female informal entrepreneurs are relatively unproductive; we find that female-run informal firms are significantly less capital intense than male-run informal firms. Women's productivity in the informal sector may also suffer from their considerable domestic work-loads, as has been pointed out by Blau (1998).

What occupational opportunities do Senegalese women have today? Arguably many of them do not have other options than to work in the informal sector. Our results suggest that in order to help women to fully break out of informal employment, one has to address multiple constraints: the low level of education and training among women; a high concentration of women in low-paid professions and industries; weak capital intensity in female-run firms (potentially due to low access to credit among women who want to become self-employed); and a highly asymmetric allocation of domestic work tasks between men and women.

The informal sector is a hugely important, yet largely unexplored, phenomenon across the developing world. Not only may further inquiries into the nature and dynamics of the informal sector fill a knowledge gap in economics – they may help policy-makers to improve the lot of thousands of women.

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<sup>22</sup> A significant wage penalty remains for women in one robustness test specification (where the "household head" is excluded and only two education dummies are used).

## Appendix A

## TABLES

TABLE 1. Percentage informal in a sector according to different measures of informality, by labor market category and sex

	Private sector				Public sector			Households
	Salaried		Self-employed		M	F	M	F
	M	F	M	F				
Written contract	48	53	10	5	93	87	7	5
Accounts	n.a.	n.a.	10	6	n.a.	n.a.	n.a.	n.a.
Payment bulletin	53	61	4	1	92	84	2	3
IPRES/CSS reg.*	61	69	5	2	100	100	n.a.	n.a.
NINEA reg.*	63	71	7	2	100	100	n.a.	n.a.
N. contribuable registration*	62	69	8	2	100	100	n.a.	n.a.
IPRES, CSS, Caisse de retraite	11	9	0	0	29	26	0	0
Irregular work	20	15	27	30	6	6	82	94
Share of all working people of same sex	35	11	48	62	12	6	3	21
Frequency†	1026	247	1387	1439	343	130	92	490

N=5,219. M=Male, F=Female. \* Note that the individuals who work in the public sector and in households do not answer this question. † Weighted and rounded off frequencies. n.a. =not applicable.

TABLE 2. Percentage women and wages by education level

Education	% of which are women	Mean wage		Median wage	
		M	F	M	F
No school	51	54	26	40	15
Primary	36	46	29	30	16
Secondary (1st cycle)	36	91	63	61	32
High school	42	108	55	85	40
University	20	158	146	150	100
Total	41	68	36	45	18

M=Male, F=Female. Wages are expressed in 1,000 FCFA.

TABLE 3. Concentration of women and wages by profession in the formal and informal sector

Profession	% formal employees compared to informal)†		Private formal			Private informal		
	M	F	% women	Median monthly wage		% women	Median monthly wage	
				M	F		M	F
Managers and professionals	68	83	21	120	60	12	50	20
Clerks	84	90	28	75	50	20	49	17
Service personnel	35	5	18	50	25	69	40	15
Artisans	33	15	8	60	40	19	50	25
Unskil. workers	60	8	23	50	40	81	30	15
Total in sector	50	17	20	60	40	58	45	15

M=Male, F=Female. Wages are expressed in 1,000 FCFA. † Excluding the few individuals who are apprentices in this profession.

TABLE 4. Percentage women and wages by industry

Industry	% women	Median monthly wage
Agriculture	15	35
Manufacturing	23	25
Construction	4	40
Trade	59	25
Transports	7	50
Real estate	19	70
Personal services	69	17

Wages are expressed in 1,000 FCFA.

TABLE 5. Multinomial logit regression results for occupational choice

Variable	Occupational state			
	Public	Private formal	Private informal	Unemployed
Age	.605*** (.041)	.387*** (.020)	.239*** (.013)	.210*** (.017)
Age squared	-.007*** (.000)	-.005*** (.000)	-.003*** (.000)	-.003*** (.000)
Female	-1.687*** (.146)	-2.353*** (.094)	-1.007*** (.068)	-.699*** (.079)
Household status ( <i>baseline: other</i> )				
Household head	.770*** (.168)	.617*** (.127)	.532*** (.103)	-.002 (.135)
Spouse	.021 (.201)	-.066 (.153)	.021 (.094)	-.190 (.117)
Married	.104 (.150)	-.330** (.101)	-.292*** (.075)	-.363*** (.091)
Children	.003 (.018)	-.022* (.011)	-.005 (.008)	-.012 (.011)
Education ( <i>baseline: none</i> )				
Primary	1.036*** (.216)	.174* (.098)	-.357*** (.066)	.161* (.083)
Secondary	2.131*** (.203)	.453*** (.108)	-.873*** (.085)	.221** (.097)
High school	2.766*** (.245)	.626*** (.170)	-.904*** (.156)	.370** (.161)
University	3.156*** (.234)	1.09*** (.162)	-1.470*** (.187)	.437** (.173)
Constant	-14.099*** (.833)	-5.963*** (.363)	-2.507*** (.231)	-3.011*** (.290)
Log likelihood	-13444.8			
LR chi2(55)	5450.8			
Probability > chi2	.000			
Pseudo $R^2$	.169			
Number of obs.	9932			

Note: Inactivity is the base outcome. Robust standard errors in parenthesis.  
Significance levels: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

TABLE 6. Predicted probabilities to be in a particular sector

Type of individual	Probability public (%)		Probability private formal (%)		Probability private informal (%)		Probability private formal / Probability private informal	
	M	F	M	F	M	F	M	F
1. Age 25, primary school	1.5	0.7	20.1	4.9	34.5	32.2	0.58	0.15
2. Age 25, secondary school	3.3	1.7	29.9	8.1	22.3	23.3	1.34	0.35
3. Age 40, no school, household head	3.6	2.0	28.4	8.2	54.4	60.3	0.52	0.14
4. Age 40, university, household head	42.5	39.2	42.6	20.2	6.3	11.5	6.76	1.76
5. Age 50, secondary school, household head	30.0	18.8	32.4	10.5	21.1	26.6	1.53	0.40

M=Male, F=Female. All five types are married and live in a household with four children, unless otherwise stated.



TABLE 7. Logit and probit regressions: likelihood to work in formal sector

Variable	Logit	Probit
Age	.131*** (.020)	.077*** (.011)
Age squared	-.001*** (.000)	-.001*** (.000)
Female	-1.314*** (.082)	-.777*** (.047)
Household status ( <i>baseline: other</i> )		
Household head	.015 (.103)	.004 (.060)
Spouse	-.069 (.133)	-.053 (.078)
Married	-.153 (.093)	-.085 (.054)
Children	-.014 (.010)	-.008 (.006)
Education ( <i>baseline: none</i> )		
Primary	.634*** (.086)	.374*** (.050)
Secondary	1.708*** (.095)	1.028*** (.056)
High school	2.115*** (.156)	1.265*** (.090)
University	3.137*** (.176)	1.824*** (.093)
Constant	-3.364*** (.355)	-1.980*** (.204)
Log pseudo-likelihood	-2628.3	-2625.9
Probability > chi2	.000	.000
Pseudo $R^2$	.224	.225
Number of obs.	5125	5125

Robust standard errors in parenthesis. Significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . "Formal sector" is public and private formal sectors pooled.

TABLE 8. Hours dedicated to unpaid, work-like activities

Men									
Activity	Public sector			Private formal sector			Private informal sector		
	% 0 hours	Mean >0	Mean with 0	% 0 hours	Mean >0	Mean with 0	% 0 hours	Mean >0	Mean with 0
Domestic unpaid work	85	5.9	0.9	84	6.0	1.0	79	10.5	2.2
Fetching water or wood, going to market	99	3.8	0.1	97	5.4	0.2	96	9.7	0.5
Women									
Activity	Public sector			Private formal sector			Private informal sector		
	% 0 hours	Mean >0	Mean with 0	% 0 hours	Mean >0	Mean with 0	% 0 hours	Mean >0	Mean with 0
Domestic unpaid work	50	14.1	7.1	41	15.8	9.3	27	22.8	16.6
Fetching water or wood, going to market	70	5.0	1.5	68	5.9	1.9	55	7.0	3.2

TABLE 9. Interval wage regressions – public sector

Variable	Specification		
	1	2	3
Age	.050 (.104)	.030 (.030)	.027 (.030)
Age squared	-.000 (.000)	-.000 (.000)	-.000 (.000)
Female	-.125 (.085)	-.132 (.086)	-.126 (.086)
<i>Education (baseline: none)</i>			
Primary education	.510*** (.127)	.505*** (.114)	.520*** (.117)
Above primary education	.980*** (.111)	.798*** (.100)	.829*** (.108)
Married	.028 (.103)	.050 (.100)	.049 (.098)
Household head	.161* (.090)	.169* (.089)	.174* (.089)
<i>Profession (baseline: artisan)</i>			
Managers and professionals		.569*** (.173)	.598*** (.172)
Clerk		.058 (.157)	.077 (.155)
Service personnel		-.072 (.171)	-.109 (.177)
Unskilled worker		-.255 (.170)	-.216 (.168)
<i>Industry (baseline: manufacturing)</i>			
Trade			.014 .155
Personal services			-.032 .153
Other industries			-.163 .110
Constant	3.706*** (.569)	4.20*** (.534)	4.33*** (.549)
Maximum Likelihood $R^2$	.245	.329	.332
McKelvey and Zavoina's $R^2$	.254	.341	.343
Number of obs.	440	436	436
Robust standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.			

TABLE 10. Interval wage regressions – private formal sector

Variable	Specification		
	1	2	3
Age	.065*** (.018)	.054*** (.017)	.053*** (.017)
Age squared	-.001** (.000)	-.000** (.000)	-.000** (.000)
Female	.056 (.065)	.012 (.064)	-.022 (.063)
<i>Education (baseline: none)</i>			
Primary education	.283*** (.078)	.225*** (.075)	.236*** (.075)
Above primary education	.733*** (.074)	.498*** (.076)	.477*** (.075)
Married	.074 (.068)	.090 (.065)	.088 (.065)
Household head	.317*** (.071)	.280*** (.068)	.281*** (.068)
<i>Profession (baseline: artisan)</i>			
Managers and professionals		.642*** (.117)	.597*** (.118)
Clerk		.272*** (.073)	.257*** (.073)
Service personnel		-.264*** (.076)	-.297*** (.077)
Unskilled worker		-.073 (.085)	-.158* (.088)
<i>Industry (baseline: manufacturing)</i>			
Trade			.129 (.094)
Personal services			.319*** (.098)
Other industries			.186*** (.061)
Constant	3.506*** (.317)	3.811*** (.307)	3.730*** (.307)
Maximum Likelihood $R^2$	.221	.282	.289
McKelvey and Zavoina's $R^2$	.197	.257	.264
Number of obs.	1200	1197	1194
Robust standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.			

TABLE 11. Interval wage regressions – private informal sector

Variable	Specification		
	1	2	3
Age	.115*** (.013)	.091*** (.013)	.090*** (.013)
Age squared	-.001*** (.000)	-.001*** (.000)	-.001*** (.000)
Female	-.544*** (.053)	-.337*** (.058)	-.282*** (.061)
<i>Education (baseline: none)</i>			
Primary education	.268*** (.056)	.202*** (.055)	.200*** (.055)
Above primary education	.657*** (.077)	.586*** (.075)	.569*** (.075)
Married	.111* (.062)	.067 (.061)	.069 (.060)
Household head	.182*** (.066)	.213*** (.064)	.215*** (.064)
<i>Profession (baseline: artisan)</i>			
Managers and professionals		.387*** (.146)	.386*** (.146)
Clerk		-.355*** (.119)	-.361*** (.123)
Service personnel		-.221*** (.064)	-.276*** (.078)
Unskilled worker		-.862*** (.083)	-.825*** (.112)
<i>Industry (baseline: manufacturing)</i>			
Trade			.173** (.086)
Personal services			.047 (.112)
Other industries			.314*** (.083)
Constant	2.458*** (.235)	3.194*** (.236)	3.073*** (.239)
Maximum Likelihood $R^2$	.155	.193	.196
McKelvey and Zavoina's $R^2$	.087	.103	.107
Number of obs.	2771	2761	2758
Robust standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.			



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## Does Innovation Pay? A Study of the Pharmaceutical Product Cycle

**ABSTRACT.** This paper studies how pharmaceutical life cycles depend on a drug's degree of therapeutic innovation. A unique data set rates all the 414 New Chemical Entities (NCEs) introduced in Sweden between 1987 and 2000 into one of three FDA innovation classes: A (important therapeutic gains); B (modest gains); and C ("me-too" drugs with little gains). This data is combined with sales figures for the 1987-2007 period. Regression analysis controlling for time effects and anatomical group shows that, over a 15-year life cycle, the average class A drug raises 15% higher revenues than B drugs and 114% higher revenues than C drugs (using a 4% discount rate). However, yearly sales for class A drugs are only significantly higher than for me-too drugs in year 14-17 after launch. Class B drugs, on the other hand, display significantly higher sales than C drugs in year 1-11 after launch. Sales of the most innovative drugs are initially weak and characterized by a high variance. When pooling A and B drugs to compare innovative and imitative (class C) drugs, we find 15-year life cycle revenues of the former to exceed those of imitative drugs by 100%. The sales difference is significant in 19 out of 20 years after launch. Finally, we find evidence of a first-mover advantage analyzing first and second mover sales differences.

Keywords: First-mover advantage; Innovation; Pharmaceuticals; Product cycle.  
JEL Classification: I11; L65; O31.

### 1. Introduction

Pharmaceutical innovation has brought tremendous health improvements to humanity in recent decades. In an attempt to quantify these gains, Nordhaus (2003) showed that, while per-capita consumption grew at a rate of 2.0% per annum from 1975 to 1995, average annual improvements in life expectancy corresponded to a value of between 1.6 and 2.0% of consumption. Murphy and Topel (2003) have reached similar conclusions. Moreover, Lichtenberg (2001) finds that not only do newer drugs decrease mortality and morbidity among patients – they also tend to lower non-drug medical expenses.

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<sup>0</sup> I am grateful for valuable comments and suggestions from Magnus Johannesson and Robert Östling, as well as from Ola Andersson, Per Granström, Sven Granström, Erik Lindqvist, Erik Mohlin, Björn Tyrefors, and seminar participants at the Research Institute of Industrial Economics (IFN) and SSE. Any remaining errors are my responsibility. I am indebted to the Jan Wallanders och Tom Hedelius stiftelse (J02-27) for financial support.

The pharmaceutical sector has been under increased scrutiny lately, however. In the United States, increasingly expensive R&D, together with an aging population and better diagnostic techniques, has inflated pharmaceutical spending to US\$ 141 billion in 2001 (Pammolli and Riccaboni 2004). As the share of income allocated to medical spending increases across industrialized countries<sup>1</sup>, calls have multiplied for cost-containment through the use of cheaper generic drugs.

Critique of "Big Pharma" often focuses on high profits and steeply increasing prices of new drugs. Producers of branded drugs have been accused of conspiring to delay the launch of cheaper generic pills (Economist 2008). Pharmaceutical innovation, it is said, has slowed down and new-drugs pipelines at big firms have run dry. Indeed, there are concerns that firms allocate too much resources to the development of "me-too" drugs; drugs that bring little or no therapeutic gains above existing drugs but are relatively cheap and less risky to develop.

Would pharmaceutical firms be right to adopt such a strategy? Are returns to R&D not higher for innovative than for me-too drugs? We address this issue by studying how the pharmaceutical product cycle (that is, the evolution of drug sales over time) depends on the degree of therapeutic innovation.<sup>2</sup> This is a neglected topic in pharmaceutical economics. Economists have studied the pricing of pharmaceuticals and how it depends on drug innovation (e.g., Reekie 1978, Lu and Comanor 1998), the diffusion of new products (e.g., Dranove and Meltzer 1994), and the costs and drivers of pharmaceutical innovation (Di Masi 2002, Di Masi et al. 2003, Henderson and Cockburn 1996). To our knowledge, only Danzon and Kim (2002) and Grabowski and Vernon (1990) consider the pharmaceutical product cycle. Yet these studies disregard the issue of therapeutic innovation.

A unique data set rates all the 414 New Chemical Entities (NCEs) introduced on the (price regulated) Swedish pharmaceutical market between 1987 and 2000 into one of three US Food and Drug Agency (FDA) innovation classes: A (important therapeutic gains); B (modest gains); and C ("me-too" drugs with little gains). This data is combined with sales figures for the 1987-2007 period (in 2006 SEK).

Analyzing yearly and total life cycle sales, we first compare class A, B and C drugs. We then pool A and B drugs to compare innovative to imitative (me-too) drugs. In OLS regressions, we control for covariates such as time effects and anatomical group. Finally, we investigate whether there is a first-mover advantage in the Swedish pharmaceutical market, that is, whether the first entrant in a market segment is rewarded by superior

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<sup>1</sup> In a group of 18 developed economies, its average share of GDP rose from 5.2% in 1970 to 8.9% in 2001 (Economist 2004).

<sup>2</sup> We shall use the terms *pharmaceutical* and *drug* interchangeably throughout this paper. The same goes for *product cycle* and *life cycle*.

sales compared to the second entrant. These issues should be of interest to economists, but also to policy-makers as increased knowledge on drug innovation, market launch and life cycles will allow for more efficacious regulation of pharmaceutical markets.<sup>3</sup>

OLS regression analysis over a 15-year life cycle shows that average class A drug revenues are 15% higher than for B drugs and 114% higher than for C drugs (using a 4% discount rate). Measuring revenues over a 20-year life cycle increases these relative differences, which indicates that a considerable part of innovative drug sales come late in the life cycle.

We note that yearly sales for class A drugs are only significantly higher than for me-too drugs in year 14-17 after launch. Class B drugs, on the other hand, display significantly higher sales than C drugs in year 1-11 after launch. Sales of the most innovative drugs are initially weaker than the sales of both its competitors. Class A sales peak around 15 years after launch. We find evidence that this is due to the introduction of new versions of the original NCEs. Furthermore, class A drug sales are characterized by high variance. Truly innovative drug R&D thus seems to involve high risks.

When pooling A and B drugs to compare innovative and imitative (class C) drugs, we find that discounted 15-year life cycle revenues of the former exceed those of imitative drugs by 100%. Innovative yearly drug sales peak at above SEK 60 million, or roughly double the peak level of imitative drugs. We also find that, 20 years after launch, sales of the average imitative drug are back to zero. Finally, we find evidence of a first-mover advantage analyzing first and second-mover sales differences across two different time measures (respective years after launch and calendar year).

This paper is organized as follows. The following section presents some related literature on the pharmaceutical market. A third section spells out our hypotheses on the relationship between market launch, innovation, sales and product life cycles. In a fourth section, the data set is discussed. Section five presents descriptive statistics. Section six is concerned with the empirical investigation (graphic and regression analysis) for class A, B and C drugs. The seventh section repeats this analysis for innovative versus imitative drugs. Section eight presents the first-mover analysis. A ninth and final section discusses the results and concludes.

## 2. Related Literature

The high R&D intensity in the pharmaceutical industry is one feature that distinguishes it from other industries (Schweitzer 2007, Berndt 2002, Scherer 1993). Several

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<sup>3</sup> The European Commission as well as the US Federal Trade Commission (FTC) are currently both looking into how to sharpen pharmaceutical regulation (Economist 2008).

strands of literature deal with pharmaceutical R&D and relate it to the pricing, market diffusion, and product cycles of new drugs.

In a groundbreaking study, Reekie (1978) examines the pricing of NCEs introduced on the U.S. market between 1958 and 1975. He finds the introductory price of a new drug (relative to that of already existing substitutes) to be positively correlated with the degree of therapeutic innovation. Furthermore, prices tend to rise faster for drugs with lower introductory prices than for drugs introduced at a higher price.

Lu and Comanor (1998) investigate how prices evolve for 144 NCEs launched on the U.S. market between 1977 and 1987. Therapeutic value and market structure are the main explanatory variables behind NCE pricing. They find that introductory prices are on average three times higher if a new NCE is considered to bring important therapeutic gains, whereas drugs representing only minor therapeutic advances were introduced at about the same price as existing substitutes. Moreover, while prices for drugs with important therapeutic gains were fairly stable over time, prices for drugs bringing only minor improvements increased over time. These findings are in line with two general pricing strategies observed by Dean (1969), skimming and penetration pricing.

Ekelund and Persson (2003) perform essentially the same investigation as Lu and Comanor (1998) – but on the price regulated Swedish market. Drug prices in Sweden are fixed by the Pharmaceutical Benefits Board (LFN), a government agency, after negotiations with the manufacturers. When setting a launch price for a new drug, LFN should consider its medical merits and health economic value, the price in comparable countries, and the price for related treatments.<sup>4</sup> As Lu and Comanor (1998), Ekelund and Persson (2003) find that introductory prices reflect the degree of innovation of a drug. Contrary to the findings from the U.S. market, however, drug prices fall over time for all therapeutic classes. Finally, and somewhat surprising, no evidence is found of branded substitutes affecting either introductory prices or price dynamics.

Another strand of the literature is concerned with the diffusion of new drugs to the market. Dranove and Meltzer (1994) develop measures of "importance" and "time to approval" for new pharmaceuticals. They use these measures to study whether more important drugs (a potential HIV vaccine, say) reach the market faster than less innovative drugs. The time for development of a drug and to its approval indeed falls with the perceived importance of a drug, indicating that earlier estimated costs of approval lags exaggerated actual costs in many cases.

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<sup>4</sup> For more information on drug market regulation in Sweden, see Ekelund and Persson (2003) and LFN at <http://www.lfn.se/>.

Still another strand of literature deals with the pharmaceutical R&D process. Henderson and Cockburn (1996) examine the relationship between pharmaceutical firm size and research productivity. Using internal firm data, they find larger research efforts to be more productive. This is in part because they benefit from economies of scale. But it is also because large firms may exploit economies of scope. By sustaining diverse research portfolios they capture internal and external knowledge spillovers.

Di Masi et al. (2003) estimate the average pre-tax drug development costs based on data on 68 randomly selected drugs from 10 pharmaceutical firms. The average cost of bringing a NCE to the market is US\$ 403 million in 2000 dollars. Accounting for the time between investment and marketing (i.e., taking the opportunity cost of capital into account) raises the cost to US\$ 802 million. The authors point out that, compared to an earlier study using a similar methodology, total capitalized costs have increased with 7.4% per annum above general price inflation. These cost estimates have been a matter of much public debate since they were first made public.<sup>5</sup>

Di Masi (2002) studies the potential effects of various strategies to reduce drug R&D costs. He shows that substantial cost reductions are to be made from decreasing development and regulatory review times, higher clinical approval success rates, earlier decisions during clinical development on drugs that fail, and the use of genomics and other new technologies.

Although related to all these strands of literature, the study of pharmaceutical product cycles has received considerably less attention. Danzon and Kim (2002) investigate drug life cycles from a cross-national perspective. They use data on outpatient sales in seven countries for the 1981-1992 period to compare average price, per capita volume and expenditure over the life cycle of a drug.<sup>6</sup> The age-volume profiles follow an inverted U; annual volume sold per drug increases for the first decade after introduction in all countries, reflecting the varying rates of diffusion of each country, after which it falls back. Moreover, when life cycle revenue per capita is compared across countries, the ranking differ considerably from the usual single point-in-time price level comparisons. While France has the lowest 1992 price level in relation to the U.S., when the 12-year per capita life cycle revenues are considered, its figures are at 96% of the U.S. values. Finally, per capita revenue is, for all countries, highest for global drugs as compared to local drugs.

Grabowski and Vernon (1990) estimate product cycles and returns to R&D for 100 NCEs introduced in the U.S. in the 1970s. For each NCE, annual cash flows are estimated over the projected life cycle of the drug. The goal is to tell whether the

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<sup>5</sup> See e.g., Frank (2003) for a brief discussion.

<sup>6</sup> The countries are Canada, France, Western Germany, Italy, Japan, the United Kingdom and the United States.

present value of the cash flows from the average NCE cover the R&D expenses. Their answer is negative. In fact, only the top 30 drugs cover average expenses on R&D. The increases in real drug prices during the 1980s were necessary for the average new drug introduced to recover its R&D expenses.

None of the studies on pharmaceutical life cycles mentioned above link the sales of a drug, or its diffusion in the market, to its degree of therapeutic innovation. Yet the product cycle of a drug should vary with the degree of therapeutic innovation.

### 3. Hypotheses on Innovation, Market Launch and Sales

We distinguish between two different types of R&D: innovative (pioneering) and imitative R&D (Nelson and Winter 1982, Grabowski and Vernon 1987). Innovative R&D is concerned with the development of new products with unprecedented therapeutic characteristics. Such research may result in class A drugs, which are defined as to bring important therapeutic gains, or class B drugs, that bring modest therapeutic gains.<sup>7</sup> Imitative R&D, on the other hand, deals with the investigation of a known family of products and will thus bring few therapeutic advances (class C drugs).

Innovative and imitative drugs should differ in terms of potential revenues as well as costs. If the market values medical innovation, pioneering pharmaceuticals should not only gain faster market access than less innovative drugs (Dranove and Meltzer 1994) – they should also display higher average sales. Innovative drugs may potentially become "blockbusters" for which revenues outstrip R&D costs by far. Yet pharmaceutical R&D is time-consuming, risky and costly (Pammolli and Riccaboni 2004, Di Masi et al. 2003, Di Masi 2002, Kettler 1999) The relatively low probability of success makes pioneering R&D particularly costly. Me-too drugs spawned through imitative R&D involve less risk. They should also be cheaper to produce (see e.g., Grabowski 2002). We conjecture, however, that they have more modest commercial possibilities.<sup>8</sup>

A product cycle expresses sales of a product as a function of time (Brockhoff 1967). Product life cycles may vary among different types of goods. Consumer goods typically go through four successive phases: product launch, market growth, market maturity and sales decline. As shown by Danzon and Kim (2002), this general pattern seems to hold also for pharmaceuticals. Drug sales rise initially as the product gets known to more and more consumers only to decline later, as the possibility of substituting to better products increases with time. We are interested in how the product cycle differs – qualitatively and quantitatively – with the degree of innovation; that is, between firms concerned with pioneering and imitative R&D.

<sup>7</sup> This FDA drug classification is further defined below.

<sup>8</sup> There is also generic competition, which consist of marketing a drug identical to one already in the market but to a lower price. We are not concerned with generic drugs here, however.



Let  $y_t^k$  be sales in time period  $t$  for a drug of type  $k$ . First, we take *type* to indicate a drug's degree of innovation. Using the innovation rating presented above, we have that  $k \in \{A, B, C\}$ . Using instead a binary innovation scale with innovative (*IN*) and imitative (*IM*) drugs, we have that  $k \in \{IN, IM\}$ . We conjecture that sales increase with the degree of innovation, *ceteris paribus*. This allows us to formulate two testable hypotheses concerning the relationship between sales and innovation.

**Hypothesis 1a:** Class A and class B drugs both have higher sales than class C drugs. We test the null hypotheses that  $y_t^A = y_t^C$  and  $y_t^B = y_t^C$ .

**Hypothesis 1b:** Innovative drugs have higher sales than imitative drugs. That is, we test the null that  $y_t^{IN} = y_t^{IM}$ .

It is also likely that the order in which drugs are launched on the market matters for sales. Among substitute drugs that target the same condition, one may think of a first-mover advantage as well as a second-mover advantage. If the first drug that enters a particular market segment benefits from higher sales, the pharmaceutical market is characterized by a first-mover advantage. According to Pammolli and Riccaboni (2004), the share of drug sales among competitors tend to be asymmetric in favor of early entrants. It is possible, however, that delayed market entry allows the second mover to develop better quality attributes than the first mover which, in turn, ultimately gives it higher sales (see Berndt et al. 2003).<sup>9</sup>

We now take *type* to indicate a first mover (*FM*) or a second mover (*SM*), so that  $k \in \{FM, SM\}$ . We formulate the following hypothesis.

**Hypothesis 2:** First-movers have higher sales than second-movers. We test the null that  $y_t^{FM} - y_t^{SM} \leq 0$ .

We test these three hypotheses in the empirical analysis.

#### 4. The Data

We use a unique data set containing all the 414 NCEs that were approved by the Swedish Medical Products Agency (MPA) and launched on the pharmaceutical market in Sweden between 1987 and 2000.<sup>10</sup> Our data set contains a rating of the therapeutic innovation of each of these 414 NCEs as well as other characteristics. In Sweden this rating was carried out by two pharmacologists connected to the MPA. Beermann and Rosén (1999) present the rating and its results.<sup>11</sup> Its purpose was to rate all NCEs

<sup>9</sup> Also Nelson and Winter (1982) point out that by playing an effective "fast second" strategy, a firm may come to dominate an industry.

<sup>10</sup> Note that the MPA approved a total of 460 NCEs during this period. Yet as 46 of these were never launched in the market, we exclude them from the analysis.

<sup>11</sup> Actually, Beermann and Rosén (1999) contains information on the rating of the NCEs introduced in the 1987-1997 period only. Using the very same technique, however, Beermann and Rosén have subsequently completed the data set with ratings for the NCEs introduced in 1998-2000.

introduced in Sweden between 1987 and 2000 with respect to therapeutic innovation, based on how the MPA judged each NCE at the time of approval. This rating followed the classification system introduced by the US Food and Drug Agency (FDA) exactly. It classifies each NCE into one of three therapeutic classes:<sup>12</sup>

**Class A: Important therapeutic gains.** Drug may provide effective therapy (by virtue of greatly increased efficacy or safety) for a disease not adequately treated or diagnosed by any marketed drug, or provide markedly improved treatment of a disease through improved efficacy or safety (including decreased abuse potential).

**Class B: Modest therapeutic gains.** Drug has a modest but real advantage over other available marketed drugs; for example, somewhat greater effectiveness, decreased adverse reactions, more convenient route of administration, et cetera.

**Class C: Little or no therapeutic gains.** Essentially duplicates one or more already existing drugs in medical importance.

In addition to the NCE innovation rating, our data set contains data on several other characteristics for each of these 414 NCEs. We have data on drug company, launch quarter and year, indication (i.e., targeted condition), Anatomical Therapeutic Chemical (ATC) code (indicating the anatomical group targeted by a drug, e.g., the nervous or respiratory system), closest substitute, et cetera.

We combine the characteristics data set with quarterly sales data from Apoteket AB for 1987:1 through 2007:2.<sup>13</sup> The sales data is in current prices (SEK) that do not include VAT ("Apotekets utköpspris", AUP). We base our analysis on sales figures in 2006 SEK. We convert current prices to 2006 year's prices using the Swedish Consumer Price Index (CPI).

Our sales data actually contain a total of 551 drugs; the 414 original versions of the NCEs and 137 additional versions of these NCEs (that were introduced at a later point in time than the original NCEs). This means that the same drug may come in different strengths (e.g., "Mite" or "Forte"), or in versions that combine several active substances to get additional benefits, say increased efficacy or prolonged effect (e.g., "Comp" or "Retard").<sup>14</sup> In our main analysis, we add sales for all different versions of a NCE for each quarter. However, as a robustness test, in the Appendix we report results for the 414 original versions of the NCEs only.

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<sup>12</sup> See Beermann and Rosén (1999), p.124.

<sup>13</sup> That is, from the first quarter of 1987 through the second quarter of 2007.

<sup>14</sup> Different doses or strengths of a drug always have an ATC code that is identical to the ATC code of the corresponding NCE. However, the "Comp" and "Retard" versions of a NCE differ from the NCE with respect to one entry in the ATC code.

## 5. Descriptive Statistics

Among the NCEs in our data set, 14% bring important therapeutic gains (class A), whereas 34% bring modest therapeutic gains (class B) and 53% bring little or no therapeutic gains (class C).

These figures are in line with what Beermann and Rosén (1999) find for the subset of these drugs that were approved in the 1987-1997 period.

The five biggest anatomical groups in terms of share of the total number of drugs in the population are: anti-infectives for systemic use (e.g., antibiotics), 17%; nervous system (e.g., antidepressants), 15%; antineoplastic and immunomodulating agents ("anti-tumor antibiotics"), 12%; cardiovascular (e.g., antihypertensives), 11%; and blood and blood-forming organs (e.g., anti-thrombotics), 7%.

FIGURE 1. Number of NCEs per year, 1987-2000

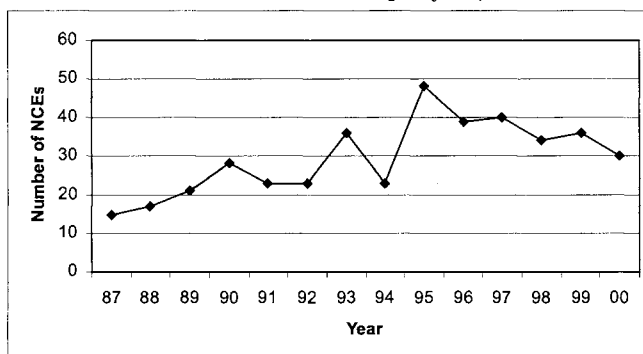
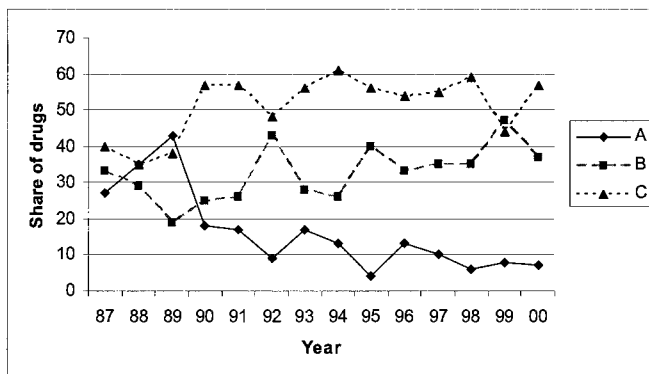


Figure 1 displays the number of approved NCEs per year in 1987-2000. It doubles over the time period. A total number of 15 NCEs were introduced in 1987. In 2000, that figure had risen to 30.

Over the same period, the relative share of therapeutically innovative drugs decreases, as seen in Figure 2. In 1987, 27% of approved drugs were class A drugs. In 2000, the most innovative drugs constituted only 5% of the drugs approved that year. At the same time, the relative share of class C drugs increases from 40% to 54%.

The relative importance of me-too drugs in the population thus increased over the period.

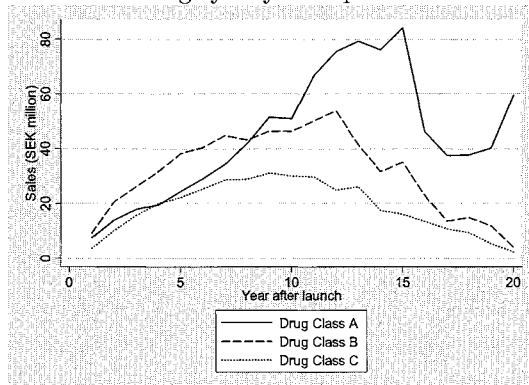
FIGURE 2. Share of NCEs per innovation class and year, 1987-2000



### 6. Analyzing Class A, B and C Drugs

Figure 3 contains average sales (in SEK million and 2006 year's prices) for year 1 to 20 after launch for A, B, and C drugs, respectively. Especially class B and C drugs display a life cycle pattern similar to that reported by Danzon and Kim (2002) and Grabowski and Vernon (1990).

FIGURE 3. Average yearly sales per innovation class



One striking finding is the initially weak sales of class A drugs. On average, class B drugs display higher sales than the most innovative drugs up to year 8 after launch. Sales of the most therapeutically innovative drugs peak late – approximately 15 years after launch. Class C drugs, on the other hand, peak around 9 years after launch,

whereas class B drugs peak approximately 12 years after launch. Sales of the most innovative drugs peak at above SEK 80 million per year. This is approximately 50% higher than class B drugs which peak around SEK 55 million, and more than 165% higher than class C drugs which peak at approximately SEK 30 million. Finally, since few class A drugs have been on the market for 20 years, caution is called for when interpreting the upward sales trend for the most innovative drugs at the end of the product cycle.<sup>15</sup>

We calculate total life cycle sales in several ways for the average drug in each innovation class. First, we present figures based on a 20-year as well as a 15-year life cycle. Due to a higher number of observations, average revenues over the 15-year life cycle should be more reliable.<sup>16</sup> Second, we present discounted as well as undiscounted sales figures. We use a discount rate of 4%, which is the risk free rate of return commonly used in the real business cycle literature (Cooley 1995). Table 1 presents the results.

TABLE 1. Absolute (SEK million) and relative life cycle revenues

Innovation class	15 year cycle		20 year cycle	
	No discounting	4% rate	No discounting	4% rate
A	673	470	895	584
B	560	417	627	452
C	331	247	372	268
A				
% more than B	20	13	43	29
% more than C	103	90	141	118
B				
% more than C	69	69	69	69

Shortening the product life cycle and discounting revenues decrease the difference in total life cycle revenues between class A drugs, on the one hand, and class B and C drugs, on the other. Discounted average revenues during a 20-year life cycle for class A drugs are 29% higher than for class B and 118% higher than for class C drugs.

<sup>15</sup> Nevertheless, the shape of the product cycle suggests that we may underestimate mean life cycle revenues for class A drugs here.

<sup>16</sup> We calculate life cycle revenues by adding mean sales for all drugs (in each innovation class) on the market in each year after launch. By using a 15-year cycle the results are less sensitive to the performance of the few drugs that have been on the market for 20 years. 29 of 57 class A drugs (53%) were launched before 1992:3 and have thus been on the market for at least 15 full years. For class B and C drugs the corresponding figures are 33 of 139 drugs (24%) and 56 of 218 drugs (26%), respectively.

Compare this to the discounted average revenues during a 15-year life cycle. They are 13% higher for class A than for B drugs, and 90% higher for class A than for C drugs. It thus seems that a considerable part of the revenues associated with the most innovative drugs come late in the product cycle. The difference between class B and C drugs, on the other hand, remains stable at about 70% in all cases.

As a robustness test, we graph product cycles and calculate life cycle sales for the original versions of the NCEs only (see Appendix). That is, we exclude new, alternative versions of the NCEs (e.g., "Mite", "Forte", "Comp", "Plus", "Retard") from the analysis. We notice two things. First, class A and B drugs now peak earlier – around 12 and 7 years after launch, respectively. The introduction of new versions of the original NCEs may thus explain the late peaks of class A and B drug sales. Second, the difference in 20-year life cycle revenues between class A and B drugs, as well as between class A and C drugs, decreases. Apparently the sales of new versions of the original NCEs represent a non-negligible part of the sales of class A drugs between year 15 and 20 after launch. Indeed, when the new versions of class A drugs are excluded from the analysis, sales of the most innovative drugs also die off around 20 years after launch.

Due to the relatively low number of class A drugs, we should interpret the above results with caution. Indeed, regression analysis confirms that the results for the most innovative drugs are often not statistically significant.

**6.1. Sales Regression Analysis.** Using OLS regression we may assess whether the average yearly sales of class A and B drugs differ significantly from those of C drugs while controlling for other covariates. With class C drugs as the baseline, we first estimate the following equation:

$$(6.1) \quad y_{it} = (\beta_1 + \beta_2 D_i^A + \beta_3 D_i^B)' \mathbf{D}_t^L + \beta_4' \mathbf{D}_{it}^{CT} + \epsilon_{it}$$

where  $y_{it}$  is sales (in SEK million) for drug  $i$  in year  $t = \{1, \dots, 20\}$  after launch,  $\mathbf{D}_t^L$  is a vector with dummies for year  $t = \{1, \dots, 20\}$  after launch (where, in  $t = 1$ , the dummy for year 1 after launch equals 1 and the other dummies equal 0),  $D_i^A$  is a scalar dummy taking the value 1 for a class A drug and 0 otherwise,  $D_i^B$  is a scalar dummy taking the value 1 for a class B drug and 0 otherwise,  $\mathbf{D}_{it}^{CT}$  is a vector that controls for potential calendar time effects, and  $\epsilon_{it}$  is the Huber-White robust error term.<sup>17</sup>

<sup>17</sup> The vector  $\mathbf{D}_{it}^{CT}$  contains 81 potential dummies: one for each quarter from 1987:2, i.e., the second quarter (Q2) 1987, through 2007:2 (Q1 is the baseline). Which of the four dummy variables associated with each calendar year that kicks in depends on a drug's launch quarter. For a drug introduced in 1987:2, the dummy variables Q2, Q6, Q10, ..., Q82 take the value 1 (the other dummies

Table 2 presents the regression results. It first presents baseline sales. Note that baseline sales equal yearly sales for class C drugs. The table then presents additional yearly sales (i.e., the average annual sales premium) for class A and B drugs.

TABLE 2. OLS regression: sales in SEK million, controlling for time effects

Year	Baseline sales	Additional sales	Additional sales
	C	B	A
1	12.6*	5.0**	1.2
2	19.3***	10.1**	1.4
3	25.4***	10.2**	-4.0
4	30.5***	11.0**	-3.8
5	33.5***	14.8**	-1.0
6	37.2***	13.9*	.52
7	40.8***	14.5*	2.6
8	41.3***	12.5	10.2
9	43.5***	14.4	19.3
10	42.5***	15.8	19.5
11	43.0***	19.3	36.0
12	37.8***	27.9*	51.0
13	40.0***	13.7	52.8
14	31.5***	12.3	58.3*
15	30.5***	16.4	68.1*
16	27.2***	8.7	33.7*
17	23.8***	4.3	28.0*
18	24.0***	5.8	26.9*
19	17.0*	8.9	36.1
20	10.5	5.8	60.2
$R^2$		.181	
N		5028	

Time dummies and robust standard errors used. Significance levels: \* 10%; \*\*5%; \*\*\*1%.

The baseline coefficients (class C drugs) all come out highly significant. Class B drugs sell significantly more than C drugs up through year 7 (and again in year 12) after launch: at the 5% significance level in year 1-5; then at the 10% level in year 6-7 and 12 after launch. Turning to class A drugs, the results are not what we expected. Class A coefficients are negative in year 3-5 after launch. Moreover, the results for class A drugs are largely non-significant. They only sell significantly more (at the 10% level) between year 14 and 18 after launch.

take the value 0). Assume instead that the drug was introduced in 1990:3; then the dummy variables Q15, Q19, Q23, ..., Q79 take the value 1 (while other dummies equal 0).

FIGURE 4. Average yearly sales, controlling for time effects

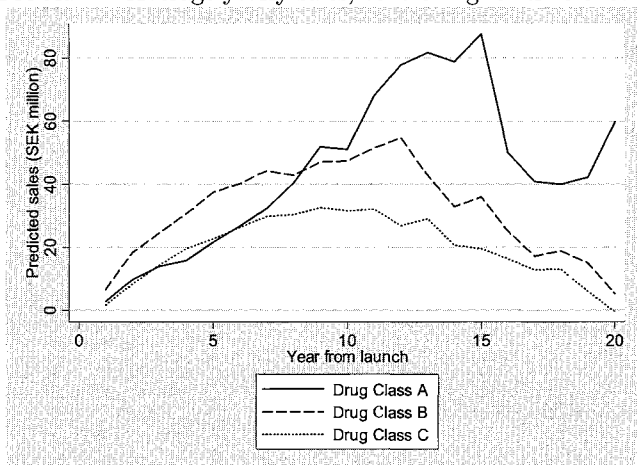


Figure 4 graphs predicted sales for class A, B and C drugs, controlling for calendar time effects.<sup>18</sup> The initially weak performance of class A drugs is now accentuated. Class A drug sales are below those of me-too drugs in year 3-5 after launch. Yet this graph is highly similar to the one presented above.

TABLE 3. Absolute (SEK million) and relative life cycle revenues, controlling for time effects

Innovation class	15 year cycle		20 year cycle	
	No discounting	4% rate	No discounting	4% rate
A	660	455	893	574
B	557	412	638	454
C	345	255	393	280
A				
% more than B	18	10	40	26
% more than C	91	78	127	105
B				
% more than C	61	62	62	62

<sup>18</sup> Product cycles are graphed based on a weighted average of all calendar time effects in the population.



Table 3 presents life cycle revenues for class A, B and C drugs, respectively, controlling for calendar time effects. The difference between class A drugs, on the one hand, and class B and C drugs, on the other, has decreased. During a 15-year life cycle with 4% discounting, the average class A drugs has 10% higher revenues than the average class B drug and 78% higher revenues than the average class C drug.

The variance in class A drug sales is high. This is potentially due to the confounding effect of other covariates that affect drug sales, such as the anatomical group targeted by a drug. As shown in Table 12 in the Appendix, some anatomical groups are characterized by high average sales (e.g., alimentary tract and metabolism, and systemic hormonal preparations); others by low average sales (e.g., anti-parasitic products, and anti-infectives). The anatomical groups also differ in the number of innovative drugs they harbor. For instance, the generally lucrative group of cardiovascular drugs contains 71% class C and only 11% class A drugs. Controlling for anatomical group should thus make it easier to detect any effect on sales from a drug's degree of innovation.

We estimate the following equation:

$$(6.2) \quad y_{it} = (\beta_1 + \beta_2 D_i^A + \beta_3 D_i^B)' \mathbf{D}_i^L + \beta_4' \mathbf{D}_{it}^{CT} + \beta_5' \mathbf{D}_i^{ANA} + \epsilon_{it}$$

where everything is as in equation 6.1, with the exception that  $\mathbf{D}_i^{ANA}$  is a vector with dummies for 13 anatomical groups (taking the value 1 if a drug belongs to that anatomical group, and 0 otherwise; with antineoplastic and immunomodulating agents as the baseline group).<sup>19</sup> Table 4 presents the results.

Most of the coefficients for the anatomical groups come out as significant or highly significant. Drugs targeting the alimentary tract, as well as the cardiovascular, hormonal and nervous systems, display much higher sales than the baseline group (antineoplastic and immunomodulating agents). Anti-parasitic, anti-infectives, dermatologicals and various drugs, on the other hand, display much lower sales.

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<sup>19</sup> As a robustness test, we run the same regression while also controlling for pharmaceutical firm. Firms may differ in size and marketing resources, for instance, which could affect sales. Indeed, firms with a strong presence on the Swedish market, such as AstraZeneca and Pfizer (which acquired Pharmacia), come out with highly significant and positive coefficients. Controlling for pharmaceutical firm does not have a large effect on the relationship between therapeutic innovation and sales, however. The sales premium for class B drugs turns non-significant for one year where it was previously significant at the 10% level. For class A drugs, the sales premium turns non-significant for two years where it was previously significant at the 10% level. Results are available upon request.

TABLE 4. OLS regression: sales in SEK million, controlling for time effects and anatomical group

Year	Baseline sales	Additional sales	Additional sales
	C	B	A
1	-9.8	9.7***	9.4**
2	-3.4	14.8***	8.9*
3	2.3	14.9***	6.6
4	7.3	15.7***	2.8
5	10.0	19.5***	5.1
6	13.5*	18.4***	6.4
7	16.7**	19.1**	8.6
8	18.1**	16.1**	15.4
9	20.6**	16.2*	24.2
10	19.6**	17.9*	24.4
11	20.1**	21.3*	40.4
12	13.2	32.1**	56.2
13	15.4*	18.8	57.1
14	8.9	14.3	59.2*
15	5.9	17.8	70.8*
16	1.7	9.0	35.9**
17	-2.2	4.0	30.3**
18	-2.3	6.7	26.6*
19	-9.4	6.9	36.8*
20	-25.9***	9.7	64.6
Alimentary tract		27.9***	
Blood-forming		-.46	
Cardiovascular		15.6***	
Dermatologicals		-18.3***	
Genito-urinary		6.7*	
Hormonal		31.3***	
Anti-infectives		-17.0***	
Musculo-skeletal		-3.4	
Nervous system		25.3***	
Anti-parasitic		-21.4***	
Respiratory		6.3	
Sensory		-8.4**	
Various		-23.0***	
$R^2$		.181	
N		5028	

Time dummies and robust standard errors used. Significance levels: \* 10%; \*\*5%; \*\*\*1%. "Antineoplastic" baseline for anatomical groups (full names in Table 12).

These controls affect the yearly sales for each innovation group, too. They make the yearly sales premium of class A and B drugs more significant. Class B drugs sell

significantly more than the baseline group in year 1-12 after launch (at least at the 10% level; at the 1% level in year 1-6 after launch). Class A drugs sell significantly more than the baseline group (at least at the 10% level) during year 1-2 and 14-19 after launch.

Figure 5 plots the predicted sales for class A, B and C drugs, controlling for anatomical group and calendar time effects.<sup>20</sup> The graph, too, shows that controlling for anatomical group strengthens the relationship between sales and innovation. Now average sales of the most innovative drugs are always higher than average sales of me-too drugs. Moreover, especially class C drugs (but also class B drugs) display zero sales, on average, after 19-20 years, whereas the average class A drug still displays highly positive sales.

FIGURE 5. Average yearly sales, controlling for time effects and anatomical group

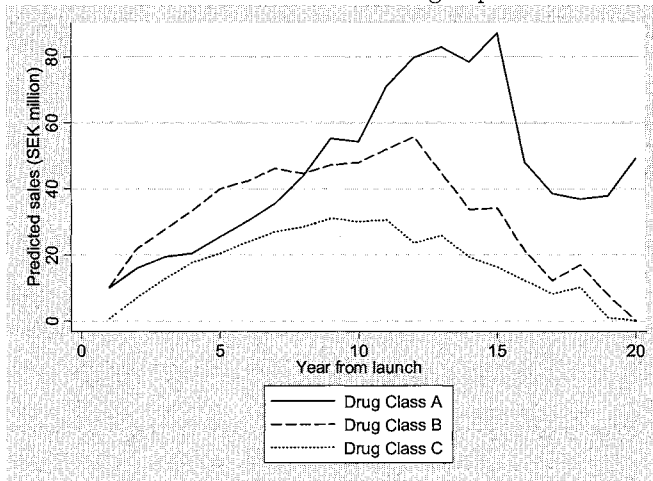


Table 5 shows life cycle revenues for class A, B and C drugs, respectively, controlling for calendar time effects and anatomical group. Controlling for anatomical group widens the relative gap in life cycle revenues between class A, B and C drugs. Over a 15-year life cycle, class A drugs raise 15% more revenues than B drugs and 114% more than C drugs with a 4% discount rate, and 22% more than B drugs and 122% more than C drugs without discounting. The gap widens further over a 20-year life cycle.

<sup>20</sup> Product cycles are graphed based on a weighted average of all anatomical groups in the population, plus the previously mentioned calendar time effect.

TABLE 5. Absolute (SEK million) and relative life cycle revenues, controlling for time effects and anatomical group

Innovation class	15 year cycle		20 year cycle	
	No discounting	4% rate	No discounting	4% rate
A	710	497	921	605
B	581	433	634	461
C	315	232	331	242
A				
% more than B	22	15	45	31
% more than C	125	114	178	150
B				
% more than C	84	87	92	90

We may now conclude our analysis of class A, B and C drugs. For class B drugs, we reject the null hypothesis that  $S_t^B = S_t^C$  : at least at the 5% significance level for year 1-7 and 12; and at least at the 10% significance level for year 8-11 after launch. For class A drugs, it is only possible to reject the null that  $S_t^A = S_t^C$  at the 10% level for year 14-15 and at the 5% level for year 16-17 after launch.

Sales for most innovative drugs are characterized by high variance. Among the 30 most selling drugs in the population there are six class A drugs; among the 30 least selling there are five. Apparently some of the most innovative drugs have put up a meagre performance in the Swedish pharmaceutical market. This suggests that truly innovative drug R&D involves considerable risks. However, the group of high-performers contains several more class B drugs than does the group of low-performers. We thus pool all innovative (class A and B) drugs and compare them to imitative (class C) drugs to see how our results change.

## 7. Analyzing Innovative Versus Imitative Drugs

We pool class A and B drugs to increase the power when analyzing the effects of innovative R&D on drug sales. Remember that Nelson and Winter (1982) and Grabowski and Vernon (1987) use a dichotomous R&D definition as either innovative or imitative. In line with the FDA classification, we label class A and class B drugs innovative and class C drugs as imitative. In our population, 196 drugs (47%) are innovative and 218 (53%) are imitative. We compare their product cycles.

FIGURE 6. Average yearly sales for innovative and imitative drugs

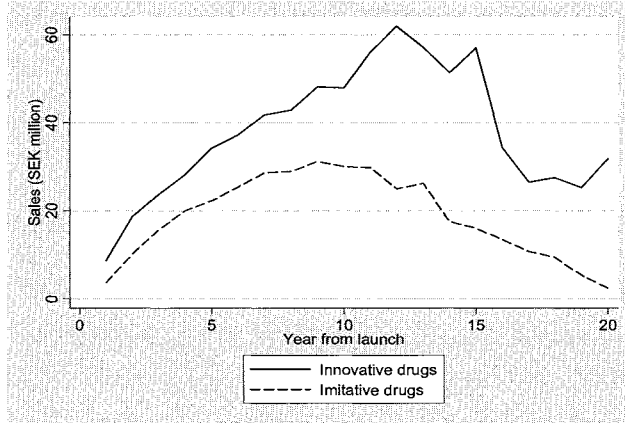


Figure 6 shows yearly sales for innovative and imitative drugs, respectively. The average innovative drug sells more in all years than the average imitative drug. The former peaks at above SEK 60 million, or roughly double the peak level of imitative drug sales. Mean sales of imitative drugs peak around 9 years after launch, and those of innovative drugs around 13 years after launch.

TABLE 6. Absolute (SEK million) and relative life cycle revenues

Innovation class	15 year cycle		20 year cycle	
	No discounting	4% rate	No discounting	4% rate
Innovative	615	445	760	520
Imitative	331	247	372	268
Innovative % more than imitative	86	82	104	94

Table 6 presents total life cycle revenues for innovative and imitative drugs. Mean discounted life cycle revenues for innovative drugs are 94% higher than imitative drugs during a 20-year life cycle and 82% higher than imitative drugs during a 15-year cycle.

**7.1. Sales Regression Analysis.** Using OLS regression, we estimate the following equation

$$(7.1) \quad y_{it} = (\beta_1 + \beta_2 D_i^{IN})' \mathbf{D}_t^L + \beta_4' \mathbf{D}_{it}^{CT} + \epsilon_{it}$$

where  $y_{it}$  is sales (in SEK million) for drug  $i$  in year  $t = \{1, \dots, 20\}$  after launch,  $\mathbf{D}_t^L$  is the vector with dummies for year  $t = \{1, \dots, 20\}$  after launch introduced above,  $D_i^{IN}$  is a scalar dummy taking the value 1 for an innovative drug and 0 otherwise,  $\mathbf{D}_{it}^{CT}$  is the vector that controls for potential calendar time effects introduced above, and  $\epsilon_{it}$  is the Huber-White robust error term.

TABLE 7. OLS regression: innovative and imitative drug sales in SEK million, controlling for time effects

Year	Sales (SEK million)	
	Imitative	Innovative
1	11.7*	3.9**
2	18.3***	7.6**
3	24.2***	7.2*
4	29.3***	6.9
5	32.2***	10.4*
6	35.8***	10.2
7	39.3***	11.2
8	39.8***	12.0
9	42.0***	16.1
10	41.0***	17.2*
11	41.4***	25.1*
12	36.2***	36.4**
13	38.3***	29.9*
14	30.0***	32.4**
15	29.0***	39.2**
16	26.0***	20.5**
17	22.9***	16.4*
18	22.9***	17.2*
19	16.2*	21.4*
20	9.9	32.6
$R^2$	.175	
N	5028	

Time dummies and robust standard errors used.  
Significance levels: \* 10%; \*\*5%; \*\*\*1%

Table 7 presents the regression results: annual sales for imitative drugs (the base-line) and additional annual sales for innovative drugs.

Innovative drugs have higher average sales than imitative drugs during 14 of 20 years after launch. The difference is significant at least at the 10% level; for six years at the 5% level. Mean revenues are approximately SEK 4 million higher for innovative drugs in year 1 after launch, and the average sales premium peaks at SEK 30-40 million during year 12-15 after launch.

Figure 7 displays the product cycles for innovative and imitative drugs, respectively, controlling for time effects. The product cycles are very similar to those graphed above. However, note that imitative drugs are, on average, back at zero sales 20 years after launch.

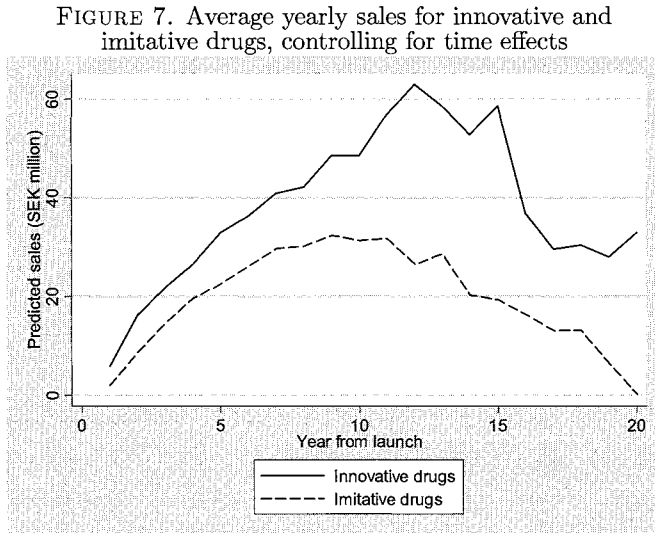


Table 8 shows life cycle revenues for innovative and imitative drugs, respectively, controlling for calendar time effects. The difference between pioneering and imitative drugs decreases. At a 4% discount rate, the average innovative drug enjoys revenues that are 72% higher than the average imitative drug during a 15-year life cycle.

TABLE 8. Absolute (SEK million) and relative life cycle revenues, controlling for time effects

Innovation class	15 year cycle		20 year cycle	
	No discounting	4% rate	No discounting	4% rate
Innovative	609	438	767	520
Imitative	343	254	393	280
Innovative % more than imitative	78	72	95	86

We also control for anatomical groups, estimating the following equation:

$$(7.2) \quad y_{it} = (\beta_1 + \beta_2 D_i^{IN})' \mathbf{D}_t^L + \beta_3' \mathbf{D}_{it}^{CT} + \beta_4' \mathbf{D}_i^{ANA} + \epsilon_{it}$$

where everything is as in equation 7.1, except that  $\mathbf{D}_i^{ANA}$  is a vector with dummies for 13 anatomical groups (taking the value 1 if a drug belongs to that anatomical group, and 0 otherwise).<sup>21</sup>

Table 9 presents the results. The sales difference between imitative and innovative drugs is now significant – often at the 5% level and during four years at the 1% level – except for year 20 after launch.

<sup>21</sup> Again, as a robustness test, we also control for pharmaceutical firm. This does not have a large effect on the relationship between therapeutic innovation and sales. Significance levels go down somewhat; the sales premium vis-à-vis imitative drugs for year 13-16 is now only significant at the 10% level, whereas for year 17-19 after launch, it turns non-significant. Results are available upon request.



TABLE 9. OLS regression: innovative and imitative drug sales in SEK million, controlling for time effects and anatomical group

Year	Baseline sales	Additional sales
	Imitative	Innovative
1	-10.2	9.4***
2	-4.0	12.9***
3	1.6	12.4***
4	6.4	12.0**
5	9.1	15.3***
6	12.6*	15.0**
7	15.8**	16.1**
8	17.1**	15.9**
9	19.6**	18.8*
10	18.6**	20.1**
11	19.0**	27.9**
12	12.1	40.8**
13	14.3	34.5**
14	7.9	33.8**
15	5.0	41.0**
16	1.1	21.4**
17	-2.6	17.1*
18	-6.8	16.9*
19	-9.5	20.1*
20	-25.5	35.4
Alimentary tract		27.9***
Blood-forming		-.36
Cardiovascular		15.4***
Dermatologicals		-19.7***
Genito-urinary		5.8
Hormonal		35.6***
Anti-infectives		-16.8***
Musculo-skeletal		-3.0
Nervous system		24.6***
Anti-parasitic		-23.1***
Respiratory		5.3
Sensory		-9.3***
Various		-22.4***
$R^2$		.221
N		5028

Time dummies and robust standard errors used. Significance levels:  
\*10%; \*\*5%; \*\*\*1%.

Figure 8 shows product cycles for innovative and imitative drugs, respectively, controlling for calendar time effects and anatomical group. The product cycles are very

similar to those graphed above. However, the tendency for imitative drug sales to be back at zero 20 years after launch is somewhat strengthened. Chances are that an innovative drug still displays considerable positive sales at that point in time.

FIGURE 8. Average yearly sales for innovative and imitative drugs, controlling for time effects and anatomical group

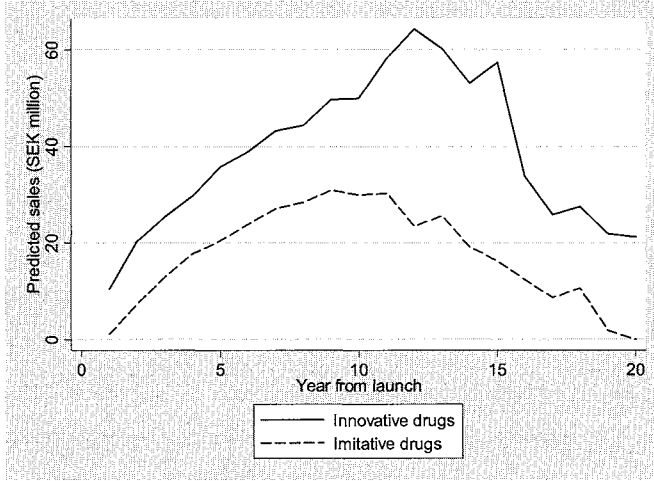


Table 10 displays average life cycle revenues for innovative and imitative drugs, respectively, controlling for calendar time effects and anatomical group. Obviously, controlling for anatomical groups strengthens the relationship between life cycle sales and innovation. With 4% discounting, the average innovative drug enjoys 100% higher revenues over a 15-year life cycle than the average imitative drug.

TABLE 10. Absolute (SEK million) and relative life cycle revenues, controlling for time effects and anatomical group

Innovation class	15 year cycle		20 year cycle	
	No discounting	4% rate	No discounting	4% rate
Innovative	641	465	771	533
Imitative	315	232	334	243
Innovative % more than imitative	103	100	131	119

To conclude the comparison of innovative and imitative drugs, we may reject the null hypothesis that  $S_t^{IN} = S_t^{IM}$  : at least at the 5% significance level for year 1-8 and 10-16 after launch; and at the 10% significance level for year 9 and 17-19 after launch.

### 8. First-mover Advantage Analysis

Does the first mover into a market segment benefit from higher sales than the second mover? This analysis is based on the 32 class C drugs in the population that have a class A or B substitute drug (targeting the same condition) that is also included in the data set. Market introduction of the class A and B drugs took place prior to the launch of the class C drugs. Class A and B drugs are thus defined as first movers, and class C drugs as second movers.<sup>22</sup> For each of the 32 drug pairs, we construct the sales difference (in SEK million) between the first and the second mover. For there to be a first-mover advantage, this sales difference should be significantly positive.

It is possible to evaluate the sales difference across two different measures of time. A first strategy is to analyze sales in the same year after launch for the first and second mover, respectively. We compare sales of the first mover in its first year after launch with sales of the second mover in its first year after launch, and so on. Most likely, sales of the first and second mover were not realized in the same calendar year. The alternative strategy analyzes sales for both drugs realized in the same calendar year (starting with the second entrant's launch year). For example, for a second mover launched in 1992:3, we would compare the performance of the two drugs in the second mover's initial year on the market (i.e., from 1992:3 through 1993:2), and so on.

We use both time measures.<sup>23</sup> Should the results point in the same direction in both cases, we may take it as evidence that the Swedish pharmaceutical market either is, or is not, characterized by a first-mover advantage.

For each drug pair  $l$ , we estimate the following equation:

$$(8.1) \quad \Delta y_l \equiv y_{it}^{FM} - y_{jt}^{SM} = \beta_1' D_t^L + \epsilon_{it}$$

where  $y_{it}^{FM}$  is sales for the first-mover  $i \neq j$  in time period  $t$  (measured in the above two ways),  $y_{jt}^{SM}$  is sales for the second-mover  $j$  in time period  $t$ ,  $D_t^L$  is a vector with dummies for year  $t = \{1, \dots, 10\}$  after launch, and  $\epsilon_{it}$  is the Huber-White robust error

<sup>22</sup> We exclude any third, fourth or fifth movers among the me-too drugs from the analysis.

<sup>23</sup> By doing so, we control for any anatomical group effects since the first and second mover belong to the same anatomical group. In particular the calendar time measure also controls for potential time effects. Time effects may potentially affect the sales level; as the first and second mover are analyzed in the same (calendar) year they are netted out here.

term. Due to the low level of drug pairs (and thus few cases where both drugs have been on the market for many years), we only include year 1-10 in the analysis.<sup>24</sup>

Table 11 presents the results. First come results for respective years after launch, then the results for the same calendar year.

TABLE 11. Sales difference (SEK million) between first and second mover

Year	Year after launch	Calendar year
1	9.8***	64.1***
2	17.0***	67.5**
3	25.6**	71.7**
4	33.8**	79.5**
5	44.2**	74.7**
6	51.5**	84.7**
7	58.6**	88.1**
8	64.9***	78.0**
9	75.6**	72.9***
10	73.1***	80.6**
$R^2$	.082	.149
N	364	357

Robust standard errors used. Significance levels: \* 10%; \*\*5%; \*\*\*1%.

Our results suggest that there is a first-mover advantage on the Swedish pharmaceutical market. The positive sales difference between the first and the second mover is significant at the 1% or 5% level for all years and using both time measures. Moreover, the sales difference is smaller when we evaluate both drugs in their respective years after launch, and higher when we compare sales in the same calendar year. That is not surprising. When we compare sales across calendar years, the first mover is already established on the market when the second mover enters the market segment in question.

As a robustness test, we exclude all drug pairs where the sales difference deviates by more than one standard deviation from the mean difference for each time measure. This is to eliminate the possibility that a few exceedingly high sales differences drive our results. The results are found in the Appendix (Table 13). When measuring time as the respective year after launch, the positive sales difference turns non significant

<sup>24</sup> We exclude drug pair observations in time periods where one or both drugs display zero or negative sales from the analysis. (Negative sales means that a drug was repurchased by Apoteket AB.) This makes our estimates more conservative. Not doing so does not affect the fundamental results, however.

in year 1-3 after launch, and then turns highly significant. Using instead the calendar time measure, the positive sales difference remains significant at the 1% or 5% level in all years. Thus, it does not seem that a few extreme values drive the above results. As Pamolli and Riccaboni (2004), we find evidence of a first-mover advantage among substitute drugs.

We may thus reject the null hypothesis that  $y_t^{FM} - y_t^{SM} \leq 0$  at least at the 5% significance level in all years analyzing using both time measures.<sup>25</sup>

## 9. Concluding Remarks

Drug life cycles is a neglected topic in studies of pharmaceutical markets. This paper examines how pharmaceutical life cycles depend on a drug's degree of therapeutic innovation. A unique data set rates all the 414 New Chemical Entities (NCEs) introduced in Sweden between 1987 and 2000 into one of three FDA innovation classes: A (important therapeutic gains); B (modest gains); and C ("me-too" drugs with little gains). This data is combined with sales figures for the 1987-2007 period.

Regression analysis controlling for time effects and anatomical group shows that, over a 15-year life cycle, the average class A drug raises 15% higher revenues than B drugs and 114% more than C drugs (using a 4% discount rate). However, yearly sales for class A drugs are only significantly higher than for me-too drugs in year 14-17 after launch. Class B drugs, on the other hand, display significantly higher sales than C drugs in year 1-11 after launch. Sales of the most innovative drugs are initially weak and characterized by a high variance. When pooling A and B drugs to compare innovative and imitative (class C) drugs, we find 15-year life cycle revenues of the former to exceed those of imitative drugs with 100%. The sales difference is significant in 19 out of 20 years after launch. Finally, we find evidence of a first-mover advantage analyzing first and second-mover sales differences across two different time measures (respective years after launch and calendar year).

Our results raise a couple of questions. The first concerns the curiously late take-off in average sales for class A drugs. As innovative drugs fill a gap in available treatments prior to their introduction, one would expect class A drug sales to increase rapidly after launch. Indeed, Pamolli and Riccaboni (2004) claim that innovative drugs tend to enjoy rapid growth. In our population of NCEs, however, mean sales for the most innovative drugs overtake class B sales only after around eight years. One potential reason is that a drug's therapeutic novelty risks to slow down its diffusion in the market. The reason spells incomplete information. It may take time before

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<sup>25</sup> And at the 10% level in year 3 after launch as well as at the  $\leq 5\%$  level in year 4-10 after launch when comparing sales in the respective years after launch and excluding all sales ratios that deviate by more than 1 standard deviation from the mean.

prescribers and patients become aware of a new drug's existence, know how to judge its side effects, and so on. Berndt et al. (2003) argue that the use of a drug may provide patients and physicians with valuable information about its efficacy or safety, so that a positive consumption externality materializes to increase demand and thus the diffusion of a drug. In an empirical investigation on  $H_2$ -antagonist anti-ulcer drugs, they find evidence of such an effect influencing market diffusion. It is possible that this type of consumption externality has significant effects on the diffusion of innovative drugs in general. This would be an interesting area for future research.

Our results also raise the question as to how R&D costs vary between innovative and me-too drugs. Di Masi et al. (2003) put the total R&D cost for bringing the average drug to the market at US\$ 802 million. It would be interesting to differentiate such R&D cost estimates across innovation classes. Doing so would probably reveal costs for basic R&D and clinical trials to be higher for innovative drugs than for me-too drugs.

Grabowski and Vernon (1990) have shown that 7 out of 10 NCEs introduced in the U.S. during the 1970s did not cover their R&D expenses. The question remains as to whether truly innovative drugs are more or less likely than the average NCE to do so. The high variance in sales for the most innovative drugs indicate that truly innovative R&D is a high-risk endeavour. Indeed, Nelson and Winter (1982) point out that one essential feature of Schumpeterian competition is that firms do not know *ex ante* whether it pays to be an innovator or an imitator.

## Appendix A

TABLE 12. Life cycle revenues and drug innovation classes across anatomical groups

Anatomical group	Code	Average life cycle sales, SEK million (size ranking)		Drugs introduced (share of all drugs in group)		
		20 years	15 years	A	B	C
Alimentary tract and metabolism	A	1,086 (2)	909 (1)	7 (19%)	6 (17%)	23 (64%)
Blood and blood-forming organs	B	456 (8)	363 (8)	6 (21%)	7 (24%)	16 (55%)
Cardiovascular system	C	744 (4)	653 (4)	5 (11%)	8 (18%)	32 (71%)
Dermatologicals	D	231 (10)	194 (10)	0	7 (58%)	5 (42%)
Genito urinary system and sex hormones	G	508 (6)	485 (5)	2 (10%)	6 (30%)	12 (60%)
Systemic hormonal preparations, excl. sex hormones and insulins	H	1,415 (1)	905 (2)	3 (50%)	1 (17%)	2 (33%)
Anti-infectives for systemic use	J	220 (11)	179 (12)	12 (23%)	27 (39%)	27 (39%)
Antineoplastic and immunomodulating agents	L	482 (7)	418 (7)	6 (12%)	30 (61%)	13 (27%)
Musculo-skeletal system	M	285 (9)	266 (9)	2 (10%)	5 (25%)	13 (35%)
Nervous system	N	832 (3)	781 (3)	2 (3%)	24 (38%)	38 (59%)
Anti-parasitic products, insecticides and repellents	P	67 (14)	49 (14)	0	3 (43%)	4 (57%)
Respiratory system	R	518 (5)	462 (6)	1 (6%)	6 (33%)	11 (61%)
Sensory organs	S	193 (12)	184 (11)	1 (7%)	3 (21%)	10 (71%)
Various	V	108 (13)	81 (13)	6 (25%)	6 (25%)	12 (50%)

Percentages may not sum to 100 due to round-off error.

TABLE 13. Sales difference (SEK million) between first and second mover, excluding extreme values

Year	Year after launch	Calendar year
1	5.7	28.4***
2	9.8	25.3**
3	11.3	25.6**
4	15.1*	28.7**
5	19.1**	30.0**
6	20.6**	31.1***
7	23.4**	29.0***
8	31.6***	30.6***
9	33.8***	34.8***
10	39.6***	32.0***
$R^2$	.190	.232
N	258	253

Robust standard errors used. Significance levels:  
\* 10%; \*\*5%; \*\*\*1%.

### Analyzing Original NCE Versions Only

As a robustness test of our results we exclude different versions of the NCEs, that is "Mite", "Forte", "Comp", "Plus", "Retard", et cetera. We calculate total life cycle revenues for the 414 original NCE versions only. The results are found in Table 14.

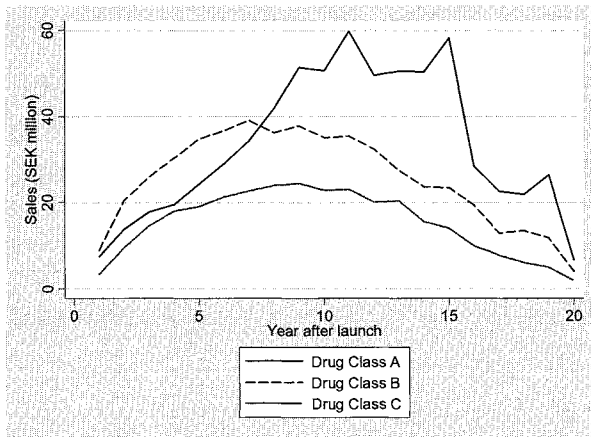
TABLE 14. Absolute (SEK million) and relative life cycle revenues for original NCE versions only

Innovation class	15 year cycle		20 year cycle	
	No discounting	4% rate	No discounting	4% rate
A	559	400	666	456
B	449	341	511	373
C	274	205	305	222
A				
% more than B	24	17	30	22
% more than C	104	95	118	105
B				
% more than C	64	66	68	68



Figure 9 shows the respective product cycles for A, B and C drugs based on original NCEs only.

FIGURE 9. Mean sales per innovation class for original version NCEs only



Note: Excluding additional versions of original NCE drugs, such as "Mite", "Forte", "Comp", "Retard", et cetera.



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